“I’ve always spoke like this, you see”: Preterite-for-participle leveling in American and British Englishes*

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Abstract: Some English verbs use distinct forms for the preterite (e.g. *I **broke** the door*) and the past participle (e.g. *I've **broken** the door*). These verbs may variably show use of the preterite form in place of the participle (e.g. *I've **broke** the door*), which we call PARTICIPLE LEVELING. This paper contributes the first detailed variationist study of participle leveling by investigating the phenomenon in perfect constructions using data collected from three corpora of conversational speech: two of American English and one of British English. A striking degree of similarity is found between the three corpora in both the linguistic and the extralinguistic constraints on variation. Constraints on participle leveling include tense of the perfect construction, verb frequency, and phonological similarity between preterite and participle forms. The variable is stable in real time and socially stratified. The paper relates the findings to theoretical linguistic treatments of the variation, and to questions of its origin and spread in Englishes transatlantically.

Keywords: Morphological variation, analogical leveling, American English, British English

1 Introduction

The English verbal paradigm is subject to quite a bit of variation, from the well-described (ING) variable in the progressive (Labov 1966/2006; Trudgill 1974; Forrest 2017, *inter alia*), to clear regional patterns in the present tense like the Northern Subject Rule (McCafferty 2003; José 2007), to a range of variability in the preterite and past participle. Investigation of the latter kinds of variation has often focused on the presence of noncanonical forms in regional varieties (Anderwald 2009) or the use of the participle form for the preterite, as in Tagliamonte's (2001) study of past-reference *come*. In this paper, we turn our focus to variation in the form of the participle.

For some speakers, variation in the participle can be found for the set of English verbs with typically distinct preterite and past participle forms. In this variation (as in 1b/c), the canonical preterite (i.e., *broke*) appears in contexts in which the canonical past participle (i.e., *broken*) would surface. Such contexts include both perfect and passive constructions.

(1) Variation in English past tense

a.	I **broke** the door	preterite
b.	I've **broken** the door	past participle
c.	I've **broke** the door	leveled form

This variation in the participle is rather understudied for two reasons. The more minor of these is that the variable has taken on multiple names over the years, in addition to being viewed by some as variation within specific verbs (e.g., Cheshire 1982). The variable has alternatively been called preterite shift (Lass 2008) and past tense spreading (Kemp et al. 2016). Multiple names for a sociolinguistic variable can make it difficult for researchers to review the literature, which may play a role in this variable being understudied.

Recognizing this, we will nevertheless contribute to this cacophony by proposing another name for the variable. Throughout this paper, we will refer to this type of variation as PARTICIPLE LEVELING. We believe this is a more theory-neutral stance on the variation, as labels describing the variable as a spread of the preterite seem to posit a view of the morphosyntactic status of the participle. Describing the variable as participle leveling places our emphasis on the variable context—the participle—while at the same time recognizing that the variation appears to resemble paradigm leveling, in which a single morphological form (in this case, the preterite) plays two morphosyntactic roles. Although a full discussion of this is beyond the scope of this paper, we also believe this view of the variable more accurately reflects the best

formal approaches to the variation (see Duncan 2021).

The second, and more major, reason why variable participle leveling is understudied is that it is not a common variable. Contexts involving a past participle are uncommon enough, but the variable context includes only the subset of verbs with canonically distinct preterites and past participles. As such, the actual variable context is not a common occurrence. For this reason, previous accounts of this phenomenon have often been less rigorously quantitative (Cheshire 1982; Bloomer 1998), or have concerned prescriptive attitudes toward the variable (Tieken-Boon van Ostade and Kostadinova 2015). Recent work has made use of corpora like the BNC (Geeraert 2010) or online speech (Kemp et al. 2016) to obtain larger datasets. However, resources such as these cannot shed light on the linguistic and social factors that contribute to the variation the same way that a primarily informal, spoken dataset can. The present paper fills this gap, contributing the first detailed, large-scale study of participle leveling from a variationist perspective by making use of three corpora of vernacular speech data from the US and England: the Philadelphia Neighborhood Corpus (Labov and Rosenfelder 2011), the Diachronic Electronic Corpus of Tyneside English (Corrigan et al. 2012), and Switchboard (Godfrey and Holliman 1997). Even with such a dataset, the infrequent nature of the variable leads us to focus on variation in perfect constructions, to the exclusion of other participle contexts like passives.

Our analysis confirms past observations that participle leveling is more frequent when the auxiliary of the perfect construction is non-tensed *have* or past-tense *had*. At the same time, we shed light on novel language-internal factors that constrain the variation: for example, the morphophonological similarity between the participle and preterite conditions variation. Our crucial finding with respect to such factors is that the three corpora we examine largely share language-internal constraints on variation. In addition, we shed particular light on social constraints: participle leveling is a socially stratified, stable sociolinguistic variable. The stability on both sides of the Atlantic and the shared linguistic constraints on variability raise the possibility of an early shared origin of the variation. We discuss the possibility that variability observed in Middle and Early Modern English has simply continued through to the present.

The rest of this paper is organized as follows. First, in §2, we discuss the history of, and previous research into, the variable use of the preterite form in participle contexts. This section additionally discusses existing morphosyntactic analyses (§2.3) and outlines the research questions we address in our own study (§2.4). We then present our methodology in §3, detailing our data sources, the protocol for coding the various social and linguistic factors, and the procedure for statistical modelling. The results of these models are presented in §4, first as a broad picture of the results and then for each potential factor in individual detail. Discussion of the implications for our results is presented in §5, and §6 concludes.

2 Background

Despite how often it has been commented on prescriptively throughout the last few centuries (Tieken-Boon van Ostade and Kostadinova 2015), the variable in question is rather understudied. In this section, we define the variable and review prior work that has discussed it in some form. Drawing on this background, we outline the still outstanding research questions that we seek to address.

2.1 The variable

The regular paradigm of bare, (past) participle, and preterite verb forms in Present-Day English shows syncretism between the preterite and participle, achieved through addition of the *-ed* affix to the bare form (e.g., *walk-walked-walked*). In addition to this regular paradigm is a set of irregular verbs or irregular paradigms (see Anderwald 2009 for a detailed discussion) in which the preterite and participle of many frequently occurring verbs are derived via vowel changes (e.g., *swim-swum-swam*) and/or use of the participial *-en* affix (e.g., *break-broken-broke*). The paradigm for *go* stands out for being suppletive (*go-gone-went*). While some irregular paradigms display preterite/participle syncretism (e.g., *buy-bought-bought*), many others maintain distinct preterite and participle forms. The "irregular" and "regular" paradigms found in Present-Day English represent what remains of the Germanic strong/weak verb distinction. In this sense, "irregular" English verbs are typically descendants of strong verbs, which declined via ablaut. "Regular" English verbs follow the pattern of weak verbs, which originally declined through a grammaticalized conjugation of *do* (see Hill 2010 for discussion), although this has since reduced to a single form with full syncretism for person/number.

The vast majority of Present-Day English forms follow the regular paradigm as a result of language change continuing through to the present. This change is a cross-Germanic phenomenon in which novel verbs are coined in the weak paradigm and strong verbs shift to the weak paradigm. In general, this shift of strong verbs into the weak paradigm is frequency-driven: less frequent strong verbs over time are more likely to have become weak verbs in English (Lieberman et al. 2007), German (Carroll, Svare and Salmons 2012), and Dutch (De Smet and Van de Velde 2019). However, cross-linguistic changes in the strong verbs also involve leveling within the paradigm itself. This is particularly common in the West Germanic languages, which tend to level ablaut patterns to achieve preterite/participle syncretism (Dammel, Nowak and Schmuck 2010).

The English verbal paradigm has therefore seen quite a bit of change over time, which, in keeping with variationist principles, entails quite a bit of variation (Weinreich, Labov and Herzog 1968). Note

that both regularization of strong verbs (for example, the adoption of *climb-climbed-climbed*, Lieberman et al. 2007) and ablaut leveling (for example, the adoption of *spin-spun-spun*, Dammel, Nowak and Schmuck 2010) involve the adoption of preterite/participle syncretism where there once was a distinction. We would expect, then, to find variation in verb form such that speakers have variably syncretic systems. Because regularization and ablaut leveling continue to occur to the present, we would expect such variation to be found among present-day speakers in the irregular paradigms that (currently) maintain a preterite/participle distinction. As a general point, we do find such variation. Much of the observed variation has been focused on preterite verbs taking the form of the participle or weakening (Bybee 1985; Anderwald 2009). Variationist studies of specific lexical items, such as Tagliamonte's (2001) study of preterite *come* in York, England, have shown that variable use of the participle form in the preterite follows language-internal and -external constraints.

In addition to variable use of the participle for the preterite, we also find variable use of the preterite form in the participle. From a historical perspective, there are two aspects of ablaut leveling in the English verbal system that suggest we should take particular interest in this latter variable. Firstly, English is messier than its West Germanic neighbors. Whereas Dutch and German predominantly achieve syncretism among strong verbs by adopting the participle form for the preterite, English has historically done this as well as adopt the preterite form in the participle (Dammel, Nowak and Schmuck 2010). This means that historical changes in the English strong verb system have involved variability in the form of the participle. Secondly, English, like Swedish but unlike Dutch and German, maintains a robust aspectual distinction between the preterite and the perfect.[1] The distinction does not mean they occur equally often; in English, the preterite context occurs more often than the perfect (Dammel, Nowak and Schmuck 2010). Setting aside potential variation or lexically specific differences in the frequency of one context or the other occurring, this fact means that preterite forms of irregular verbs are used more than participle forms. There are thus countervailing pressures on the remaining strong verbs: the trend toward ablaut leveling and overall greater frequency of the preterite constitutes pressure to level the preterite and participle by adopting the preterite form in the participle, while the strongly maintained aspectual distinction between preterite and perfect constitutes pressure to maintain a distinction between the preterite and participle forms. These countervailing pressures suggest that the form of the participle is a situation that is ripe for variation.

In fact, variation in the form of the participle has been attested since the late Middle English period, and appears to be robustly attested since the early Modern English period (Lass 2008). Examples abound in writing, and seventeenth and eighteenth century grammarians note that several verbs have

competing variants for the participle, in which the present day preterite and participle are at least two of the variants (see Greblick 2000 and Tieken-Boon van Ostade and Kostadinova 2015 for discussion and examples). Although these grammarians worked to standardize the English verbal paradigm (Tieken-Boon van Ostade and Kostadinova 2015), this type of variability has been attested in several varieties of English in the United States (Bloomer 1998; Kemp et al. 2016; Wolfram 2003), the United Kingdom (Cheshire 1982; Smith 2004), and Australia (Eisikovits 1987).

Given these attestations, we suggest that the form of the participle in irregular paradigms is indeed a linguistic variable. There are two variants under consideration: the preterite form and the participle form. This means, therefore, that the envelope of variation under consideration includes only those verbs which do not already display preterite/participle syncretism (i.e., we are concerned with a subset of a subset of verbs: the non-syncretic irregulars). This also means that for verbs in this subset, we treat local variants of the participle (e.g., *getten* for *gotten* in the North East of England, Beal 2004) as instances of the participle variant rather than a different variable themselves.

2.2 Previous research into the variable

Although (variable) use of the preterite variant in the participle is reasonably well attested across modern varieties of English, there is a tendency for some researchers to remark upon the variable in passing rather than investigate it in depth. For example, the variable earns about a paragraph or two in Cheshire's (1982) monograph on grammatical variation in Reading, England. Somewhat similarly, Wolfram (2003) mentions it as a variable found in enclave dialects of the Southern United States, but goes no further in discussion. Perhaps because it has been more remarked on than studied, the variable has drawn further attention in relatively recent years from a variety of linguistic perspectives. In addition to an early variationist approach (Eisikovits 1987), researchers have approached the variable from corpus linguistic (Geeraert 2010; Geeraert and Newman 2011), morphosyntactic (Greblick 2000; Munn 2015; Tortora et al. 2015), psycholinguistic (Geeraert 2012), and language ideology (Tieken-Boon van Ostade and Kostadinova 2015) perspectives.

That there are relatively few variationist studies of this variable is perhaps surprising, but likely due to low token counts. Cheshire's (1982) work, for example, seems to suggest that the variable would have been explored further had there been sufficient data. The one clear variationist study by Eisikovits (1987) has relatively few tokens when compared to studies of other variables from that period. Kemp et al. (2016) only examine use of *gone*/*went* as opposed to further variability in the participle. While this is in part due to the project being used as a teaching example and therefore somewhat constrained in focus, another

contributing aspect to the limitation may well have been that other, less frequent verbs may have not occurred enough to be worth sampling in a classroom exercise. The study with the largest number of tokens has taken a corpus linguistics approach (Geeraert 2010; Geeraert and Newman 2011). In this study, the authors use the British National Corpus and Corpus of Contemporary American English to obtain large numbers of perfects with which to examine participle variation. Geeraert (2010) also uses Google NGrams to obtain tokens for a more variationist-style analysis. These corpora, while useful, are not quite vernacular data in the sense that Cheshire (1982) and Eisikovits (1987) sought. All the same, although variationist sociolinguistic studies of the variable are limited in scope by token count, it is worth considering what results do appear.

2.2.1 Findings regarding internal factors

The most robust finding by far has been that the presence or absence of a modal verb in the utterance constrains variant selection, with the preterite form more likely to occur in sentences that contain a modal, as in the following:

(2) I should have (**gone/went**) to the store yesterday.

This constraint has been found in local vernacular speech (Eisikovits 1987), large-scale corpora (Geeraert 2010; Geeraert and Newman 2011), and internet language on Twitter (Kemp et al. 2016). Bloomer's (1998) work also suggests a modal effect; while the data presented does not take the full envelope of variation into account, the overwhelming majority of preterite-form participle tokens collected in the study have a modal in them. The modal effect appears to be strong enough that introspective research methods can also reveal it, as morphosyntacticians have noted that the preterite-form participle is more acceptable to them and other informants when a modal is in a constructed test sentence (Greblick 2000; Munn 2015).

Whether language-internal factors other than the presence/absence of a modal constrain variation in the participle is less clear. We summarize various findings regarding this question below. Eisikovits (1987) shows that use of the preterite form is strongly favored in the perfect (3) over the passive (4).

(3) I had (**gone/went**) to the store yesterday.

(4) The window was (**broken/broke**) by the vandals.

Within the perfect, both Eisikovits (1987) and Kemp et al. (2016) find that past tense (3) favors the preterite over present tense (5).

(5) I have (**gone/went**) to the store already this week.

This may be only a relative favoring; for Kemp et al., the past perfect is still disfavored overall when considered alongside the modal perfect tokens. Most other studies (and indeed, this present one) only analyze data collected from perfect constructions, which limits the replicability of the finding that leveling is dispreferred in the passive. At the same time, the fact that so few studies have considered the possibility of variability when participles occur in the passive is likely anecdotal evidence that the perfect does display more variability than the passive. Another potential language-internal factor that has been suggested to constrain variation is the presence or absence of negation; Geeraert (2010) finds limited evidence of this, but whether the effect emerges from the data or not depends in part upon the inferential statistics used in the analysis. Greblick (2000) suggests that the preterite-form participle is ungrammatical when there is intervening material, particularly a full adverb, between HAVE and the participle:

(6) ?Mary had hurriedly **ran** out of the house.

Kemp et al. (2016) find an effect of subject person/number: first person subjects, regardless of number, favor the preterite form, while third person plural favors the participle form. Finally, Geeraert (2010) finds that verb frequency conditions variation, such that infrequent verbs are more likely to see the preterite-form participle than frequent verbs.

2.2.2 Findings regarding external factors

As with the non-modal language-internal factors, there is limited evidence of language-external factors constraining variation. Wolfram (2003), for example, suggests that the variable fits into the classic pattern of social stratification whereby lower social classes are more likely to use the preterite-form participle. This is possible; Miller's (1987) examination of *bite*, *ride*, and *shrink* in Georgia indicates that there are class- and race-based distinctions in usage of the preterite or participle form, especially for *bit/bitten*. Tieken-Boon van Ostade and Kostadinova (2015) note that prescriptivist attitudes against the preterite-form participle from the eighteenth century are still present in the modern day, with American Englishes in particular seeing nonstandard participle production as a usage problem. As part of their study, they solicited qualitative evidence from American English speakers, some of whom claimed that there is a stylistic difference between use of *gone/went* for the participle.

This stylistic difference may be register variation. Geeraert (2010) and Geeraert and Newman (2011) show that the preterite-form participle is favored in the spoken sections of the BNC and COCA compared to written sections, with COCA additionally favoring the preterite-form participle in fiction writing compared to nonfiction writing. These findings are consistent with a variable displaying social stratification,

235 although Geeraert (2010) notes that there is not sufficient demographic data to know whether this is in-
236 deed true of the BNC and COCA. There is less evidence of other language-external factors conditioning
237 variation. Some authors suggest an age effect without evidence, although Smith (2004) is the only author
238 to clearly find one. In a study of Buckie Scots, she finds that younger speakers use the preterite-form
239 participle more than older speakers. This potential change in progress, however, seems to be linked to a
240 larger reorganization of the past tense/aspect system in Buckie Scots. As such, it is not clear whether we
241 should expect a similar age effect in varieties with more stable past tense/aspect systems.

242 ## 2.3 Previous morphosyntactic analyses of the variable

243 Morphosyntacticians have extrapolated some strong claims about the variable based in part on the re-
244 sults outlined above, specifically the modal effect. In conjunction with the modal effect, these analysts
245 note rampant phonetic reduction when a modal is present. The phonetic reduction in question involves
246 *have* reducing to [əv] or [ə] when following a modal. This reduction is often operationalized in orthogra-
247 phy (7–8).

248 (7) Anyone wish we **woulda gone** hard after Chris Petersen?
249 (message board subject, https://247sports.com/college/oregon/Board/45/Contents/Anyone-wish-
250 we-woulda-gone-hard-after-Chris-Petersen-111799756/, accessed 19 October 2020)

251 (8) This act of fascism against the press **might of saved** her life.
252 (comment on Jezebel article, https://theslot.jezebel.com/a-nyt-reporter-got-kicked-out-of-a-trump-
253 rally-after-si-1845025005, accessed 19 October 2020)

254 Based on this, Kayne (1997) proposed that *have* in these contexts has been reanalyzed into a comple-
255 mentizer *of*. It is unclear why exactly this may yield the preterite form when following this complemen-
256 tizer, but a more basic reading of this claim is that modal+*have* perfects have a different syntactic struc-
257 ture than *have* perfects. Other approaches have similarly proposed reanalysis and grammaticalization
258 of modal+*have* such that perfects in this context differ syntactically from other perfects. Tang Boyland
259 (1998) proposes that *would* (and presumably other modals) has merged with *have* into a single auxil-
260 iary verb. Greblick (2000) suggests that reduced *have* combined with the modals into an adverb: *coulda,*
261 *woulda, shoulda.* Bloomer (1998) suggests something along these lines as well. An advantage of this
262 particular proposal of reanalysis and grammaticalization is that if the modal verb has become a modal
263 adverb, the verb to be tensed in modal perfect constructions would be the main verb. The Kayne and
264 Tang Boyland proposals, unlike the Greblick one, do not clearly explain why the preterite would some-

times surface. On the other hand, the modal adverb proposal seems to suggest a categorical distribution: the preterite always occurs in modal perfect constructions, while the participle always occurs in non-modal perfect constructions. Along this view, there is no variation in the form of the participle; it is a true preterite surfacing in the modal perfect. This proposal could be adapted to permit variation through grammar competition (Kroch 1994) by which modal+*have* is variably produced as a modal adverb or set of auxiliaries, in which case the main verb would vary between appearing as a preterite or participle. However, were Greblick's proposal to admit such a competition between grammars, it would still rule out the preterite form from appearing in perfect constructions in which no modal is present.

Although he relies less on the phonetic reduction of *have*, Munn (2015) similarly extrapolates a morphosyntactic analysis from the modal effect. He follows Bobaljik (2012; and see also Adamson 2019 for further discussion) in noting that when arranging the verbal paradigm as bare-participle-preterite, English verbs seem to exclude ABA patterns (e.g., **give-gave-give*). In Bobaljik's account of patterns like this, the syntactic structure of the preterite would contain the structure of the participle. Munn adopts this view within a Distributed Morphology (Halle and Marantz 1994) approach to suggest that the modal effect is contextual allomorphy. In this view, an impoverishment rule conditioned by the presence of a modal could spell the participle out as a preterite form. He does make room for variability in his analysis, as he allows for the impoverishment rule to be variable (Nevins and Parrott 2010). However, the reliance on contextual allomorphy still predicts that in non-modal perfect contexts, the participle form will categorically surface.

The above extrapolations assume that English maintains the past/perfect aspectual distinction. It should be noted that some authors suggest that this distinction is disappearing. Sampson (2002) draws mainly on evidence from the use of bare *got* in British English varieties to argue that such varieties have collapsed the past and perfect into a single category. He notes that this would also explain why speakers are able to use the preterite form for the participle: they are essentially both forms for a single category. Tortora et al. (2015) make a similar claim regarding Appalachian English on the basis of the seeming interchangeability of forms like *drank*/*drunk* in both the preterite and participle contexts. However, this would seem to imply that variable use of the participle form in the preterite and variable use of the preterite form in the participle would work in the same way. This is not the case; Geeraert (2012) offers experimental evidence that clearly shows that variable forms in the preterite, but not variable forms in the participle, are lexically and phonotactically constrained.

2.4 Outstanding research questions

Based on the above discussion, there appear to be language-internal and -external constraints on participle variation, but what exactly they are is unclear. As such, we aim to provide a variationist study large enough in scale to consider these issues. In particular, we aim to address the following points:

a. WHAT IS THE VARIABLE, ACTUALLY? Throughout the above discussion we have treated variation in the participle as though it is a system-level phenomenon. In other words, we have assumed that any verb that has distinct preterite/participle forms can vary in the form the participle takes between preterite and participle. We are in good company on this; Eisikovits (1987) and Geeraert (2010) take this approach in their quantitative work, and Greblick (2000) and Munn (2015) do so as well. However, it should be noted that many researchers list specific verbs which have preterite variants (Cheshire 1982; Beal 2004), which suggests that to them the variable is lexically constrained. Beal in particular does not seem to see this as a variable at all, as she claims that preterite usage in the lexically constrained set is categorical in the North of England. Other studies which focus solely on *go* (Tieken-Boon van Ostade and Kostadinova 2015; Kemp et al. 2016) or a small set of verbs (Miller 1987) similarly suggest the variable is lexically constrained.[2] This view is shared by Quirk et al. (1985), who describe English participles as mainly categorical in form with exceptions like *beat*.

b. WHAT CONDITIONS VARIATION OF THE PARTICIPLE? Given the robustness of the modal effect, we expect use of the preterite form to be favored when a modal is present relative to other contexts. The other proposed language-internal constraints have less evidence in favor of them, in part because of how the evidence was gathered. Introspective judgements may not be sensitive to fine-grained constraints on variation, for example. At the same time, some previous studies were simply not designed to consider all potential factors. Geeraert's (2010) corpus study, for example, was conducted by searching for HAVE+verb form, and therefore missed any examples with intervening material, such as *n't* or an adverb, between HAVE and the participle. As such, our study aims to shed light on whether these—negation, intervening material, as well as frequency, and phonological form—do constrain variation. Likewise, while it seems likely that variation is socially stratified, the roles of class and other language-external factors need to be explored in more detail. Previous datasets (Cheshire 1982; Eisikovits 1987) structured for sociolinguistic analysis have not had the token counts necessary to do so, while those with sufficient tokens (Geeraert 2010; Geeraert and Newman 2011) have by necessity not been structured to examine language-external constraints in detail. A key language-external factor to consider is age: does this variable represent a change in progress or not?

c. IS THE VARIABLE AN AMERICANISM? Several sources suggest that the variable is an Americanism, as opposed to being a broader feature of English. Greblick (2000), for example, suggests that use of the preterite form in modal perfect constructions is a feature of Colloquial American English. To the extent that Quirk et al. (1985) acknowledge variation in the participle, they suggest that the preterite form (e.g., participle *beat*) is American. The key change highlighted in Tang Boyland's (1998) argument for grammaticalization of modal+*have* into a single auxiliary is found in American English, which implies that any variation in the participle as a result of this grammaticalization would be an Americanism. Of course, the variable is well documented globally. This does not, however, preclude it from having originated in the US before spreading globally. This is a testable hypothesis; we would expect to see evidence of real- or apparent-time change in non-American data as the variable spread from the US.

d. WHAT ELSE CAN A CROSS-ATLANTIC COMPARATIVE APPROACH TELL US ABOUT THIS VARIABLE? As noted, the inclusion of non-American data will enable us to determine whether this variable is uniquely or originally American. Outside of the question of whether speaker age effects are suggestive of diffusion, attention to language-internal and -external constraints will help to shed light on the history and grammar of the variable.

One specific contribution of our approach to the data is to evaluate previous morphosyntactic analyses of the variable. We take the view that linguistic variation can act as a window into morphological and morphosyntactic structure (see, e.g., MacKenzie 2013; Duncan 2019; MacKenzie 2020). In particular, we contend that a variationist study of the participle can help us to evaluate the proposals put forward by Greblick (2000) and Munn (2015). Namely, both of these proposals appear to suggest that the participle form should surface categorically in non-modal perfect contexts. If we find consistent evidence of variation in these contexts, it would constitute evidence against these analyses because they would undergenerate the facts on the ground.

3 Methods

The discussion of the methods is as follows: We first discuss the data sources and the process of extracting and selecting tokens in §3.1, then describe the variables that each of these tokens was coded for in §3.2. §3.3 discusses how we used these variables as predictors in our statistical models, and then we continue to results.

354 ### 3.1 Sources of data

355 Data were gathered from three corpora: two that are collections of American English, and one of British
356 English. The American English sources were Switchboard (Godfrey and Holliman 1997) and the Philadel-
357 phia Neighborhood Corpus (PNC; Labov and Rosenfelder 2011). Switchboard is comprised of 240 hours
358 (3 million words) of telephone conversations between strangers that were recorded between 1991–1992.
359 No two speakers were paired more than once, and the conversation topics (sports, travel, or political is-
360 sues) were assigned by the researchers. Of the 542 unique speakers in the corpus, 55% were men, 60%
361 were under age 40, and 89% were college-educated. 29% of these participants were from the South Mid-
362 land dialect region, which is where the company that ran the project (Texas Instruments) is based. The
363 PNC data come from 287 sociolinguistic interviews carried out by graduate students from the Univer-
364 sity of Pennsylvania beginning in 1973. The interviewed participants are adult speakers of Philadelphia
365 English from a variety of educational, economic, and racial backgrounds.

366 The British English source was the Diachronic Electronic Corpus of Tyneside English (DECTE) (Cor-
367 rigan et al. 2012), a longitudinal compilation of three subcorpora of sociolinguistic interviews collected
368 in the 1960s–1970s, mid 1990s, and late 2000s. Together, there are just under 72 hours of recorded inter-
369 views (804,266 words). The majority of the corpus consists of dyadic interviews, while the remainder is
370 one-on-one interviews.

371 A comparison of the corpora can be found in Table 1.

Table 1: A comparison of the corpora used.

	Switchboard	PNC	DECTE
Dialect	mixed American, bias towards South Midlands	Philadelphia (American)	Tyneside (British)
Demographics	mix of sex and age, bias towards college-educated	mix of education, socioeconomic status, and race	mix of age and gender, bias toward working class.
No. of speakers	542	408	160
No. of conversations	~ 2430	287	99
No. of words	~ 3 million	~ 1.6 million	~ 800 thousand
Data type	one-on-one phone conversations between strangers on set topics	sociolinguistic interviews	dyadic sociolinguistic interviews
Date of collection	1991–1992	1973–2012	1960s–1970s, 1990s, 2007–2010

Each corpus provides distinct advantages for our analysis. Switchboard is large, and has potentially less-casual speech compared to the others, due to the nature of telephone conversations between strangers. The other two corpora (PNC and DECTE) are smaller but are constructed from vernacular sociolinguistic interviews. Using all three corpora allows us to (i) get a transatlantic perspective, (ii) examine register variation within the conversational domain, and (iii) potentially detect language-internal effects that are only apparent with higher statistical power. This being said, the fact that Switchboard differs from the other two corpora in both size and data type means we might expect the speech in Switchboard to pattern somewhat differently, and indeed we do find that (Section 4).

From these three corpora, we analyzed tokens of 46 English verbs with prescriptively unique preterite and participle forms in a perfect construction; that is, that are subject to participle leveling. Tokens were extracted from corpus transcripts using a Python script designed to search for perfect constructions with any form of *have* and any of the verbs from our list in either their participle or preterite form, with at most one word between the auxiliary verb and the past participle (to allow for intervening adverbs). Code for this query and the list of verbs are available in Appendix A.

Because of the way our script searched for perfect constructions, it also captured some passives,

387 causatives, and adjectives, along with spurious hits of preterite forms, infinitives, and some ambiguous
388 constructions. Each extracted token was coded by two analysts according to these categories, with ref-
389 erence to the audio and/or the wider discourse context where necessary to resolve strings of ambiguous
390 structure. Tokens were kept only if both analysts agreed that the construction was a perfect, and thus
391 relevant to the analysis.[3] This was done according to the protocol given in Table 2. Note that in this ta-
392 ble, and elsewhere throughout the paper, examples are accompanied by speaker identifiers. Four-digit
393 speaker IDs are from Switchboard, the speaker IDs starting with PH are from PNC, and other ID formats
394 are from DECTE, with a different format for the various DECTE subcorpora.

Table 2: Codes for broad grammatical structure.

Type	Code	Notes / Example
Perfect (keep)	k	Collocates of forms of *have*, including contracted forms and forms found in larger constructions: *have/had/has/'ve/'d/'s/n't, would have/would've/woulda, could have/could've/coulda,* etc.
Passive	p	Collocates of forms of *be* and forms of *get*, as well as causatives (*had work* ***done***)
Adjective	a	e.g. *No, because he might have a* ***broken*** *back* (y07i007a)
Irrelevant	i	e.g. *I just haven't* ***got*** *the nerve* (1180), see Note 3
Ambiguous	x	Indeterminate structure, not resolvable by audio/context, e.g. PH85-3-11: *What****'s*** *she* ***beat*** *you up for?* could be: (1) What [has] she beat-PP you up for *or* (2) What [does] she beat-INF you up for

395 This coding scheme allowed us to mark relevant tokens of perfect constructions as well as ones that
396 might be relevant for future study (i.e. passives) while keeping these separate from tokens for which
397 the structure cannot be determined definitively. Any tokens marked as ambiguous were checked by
398 other coders to confirm that the structure could not be resolved and thus re-categorized. After this step
399 of determining grammatical structure, there were a total of 6,829 data points from the three corpora
400 combined, which were then coded for a number of language-internal and social predictors, discussed in
401 the following subsection.

Not all data points included complete social information about their speakers. If a relevant social factor was missing, the data point was omitted from the analysis. This was particularly common in the PNC, where a number of data points were from interviewers, for whom demographic data was not collected, but Switchboard also has a handful of speakers whose education information was unknown. Following the exclusion of these data points, the data set consisted of 6,404 tokens of perfect constructions from 44 verbs across the three corpora. A breakdown of token counts by corpus is provided in Table 3.

Switchboard	4411
PNC	911
DECTE	1082
total	6404

Table 3: Tokens for analysis, by corpus.

3.2 Dependent and independent variables

Each token was coded for a number of language-internal factors chosen because of their possible influence on the leveling of participles based on previous work (see §2). Our decisions surrounding these variables and their categories are described in §3.2.2. We also included a number of social predictors in our models depending on the information available from the corpora, which are discussed in §3.2.3. Each token was also coded with the corpus it came from (DECTE, Switchboard, or PNC). This allows us to examine the effects of the particular corpora on leveling overall, as well as to determine whether internal and external predictors apply consistently across the different corpora (as we will do in §4).

3.2.1 Dependent variable

Each token was coded for whether it showed participle leveling (i.e. the preterite form was used for the participle) or not (that is, the prescriptive form of the past participle was used). This served as the dependent variable in our statistical models.

3.2.2 Language-internal factors

AUXILIARY TENSE. Each token was coded for whether the auxiliary of the perfect construction was non-tensed (9a–9e), present tense *has* (9f), present tense *have* (9g), or past tense (9h). We kept the two present

tense forms of the auxiliary separate to see if there is any effect on leveling of the form of the auxiliary itself. Perfects with present-tense auxiliaries are most prevalent in the data.

Note from the examples that non-tensed auxiliaries may either be preceded by a modal (which is most common, as in 9a–9d) or not (9e). In the examples below, the perfect is in bold, and the auxiliary is underlined for reference.

(9) Auxiliary tense

a. I should'**ve bit** my tongue. (PH91-2-15)

b. Then I would**a** just **broke** it up. (PH94-2-4)

c. I might not **have come** back alive. (PH12-1-10)

d. They may **have done** it. (1092)

e. They used to **have come** on the school bus. (1pvc03b)

f. It'**s become** a big event. (PH06-2-3)

g. Him and I **have become** great friends. (PH82-1-10)

h. Somebody **had broke** a window. (PH02-2-9)

NEGATION. Each token was coded for whether the perfect construction was negated or not. Negation was defined as sentential negation of the perfect construction with *never*, *not*, or its contracted form *n't*. This negation could appear either before the auxiliary, as in (10a–10c), or between the auxiliary and past participle, as in (10d) and (10e).

(10) Negation of the perfect construction

a. I never **have seen** any of those. (1413)

b. I might not **have came** back alive. (PH12-1-10)

c. They shouldn't **have done** it. (PH92-1-4)

d. I'**ve** never **broken** anything before. (PH00-1-3)

e. I **have**n't **come** to that point yet. (PH82-1-9)

For the tokens with negation, we added an additional code capturing whether the negation appeared between the auxiliary and past participle (intervening negation present, as in 10d and 10e) or not (intervening negation absent).

QUESTIONS. Each token was coded for whether or not a question was present in the clause containing the

perfect. Some examples of questions are presented in (11); note that these include instances where there is subject-auxiliary inversion and also instances where there is not. Cases that include subject-auxiliary inversion but no question (e.g. *That would be gone had I written a check*) were coded as absence of a question.

(11) Questions

a. What **had** you **done**? (PH85-3-12)

b. **Has** he **done** this to you? (PH81-0-5)

c. Who **had stolen** it? (PH06-2-1)

d. Where would you like to **have gone**? (PH82-1-7)

e. What would you **have done** differently? (1244)

f. So that was after you'**d come** out the Wrens? (2y07i011a)

g. It's on bleach, you **have**n't **seen** it? (2y07i007b)

INTERVENING MATERIAL. This predictor codes for whether any linguistic material besides contracted *-n't* and *not* intervenes between the auxiliary and the past participle. These interveners were most typically adverbs, but could also be quantifiers and/or discourse markers. Some examples of tokens with interveners are shown in (12), with the intervener underlined and the perfect construction in bold. Because this is intended primarily as a code to capture intervening adverbs, we include *never* as an intervener, as in (12d), but note that in cases like in (12c), the contracted *n't*, along with cases of *not*, are not counted as interveners as they are not adverbs. Along these lines, disfluencies such as *uh* and *um* are also not considered interveners, nor are the auxiliary-inverted subjects of the type presented in 10.

(12) Intervening material

a. He'**s** <u>always</u> **done** a lot for us. (PH82-1-12)

b. I would**a** <u>just</u> **broke** it up. (PH94-2-4)

c. She didn't — **had**n't <u>really</u> **come** out to my father. (PH97-3-5)

d. I'**ve** <u>never</u> **broken** anything before. (PH00-1-3)

e. They'**ve** <u>all</u> **gotten** married. (PH10-1-4)

PERSON, NUMBER. All tokens were coded for person (1st, 2nd, 3rd) and number (singular, plural) of the subject of the perfect construction, as two separate predictors.

VERB FREQUENCY. Verb frequency measures come from SUBTLEX (for the US data; Brysbaert and New 2009) and SUBTLEXuk (for the DECTE data; van Heuven et al. 2014), and measure the frequency of each verb lemma. A verb's raw frequency was calculated by summing its frequencies in all of its verbal forms. As an example, take the verb *bite*, which has the past participle *bitten* and the preterite form *bit*. The frequency for *bite* was calculated as follows (numbers are from US SUBTLEX):

bite	1210
bit	638
bitten	188
biting	191
bites	114
total	2341

Table 4: Calculating verbal frequency for *bite*.

Where a lexeme could occur as more than one part of speech (e.g. *bite* can be both a verb and a noun), care was taken to ensure we obtained its frequency only as a verb (as SUBTLEX provides part-of-speech-specific frequency counts).

Raw frequencies were then transformed to van Heuven et al.'s (2014) Zipf scale by taking the $\log_{10}$ of the frequency per million words. As a check, we determined the Pearson's correlation between the Zipf frequencies of the lexical items in the US data and those in the UK data. This was 0.959 ($p < 0.001$), indicating that the verbs that are more frequent in US English are also more frequent in UK English. That is, the varieties are consistent about which verbs are more frequent than others.[4]

PHONOLOGICAL DIFFERENCE FROM PRETERITE. One crucial way in which the verbs involved in leveling differ from one another is in how the standard form of the participle is phonologically different from the preterite form. Standard participles may differ from their corresponding preterites in one of four ways:

- The participle has an AFFIX which the preterite doesn't:
  e.g. *beaten - beat, bitten - bit, frozen - froze*
- The participle has a DIFFERENT VOWEL than the preterite:
  e.g. *become - became, run - ran, rung - rang*
- The participle has BOTH AN AFFIX AND A DIFFERENT VOWEL from the preterite:

503 e.g. *eaten - ate, grown - grew, taken - took, written - wrote*

504 • The participle is a SUPPLETIVE form, with no phonological relationship to the preterite:
505 only *gone - went*

506 We coded each token for which of these four differences the verb standardly shows. This allows us to ac-
507 count for these phonological differences without grouping verbs into conjugation classes, which depend
508 on theoretical motivation.

509 **3.2.3 Language-external (social) factors**

510 GENDER. Each token was coded for the gender of the speaker as a binary (male or female) when the
511 information was available.
512
513 SOCIAL CLASS, EDUCATION. All three corpora have different ways of coding for social class or education.
514 DECTE is coded for speaker social class, PNC provides a speaker's years of schooling, and Switchboard
515 bins speakers based on years of schooling. The way that each social class or education level was desig-
516 nated per corpus is given below.

517 • DECTE: Middle class, lower middle class, or working class.

518 • PNC: Education was treated as a continuous measure (number of years of schooling).

519 • Switchboard: Education level was rated on a 4-point scale: less than high school, less than college,
520 college, more than college.

521 REAL TIME. Switchboard data was all collected in a fourteen-month period from March 1991 to May
522 1992, so effects of real time (that is, whether the general application of participle leveling has changed
523 over time) cannot be examined. By contrast, the other two corpora are diachronic. The earliest PNC
524 interview in our data is from 1973 and the latest is from 2012. DECTE consists of three subcorpora: the
525 first from the late 1960s, the second from the 1990s, and the third from 2007–2010. The latter two cor-
526 pora, then, offer potential for looking at real time change, with the caveat that the speaker samples in the
527 different DECTE subcorpora were not equally balanced for social factors like class.
528
529 AGE. DECTE bins speakers into eight age groups, corresponding to teenagers, 20s, 30s, and so on up
530 to 80s. Switchboard and PNC provide speakers' year of birth, from which age can be calculated as year

of recording minus year of birth. It is crucial to calculate age for the PNC data, rather than using year of birth as a proxy for age, because the corpus was collected over four decades: thus, a speaker born in 1950 would be a very different age depending on whether they were interviewed in 1973 or 2012. The same is not true for Switchboard, whose data was all collected within fourteen months; though we could in principle use either year of birth or age to investigate age-grading in Switchboard, we choose age for consistency with the other two corpora.

3.3 Modeling

The statistical models used in this paper are mixed-effects logistic regressions fit using the `lme4` package (v.1.1-26, Bates, Mächler, Bolker and Walker 2015) with the bobyqa optimizer (200,000 iterations) in R (v.4.0.5, R Core Team 2013). Logistic regression considers all possible predictors simultaneously; this means that the significant factors presented in §4 are significant after taking all other factors into account, that is, they cannot be reduced to each other.

In this study, we are interested not only in the factors that condition participle leveling, but also in the extent to which those factors are shared across our three data sets. The best way to test this is by creating one single model containing data from all three corpora, and including a statistical interaction with corpus for each predictor. These statistical interactions tell us whether the effects of each predictor are significantly modulated across the different corpora.

It is only possible for a model to contain a statistical interaction between corpus and some predictor when that predictor has been coded identically across the different corpora. This is the case for all of our internal factors, and for speaker gender. Accordingly, our full model analyzed data from all three corpora, and tested the significance of every internal predictor, speaker gender, and the interaction of each of these with corpus. We will refer to this model as the "full model" throughout the paper.

Other social factors, however, were not coded the same way across the different corpora (e.g. age, class/education). To assess the significance of these factors, we have to construct one model for each individual corpus. In this case, we cannot directly compare the size of effects or the p-values across the different data sets. That is, we can say that an effect is or isn't statistically significant in one data set or another, but not whether that effect is stronger in one data set compared to another. This contrasts with the types of conclusions that can be drawn from the full model with interactions.

Speaker and verb were included as random intercepts in each model (as the 'by participant' and 'by item' corrections respectively). For modeling year of recording in the PNC data, we center year of recording around its median and rescale it to decades.[5] Age group in the DECTE corpus was backwards-

562 difference coded, which allowed us to compare the rate of leveling in each age group with that of the
563 age group directly below it (following, e.g., Röthlisberger and Tagliamonte 2020). Level of education in
564 Switchboard was likewise reverse-difference coded. All other fixed-effect predictors were sum-coded for
565 modeling unless there was an obvious default option, in which case that default option was set as the
566 reference level of a treatment-coded predictor.[6] Additionally, when a sum-coded predictor turned out to
567 significantly improve model fit, we re-ran the model with treatment-coding of that predictor and carried
568 out post hoc comparison of contrasts with the `emmeans` package in R, using the Tukey adjustment for
569 multiple comparisons. This allowed us to determine exactly which pairs of levels of the predictor differed
570 from one another.

571 Model-building proceeded as follows. For each model, we started with only the random effects
572 (speaker and verb), adding one predictor at a time, in an order that was based on the apparent strength
573 of their effects as assessed through visualization of the data. Then we used ANOVAs and comparison of
574 AIC and BIC to test for significance in the addition of each predictor, keeping the predictor in the model
575 if it significantly improved the model fit and lowered AIC and/or BIC. In the case of the full model, we
576 tested the interaction of each predictor with corpus as well, regardless of whether that predictor signif-
577 icantly improved model fit on its own. The final output for the full model is available in Table 5; for the
578 by-corpus models, Tables 6–8.

579 4 Results

580 4.1 General pattern

581 Use of the preterite for the participle is variable both within and across speakers in our data. 13–15
582 demonstrate variability within individuals, Table 5 provides the output from the full regression model
583 with by-corpus interactions, and Figure 1 depicts the leveling rates in the three corpora under study.

584 (13) Switchboard, speaker 1236:

585 a. Latest one **I've saw**, which was a mistake to go see, was *Lionheart*.

586 b. I can't remember, it's been a while since **I've seen** it.

587 (14) PNC, speaker PH94-2-4:

588 a. Then I would**a** just **broke** it up.

589 b. If it was a one-on-one fight then I'd**a broken** it up.

590 (15) DECTE, speaker tlsg25a:

591 a. She'**s** just **came** back fortnight ago from Cannes.

592 b. Well I'**ve** just **come** out of hospital, you see.

Table 5: Best full model. Accompanying each predictor are coefficient, standard error (in parentheses), and significance level (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Coefficients of treatment-coded predictors should be interpreted in relation to the reference level, given in parentheses alongside the predictor name. Other predictors are continuous. Significant positive coefficients indicate that the environment in question promotes leveling.

	Dependent variable:
	Use of leveled variant
CORPUS (VS. SWITCHBOARD)	
PNC	−0.449 (0.434)
DECTE	3.522*** (0.407)
AUXILIARY TENSE (VS. PRESENT)	
Past	0.973*** (0.265)
Non-tensed	1.063** (0.334)
DIFFERENCE FROM PRETERITE (VS. AFFIX ONLY)	
Affix + vowel	−2.540*** (0.666)
Vowel only	−0.073 (0.740)
Suppletive	−0.683 (1.453)
FREQUENCY (ZIPF SCALE)	−0.871* (0.349)
INTERVENING NEGATION (VS. ABSENT)	
Present	0.619** (0.192)
SUBJECT PERSON (VS. 1ST)	
2nd	0.298 (0.420)
3rd	−0.733*** (0.221)
SPEAKER GENDER (VS. FEMALE)	
Male	−0.018 (0.249)
CORPUS × TENSE	
PNC × past	0.960* (0.432)
DECTE × past	−0.342 (0.384)
PNC × non-tensed	2.290*** (0.485)
DECTE × non-tensed	0.289 (0.450)
CORPUS × DIFFERENCE FROM PRETERITE	
PNC × affix + vowel	1.668*** (0.441)

DECTE × affix + vowel	−0.959* (0.441)
PNC × vowel	0.522 (0.580)
DECTE × vowel	−1.762** (0.546)
PNC × suppletive	1.655*** (0.475)
DECTE × suppletive	−0.944* (0.479)
CORPUS × SUBJECT PERSON	
PNC × 2nd	−0.947 (0.698)
DECTE × 2nd	−0.130 (0.567)
PNC × 3rd	0.685* (0.349)
DECTE × 3rd	0.720* (0.330)
CORPUS × SPEAKER GENDER	
PNC × male	1.143** (0.401)
DECTE × male	−0.153 (0.396)
Intercept	2.122 (1.906)
Observations	6,404
Log Likelihood	-1,125.142
Akaike Inf. Crit.	2,312.284
Bayesian Inf. Crit.	2,521.989
Note:	*p<0.05; **p<0.01; ***p<0.001

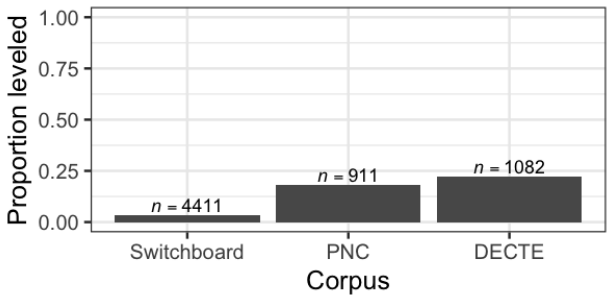

Figure 1: Proportions of participle leveling by corpus.

As Figure 1 shows, the leveling rate is considerably lower in Switchboard (3%) than either PNC (15%) or DECTE (22%). Indeed, corpus is a statistically significant predictor of leveling in the full model (Table 5), which finds DECTE to show significantly more leveling than Switchboard. The PNC–Switchboard comparison does not reach significance in this model, but post hoc pairwise comparison of contrasts with the Tukey adjustment for multiple comparisons does find significantly more leveling in PNC than

Switchboard. PNC and DECTE, however, do not consistently differ from one another.[7]

Leveling is not restricted to a small subset of verbs, either. Of the 44 verbs represented in our study, all but eight show leveling rates greater than 0, and seven of those eight are infrequent, represented in our data by fewer than ten tokens. We provide further discussion of verb-specific leveling patterns throughout this section and in §5.

In the rest of this section, we will present the results of the different predictors under consideration one at a time, discussing by-corpus interactions where relevant. Because some external predictors pertain only to particular corpora (e.g. Switchboard does not have a real-time component while the other two corpora do), those predictors will be discussed on a corpus-specific basis.

As we will see, there is a large degree of conformity across the corpora in the factors that condition leveling. This is despite the fact that the Switchboard corpus differs from the other two in several ways: modality (phone rather than in-person conversations), register (conversations on assigned topics rather than sociolinguistic interviews designed to draw out the vernacular), and participant demographics (from all over the U.S. as opposed to from a particular speech community). For all of these reasons, it is perhaps expected that the speech in Switchboard would pattern somewhat differently, and indeed, we see this in Switchboard's extremely low rate of leveling compared to the other two corpora. Nonetheless, the primary takeaway point of this section will be that the majority of predictors operate in the same way across all three corpora, regardless of register, modality, or variety.

4.2 Language-internal factors

In all three corpora, as well as in the combined data, one of the strongest predictors affecting the variation is AUXILIARY TENSE. As shown in Figure 2, all three corpora show more leveling when the auxiliary of the perfect is non-tensed or past tense, compared to when it is present tense. The beta coefficients, standard errors, and p-values for the main effect of auxiliary tense in Table 5 capture the effect of this predictor in Switchboard. (Significant positive coefficients reflect increased leveling compared to the reference level.) The interaction terms for DECTE do not reach significance, indicating no significant difference in the effects of non-tensed or past-tense auxiliaries between the two corpora. The interaction terms for PNC are both positive, indicating even stronger promotion of leveling with non-tensed and past-tense auxiliaries in that corpus than we find in Switchboard.

In 94% of tokens containing a non-tensed auxiliary in our data, the auxiliary is preceded by a modal. Thus, the strong effect of a non-tensed auxiliary replicates a large body of previous work that has found more leveling with a modal (reviewed in §2.2.1). The favoring effect of the past perfect is consistent with

629 the findings of Eisikovits (1987) and Kemp et al. (2016).

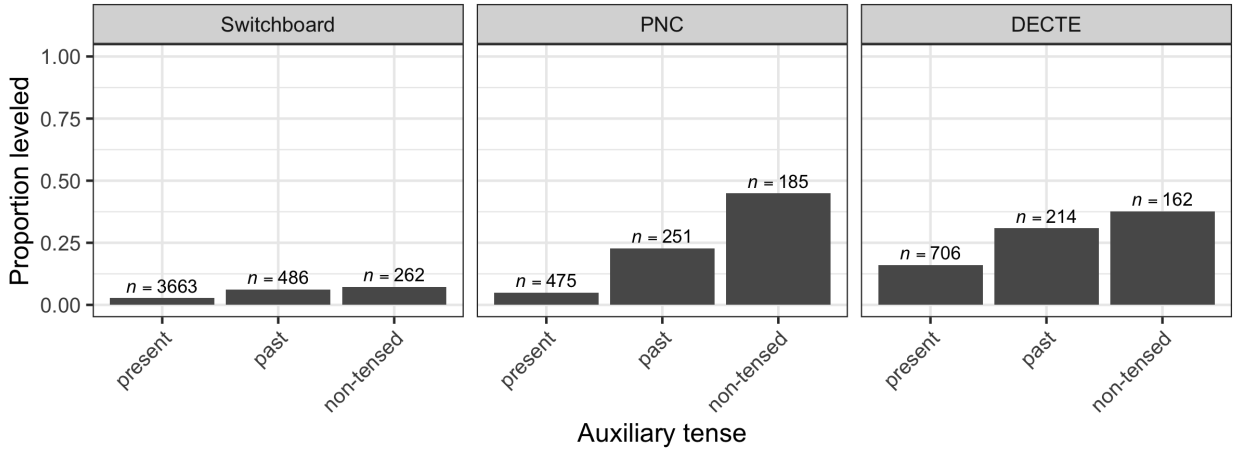

Figure 2: Proportions of participle leveling by corpus and auxiliary tense.

630 Additionally evident from Table 5 is that the boost in leveling when the auxiliary is non-tensed (com-
631 pared to present tense) is greater than the boost in leveling when the auxiliary is past tense (again, com-
632 pared to present tense). That is, both non-tensed and past-tense auxiliaries induce more leveling on the
633 participle than present-tense auxiliaries do, but this effect is stronger for non-tensed than for past-tense.
634 This can be seen in the greater β values for non-tensed than for past-tense auxiliaries, for both Switch-
635 board (the main effect at the top of the table) and PNC (the interaction in the middle of the table). Post
636 hoc pairwise comparisons find that non-tensed and past-tense contexts differ from one another only in
637 PNC ($\beta = -1.42$, SE = 0.32, $p < 0.001$).

638 Another particularly strong factor affecting the variation is the PHONOLOGICAL DIFFERENCE BETWEEN
639 THE PARTICIPLE AND THE PRETERITE IN THE STANDARD LANGUAGE (Figure 3). We treatment-code this
640 predictor; the reference level in Table 5 is verbs whose participle differs from the preterite only through
641 the addition of an affix (e.g. *frozen* compared to *froze*). In Switchboard (the main effect near the top of the
642 table), we find significantly less leveling of verbs whose participle differs from the preterite through both
643 the addition of an affix and a different vowel (e.g. *written* compared to *wrote*). The significant positive
644 coefficient of the PNC × affix+vowel interaction term indicates that this effect is weakened, though not
645 completely erased, in PNC. The significant negative effect of the DECTE × affix+vowel interaction term
646 indicates that the effect is even stronger in that corpus.

647 The other two phonological classes—participles that are formed by changing the vowel of the preterite
648 (e.g. *swum* compared to *swam*), and the one verb whose participle form is suppletive (*gone* compared to
649 *went*)—do not differ consistently from the affix-only class, or from each other, as assessed through post

650 hoc pairwise tests. These post hoc pairwise tests find that the only other pair with a robust difference in
651 leveling is affix+vowel compared to vowel-only in Switchboard ($\beta = -2.47$, SE = 0.79, $p = 0.01$).

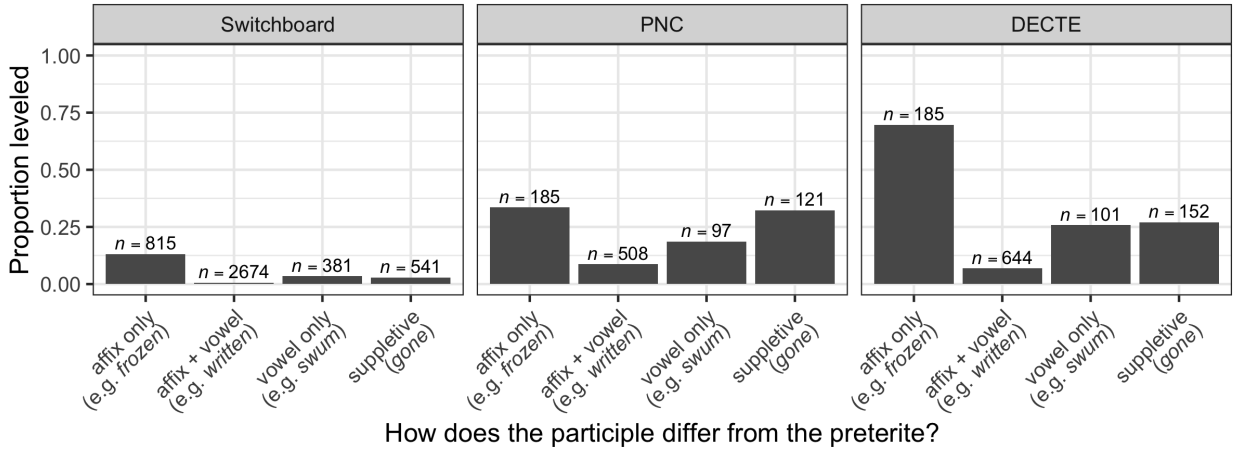

Figure 3: Proportions of participle leveling by corpus and phonological difference between participle and preterite.

652 The general conclusion that can be drawn from this is that leveling is more frequent the more phono-
653 logically similar participle and preterite are: that is, when the two differ by only an affix or a vowel,
654 leveling rates are higher; when two morphophonological features differentiate them (an affix *and* a
655 vowel), the verb resists leveling.[8] The suppletive category would seem to go against this, as participle
656 and preterite are considerably different in a suppletive verb, but there is only one such verb, so it cannot
657 tell us much about this category.

658 VERB FREQUENCY affects variation in Switchboard, and the lack of a significant by-corpus interaction
659 for this term means that we have no evidence that this effect differs in either of the other two corpora.
660 The direction of the effect is such that higher leveling rates are observed with less frequent words, in
661 keeping with previous studies of analogical leveling (e.g. Hooper 1976). This can be seen in Figure 4.

662 Close scrutiny of the DECTE panel of Figure 4 reveals an outlier in this pattern: the verb *get*, which,
663 despite its high frequency (6.83 on the Zipf scale), levels at a very high rate (85%). This high rate of *get*-
664 leveling is consistent with other research on the past participle of *get* in British English, which has found
665 that *gotten* is "hardly used," and that *got* is the standard past participle to the point that prescriptivists
666 express negative attitudes about *gotten*, which is perceived as an Americanism (Murphy 2018, 118). The
667 high rate of *get*-leveling to *got* in our DECTE data reveals that not only is *gotten* dispreferred in the North
668 East of England, but the local form *getten* is, as well. There is thus a case to be made for excluding *get* from
669 the DECTE data entirely: unlike the other verbs under study, its standard form is the leveled one, not the

-en-affixed form. We leave it in because it does nonetheless alternate in the English of the North East of England, but we return to the status of *get*, and other verbs which differ in their patterning between American and British English, in §5.

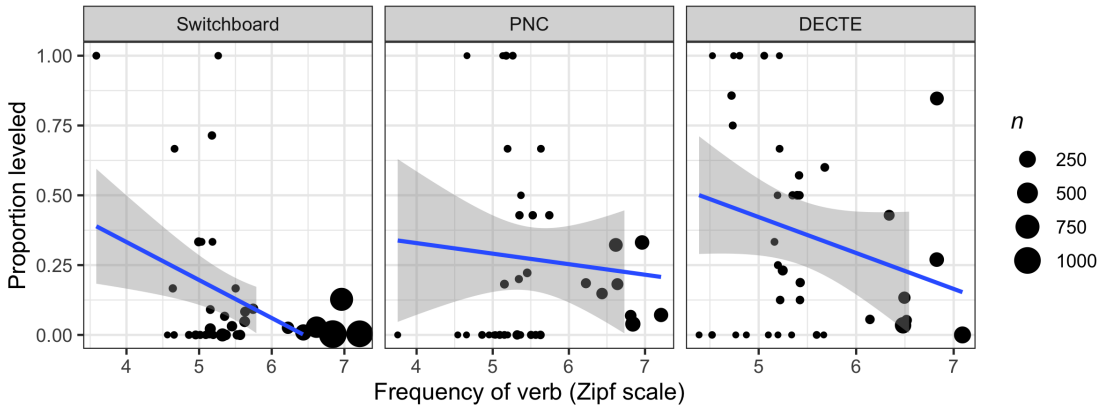

Figure 4: Proportions of participle leveling by verb frequency.

Like verb frequency, NEGATION OF THE PERFECT CONSTRUCTION is significant in the pooled data set, and its interaction with corpus does not reach significance. Negation is found to significantly increase leveling (Figure 5); though PNC and DECTE appear to show the opposite pattern, this is not supported by the statistical modeling. We additionally find that refining this predictor to capture specifically negation that intervenes between the auxiliary and the participle (as in *have**n't** [participle]*) is a slightly better fit for the data than defining it to also encompass negation that does not intervene (as in ***never** have [participle]*). In other words, when auxiliary and participle are separated by a negator, leveling is increased, an effect which does not extend to a negator that precedes the auxiliary.

SUBJECT PERSON significantly affects the variation only in Switchboard, where third-person subjects are accompanied by significantly less leveling than first-person ones (Figure 6). Post hoc comparisons do not find the other pairs (first versus second, second versus third) to differ significantly. Subject person interacts significantly with corpus such that the third-person effect is effectively erased in PNC and DECTE; post hoc tests do not find any pairs of persons to differ significantly in those corpora.

By way of explanation for the person effect in Switchboard, one obvious difference between third person and the other two is that third person induces different morphology on the present-tense auxiliary when singular (*has*, as opposed to *have* with other persons). However, replacing the person predictor with one that captures whether the auxiliary is *has* versus *have* does not improve model fit, nor does combining person and number into a single category, suggesting that the observed person effect is not

691 being driven solely by singular present-tense contexts.

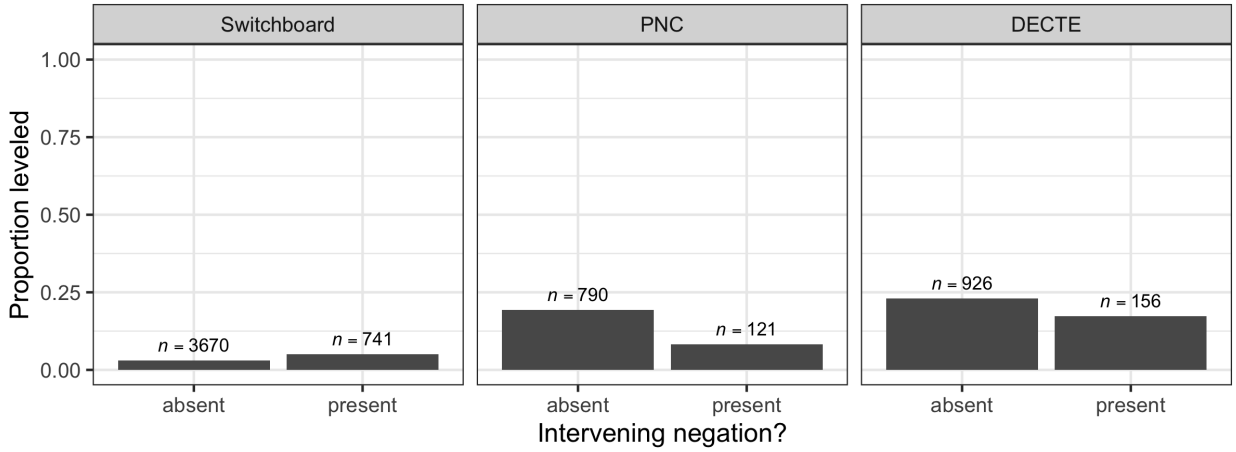

Figure 5: Proportions of participle leveling by presence of negation that intervenes between auxiliary and participle.

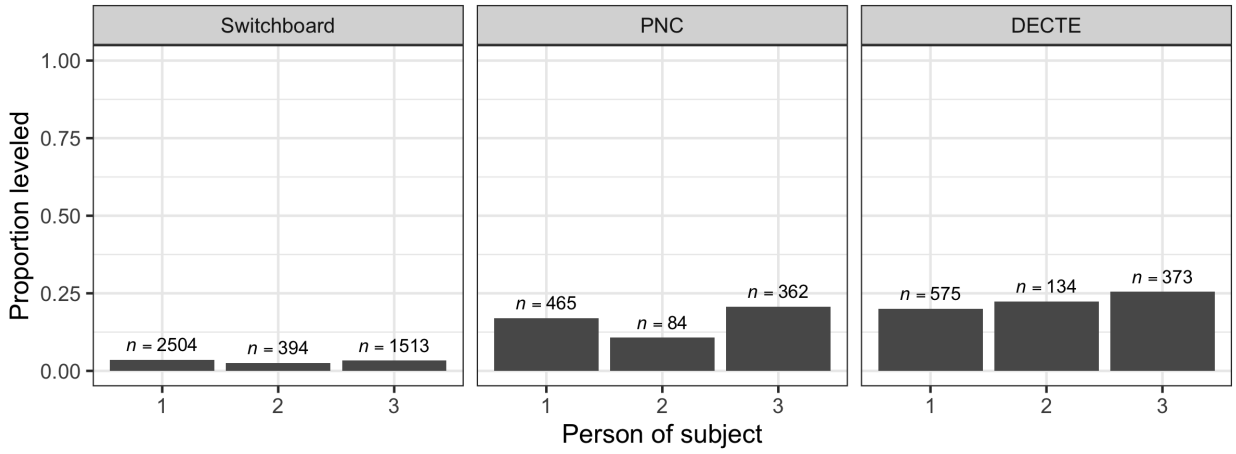

Figure 6: Proportions of participle leveling by subject person.

692 Finally, three predictors have no effect on the variation: SUBJECT NUMBER, QUESTION, and INTER-
693 VENER. There is no evidence of these predictors significantly improving model fit, either alone or with an
694 interaction with corpus.

695 4.3 Language-external factors

696 As this subsection will show, the general pattern from the language-external factors is that participle
697 leveling is a diachronically stable variable which shows the expected social correlates: that is, more non-

698 standard forms among men, younger speakers, and those with less education and/or of a lower social
699 class (Labov 2001). Not all social factors examined are significant in every corpus, potentially demon-
700 strating community-specific nuances in the socioindexical meaning of leveled participles (Eckert 2008),
701 or perhaps simply due to the differences in corpus size and composition. A productive direction for fu-
702 ture work will be to probe the social associations of this variable further, for instance through dedicated
703 perception studies, given the dearth of perception research on the social meaning of morphosyntactic
704 variation (Robinson and MacKenzie 2019; MacKenzie and Robinson 2019).

705 The regression model output for the three corpora are provided in Tables 6–8. To reiterate from Sec-
706 tion 3.3, several external predictors could not be included in the full model due to their being oper-
707 ationalized differently across the three different corpora, so we had to model them separately. These
708 separate by-corpus models necessarily include significant internal predictors, too, but our focus here is
709 on the external ones.

710 The predictors capturing LEVEL OF EDUCATION OR SOCIAL CLASS are all statistically significant across
711 the three data sets. In Switchboard, speakers with postgraduate education ("more than college" in the re-
712 gression output) level significantly less than those whose education stopped with a college degree. Post
713 hoc pairwise comparisons find a similar difference between speakers with postgraduate education com-
714 pared to those with less than a college degree ($\beta = -1.12$, SE = 0.43, $p = 0.04$), but no other significant
715 pairwise differences. In PNC, where education is coded as a continuous measure of years of schooling,
716 more education similarly correlates with less leveling. Finally, in DECTE, the only corpus coded for so-
717 cial class, both middle class and lower middle class speakers level significantly less than working class
718 speakers (but post hoc pairwise comparisons do not find them to differ from each other). These patterns
719 are depicted in Figure 7.

720 SPEAKER AGE is another influential predictor, affecting the variation in the two most vernacular cor-
721 pora, PNC and DECTE (Figure 8). In PNC, we find significantly less leveling among older speakers. Be-
722 cause the continuous age predictor in the regression model has been rescaled to decades, we can un-
723 derstand its beta coefficient as reflecting the change in log odds of leveling associated with each decade
724 of increasing age. In DECTE, where speakers are binned into age groups by decades, and the logistic
725 regression modeling compares each age group to the one below it, the picture is slightly more compli-
726 cated. Speakers in their 20s level less than those in their teens—suggesting a similar pattern to that of
727 Switchboard, namely decreased leveling with increased age—but then speakers in their 30s level more
728 than those in their 20s, suggesting an apparent reversal. This reversal is then apparently *re*-reversed
729 among speakers in their 40s, who level less than those in their 30s. We suggest that the low rate of level-

Table 6: Best Switchboard model. Accompanying each predictor are coefficient, standard error (in parentheses), and significance level (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$). Coefficients of treatment-coded predictors should be interpreted in relation to the reference level, given in parentheses alongside the predictor name. Other predictors are continuous. Significant positive coefficients indicate that the environment in question promotes leveling.

	Dependent variable:
	Use of leveled variant
AUXILIARY TENSE (VS. PRESENT)	
Past	0.971^{***} (0.260)
Non-tensed	1.181^{***} (0.333)
DIFFERENCE FROM PRETERITE (VS. AFFIX ONLY)	
Affix + vowel	-2.719^{***} (0.647)
Vowel only	-0.650 (0.726)
Suppletive	-0.990 (1.221)
FREQUENCY (ZIPF SCALE)	-0.962^{**} (0.351)
INTERVENING NEGATION (VS. ABSENT)	
Present	0.925^{***} (0.245)
SUBJECT PERSON (VS. 1ST)	
2nd	0.462 (0.413)
3rd	-0.642^{**} (0.222)
EDUCATION (VS. PREVIOUS)	
Less than college	0.193 (1.300)
College	-0.560 (0.391)
More than college	-0.590^{*} (0.265)
Intercept	3.250 (1.964)
Observations	4,411
Log Likelihood	-487.711
Akaike Inf. Crit.	1,005.422
Bayesian Inf. Crit.	1,101.299
Note:	*p<0.05; **p<0.01; ***p<0.001

Table 7: Best PNC model. Accompanying each predictor are coefficient, standard error (in parentheses), and significance level (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$). Coefficients of treatment-coded predictors should be interpreted in relation to the reference level, given in parentheses alongside the predictor name. Other predictors are continuous. Significant positive coefficients indicate that the environment in question promotes leveling.

	Dependent variable:
	Use of leveled variant
AXUILIARY TENSE (VS. PRESENT)	
Past	1.936^{***} (0.350)
Non-tensed	3.100^{***} (0.365)
DIFFERENCE FROM PRETERITE (VS. AFFIX ONLY)	
Affix + vowel	-2.120^{***} (0.330)
Vowel only	-1.119^{*} (0.447)
Suppletive	-0.232 (0.364)
FREQUENCY (ZIPF SCALE)	-0.607^{**} (0.228)
YEARS OF SCHOOLING	-0.202^{***} (0.057)
AGE (CENTERED)	-0.320^{***} (0.086)
GENDER (VS. FEMALE)	
Male	1.020^{**} (0.324)
Intercept	3.682^{*} (1.720)
Observations	911
Log Likelihood	-285.061
Akaike Inf. Crit.	594.123
Bayesian Inf. Crit.	651.897
Note:	*p<0.05; **p<0.01; ***p<0.001

Table 8: Best DECTE model. Accompanying each predictor are coefficient, standard error (in parentheses), and significance level (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$). Coefficients of treatment-coded predictors should be interpreted in relation to the reference level, given in parentheses alongside the predictor name. Other predictors are continuous. Significant positive coefficients indicate that the environment in question promotes leveling.

	Dependent variable:
	Use of leveled variant
AUXILIARY TENSE (VS. PRESENT)	
Past	0.869** (0.313)
Non-tensed	1.284*** (0.347)
DIFFERENCE FROM PRETERITE (VS. AFFIX ONLY)	
Affix + vowel	−2.541** (0.893)
Vowel only	−0.723 (1.037)
Suppletive	−0.718 (1.984)
FREQUENCY (ZIPF SCALE)	−0.831 (0.572)
CLASS (VS. WORKING CLASS)	
Lower middle	−1.655*** (0.379)
Middle	−1.640*** (0.398)
AGE GROUP (VS. PREVIOUS)	
20s	−0.999* (0.471)
30s	1.394* (0.630)
40s	−1.301* (0.655)
50s	−0.520 (0.670)
60s	0.121 (0.697)
70s	−1.010 (1.423)
80s	0.595 (1.568)
Intercept	5.142 (3.178)
Observations	1,069
Log Likelihood	-284.398
Akaike Inf. Crit.	604.796
Bayesian Inf. Crit.	694.337
Note:	*p<0.05; **p<0.01; ***p<0.001

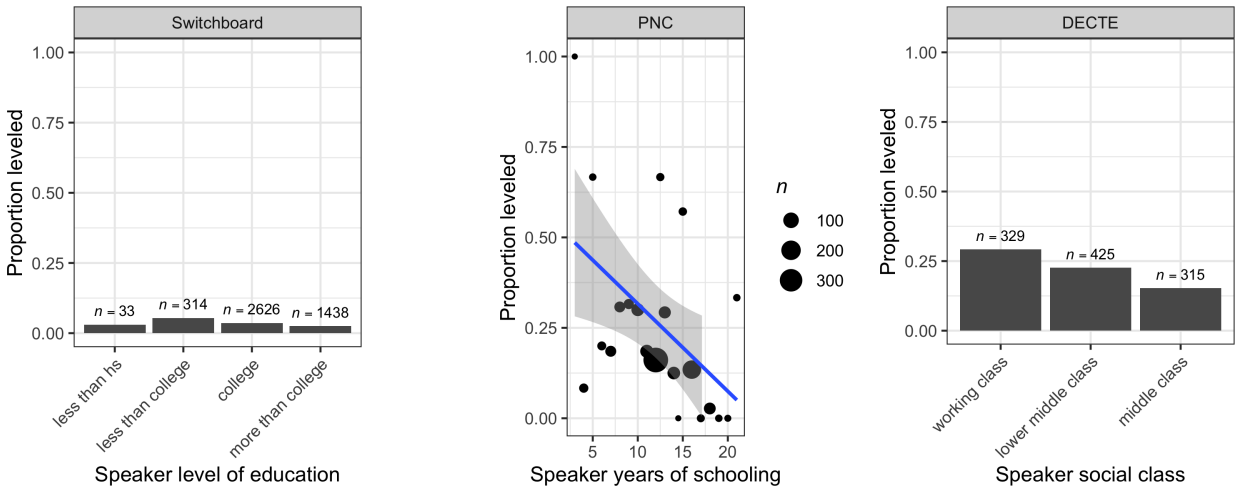

Figure 7: Proportions of participle leveling by speaker level of education (Switchboard, left), years of schooling (PNC, center), and social class (DECTE, right).

ing among speakers in their 20s is due to the fact that a large proportion of speakers in this group were university students at the time. The standardizing effect of being immersed in higher education (e.g. Wagner 2012) may thus be dampening leveling rates among this particular age cohort. Abstracting away over this anomalous group, the general picture is of more leveling among younger speakers, as we find in PNC.

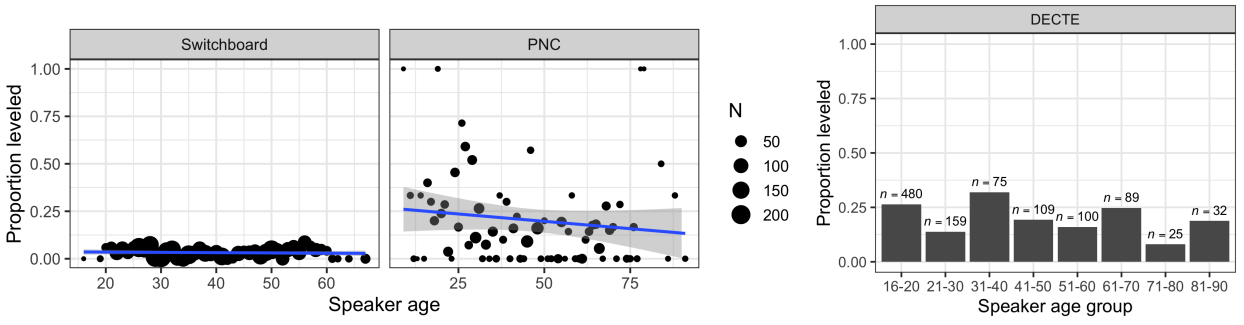

Figure 8: Proportions of participle leveling by speaker age (group).

While in principle this pattern could be compatible with either age-grading or change in progress, we can actually adjudicate between these two interpretations because both PNC and DECTE have a real-time component, visualized in Figure 9. In fact, neither real-time predictor (year of recording in PNC; subcorpus in DECTE) improves model fit when added. For this reason, neither real-time predictor is included in the final model outputs in Tables 7 and 8. This means that there is no evidence of change

740 in progress, and that the age patterns are more likely to reflect age-grading, that is, speakers decreasing
741 their use of leveling as they age.

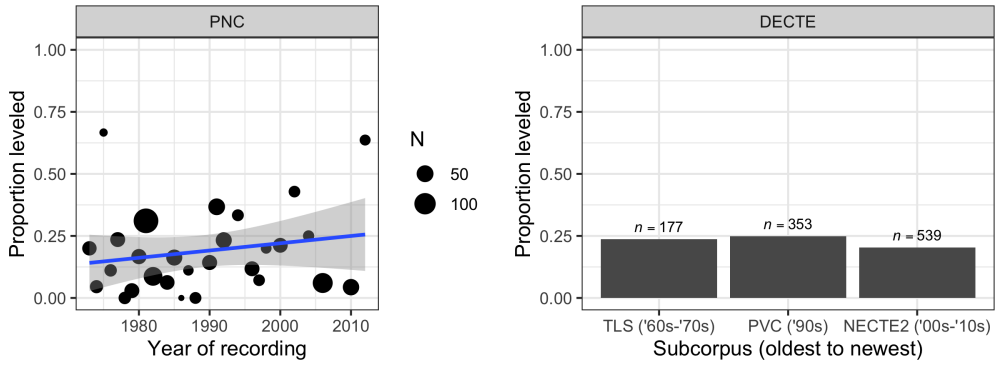

Figure 9: Proportions of participle leveling in real time.

742 Finally, SPEAKER GENDER plays a limited role in conditioning participle leveling (Figure 10). Because
743 this is the only extralinguistic factor that is present and operationalized in the same way across the three
744 corpora, we were able to include it in the full model with a by-corpus interaction (Table 5). Doing this
745 reveals that gender affects the variation only in PNC, where speakers whose gender is recorded as male
746 level more than those whose gender is recorded as female.

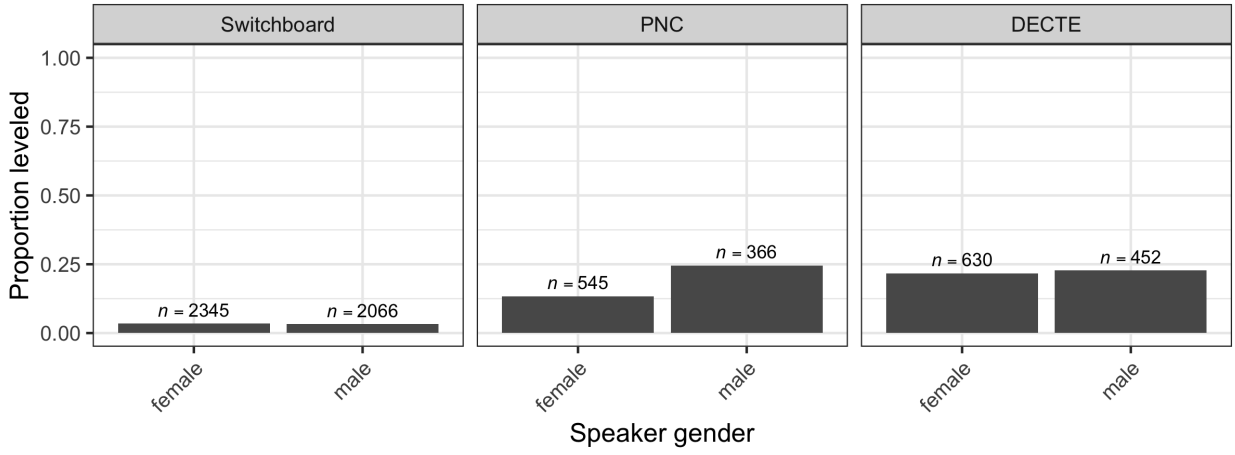

Figure 10: Proportions of participle leveling by speaker gender.

5 Discussion

Here we return to the four questions we enumerated in §2.4. First, we address question a. WHAT IS THE VARIABLE, ACTUALLY? The primary aim of this question was to determine whether any verb with distinct preterite/participle forms can vary in production of the participle, or whether variation is lexically constrained. The answer to this question is that just about any verb can vary; the variability appears to be largely systemic. Of the 44 verbs represented in our study, all but eight show non-zero leveling rates.[9] Of the eight verbs that are categorically produced in their participial (that is, unleveled) form, seven are extremely infrequent, surfacing fewer than 10 times across the three corpora combined, suggesting that their lack of leveling is simply due to a lack of opportunity to observe them in their leveled form.[10] The eighth invariant verb is *become*, which is actually fairly well represented in our data, with 118 total tokens. This suggests that this verb is truly an exception to leveling in these varieties, in a way that its phonological counterpart *come*—which levels at a rate of 7.5% across the three corpora—is not.

When we break the data down by variety, the picture changes slightly, revealing that leveling is progressing through the language on a verb-by-verb basis differently in British versus American English. Namely, within the two American corpora, there are two additional verbs which are well represented (with more than 20 tokens each) but never level: *drive* (N = 38) and *eat* (N = 34). Each of these verbs is attested at least once in its leveled form in DECTE. By contrast, in DECTE, we find no leveling whatsoever of *do*, despite a large amount of data (N = 259). This contrasts with Switchboard and PNC, where *do* is leveled (albeit very infrequently).[11] We take up other variety-specific patterns of leveling again at the end of this section.

Having addressed the first of our research questions, we are now able to turn to the remaining three:

b. WHAT CONDITIONS VARIATION OF THE PARTICIPLE? Our results confirm the well-documented favoring effect of the presence of a modal verb on leveling; this is one of the strongest factors affecting the variation in our data. Less commonly demonstrated in the previous literature, but also apparent in our data, is that past perfect contexts also boost leveling, compared to present perfect. Participle leveling also shows hallmarks of analogical leveling processes more generally, with more leveling of less frequent verbs, and more leveling the more phonologically similar the participle and preterite are. We additionally find limited evidence for an inhibiting effect of intervening negation on leveling, as suggested by Geeraert (2010) and Greblick (2000), though contra Greblick, this effect does not extend to adverbs that intervene between auxiliary and participle. Like Kemp et al. (2016), we find a (weak) effect of subject person/number on leveling, with both studies agreeing that first person is a favoring context for leveling

778 and third person (plural, in their case) a disfavoring one.

779 Finally, our finding of socially-stratified, age-graded, stable variation accords with the impressions
780 of a large number of sociolinguists who have speculated on the social patterning of this variable (as
781 summarized in §2.2.2). The presence of a real-time component in two of our corpora gives no evidence
782 that this variation is changing over the time span considered in our corpora (i.e. the second half of the
783 twentieth century).

784 c. IS THE VARIABLE AN AMERICANISM OR BROADER FEATURE OF ENGLISH? We find leveling in both
785 American and British Englishes; in fact, the rate of leveling is highest in DECTE, the British English cor-
786 pus. Moreover, we find no evidence for real-time change in DECTE: the variability appears to be di-
787 achronically stable (and likewise for PNC, the American real-time corpus). If leveling has spread from
788 American to British English, then, it certainly did not happen recently, and any such incursion of level-
789 ing into British English has either been arrested or is progressing so slowly that it cannot be detected over
790 the course of several decades.

791 d. WHAT ELSE CAN A CROSS-ATLANTIC COMPARATIVE APPROACH TELL US ABOUT THIS VARIABLE? We
792 suggested that our data may additionally shed light on the history and grammar of the variable. One way
793 in which it could do so was by providing examples for evaluating previous morphosyntactic analyses
794 of the variable. Recall from §2.3 that some researchers have suggested that participle leveling to the
795 preterite is triggered by a modal preceding the auxiliary verb *have*, implying that leveling should not
796 be attested without a modal being present. The high rate of leveling in past perfect constructions in
797 our data demonstrates that this analysis cannot be correct. Even in present perfect contexts, the least
798 favoring tense for leveling, we find a leveling rate of 5%.

799 One suggestion put forth by previous researchers is that the phonetic reduction of *have* in modal
800 contexts induces leveling, for instance by reflecting a modal+auxiliary unit that has grammaticalized to
801 an adverb, which is then followed by a true pretite form. While this cannot be the only factor that triggers
802 leveling, for reasons laid out in the previous paragraph, an open question is whether phonetic reduc-
803 tion of *have* boosts leveling rates compared to cases of modal+*have* that are not phonetically reduced.
804 Coding the phonetic realization of *have* as a potential predictor of leveling is a worthy direction for future
805 work, and one which was not undertaken in the present study, for which coding was primarily done from
806 written transcripts. (See MacKenzie (2020) for evidence that orthographic transcriptions of contracted
807 auxiliary verbs, at least in the Switchboard corpus, are not fully reliable.)

808 Furthermore, we note that the lack of real time change in our data suggests that this is a stable vari-
809 able, one which, contrary to some claims, is likely not a novel Americanism. Beyond this observation,

it is additionally noteworthy that our findings regarding language-internal constraints on variation are shared across corpora. In large part, the same constraints influence variant selection in the same direction in both US- and UK-based corpora (not to mention their corroboration of Eisikovits's (1987) results from Australia). Work in comparative sociolinguistics (for instance, Carmichael and Becker (2018), Erker and Otheguy (2021); and see MacKenzie (2019) for a recent review) has suggested that when two dialects share constraints on the same variable, they likely share an origin of the variation.[12] Following this logic, our cross-Atlantic comparative approach suggests that variable participle leveling on both sides of the Atlantic shares a common origin, given the crucial shared constraint of auxiliary tense on the variation, which is unlikely to have a universal non-linguistic source. There are two reasonable hypotheses as to how this may be derived. The first is that because the dialects began to diverge several centuries ago, variable participle leveling has been a stable variable in English for quite some time. Perhaps the variation observed in late Middle English/Early Modern English (Lass 2008) has simply continued to the present. An alternative possibility recognizes that the varieties included in our study and others (i.e., Eisikovits (1987)) are either British English or settler colonial varieties. Given that settler colonial varieties can show parallel developments across vast spaces (Denis and D'Arcy 2019), it is possible that the varieties independently developed the participle leveling we see synchronically based on inherited constraints that predate the colonial enterprise. In either of these possibilities, however, our data ultimately suggests an early, English-specific, shared origin for some element of the variability. We suggest that the investigation of variable participle leveling by researchers in historical (socio)linguistics would shed much-needed light on the development of this sociolinguistic variable.

At the same time, our cross-Atlantic comparative approach has revealed that leveling is constrained by lexical frequency in such a manner that it appears to be progressing through the language over a longer time-span than that sampled in this study. Such progress appears to be slightly different in British versus American English. Earlier in this section, we noted that different verbs constitute apparent exceptions to leveling in the different varieties. And in §4.2, we demonstrated that *get* behaves differently in the two varieties, too, with high rates of leveling in British English—where *got* has been standard for some time—and a much stronger tendency to use *gotten* in American English. Another verb that has been noted to behave differently in British versus American English is *prove* (Murphy 2018, 117); our results corroborate Murphy's finding that American English prefers *proven* for the past participle while British English prefers *proved*.[13] According to Murphy, the preference for *gotten* and *proven* in American English stems from 19th-century "resurrections" of historical forms that had long fallen out of use in British English. If this variable is a change over a large time-scale, it would have nearly gone to completion for these

two verbs in British English, but reversed its course in American English. We suggest that it is a reasonable hypothesis that even though our real-time corpora found no change in leveling rates over the course of the twentieth century, the participle forms of these verbs are nonetheless changing over time, albeit in a frequency-driven, lexically-specific way very slowly over centuries. In this way, the change would resemble the regularization of irregular English past tenses over time, a similarly slowly-progressing and lexically-specific change (Lieberman et al. 2007). If further research in historical (socio)linguistics shows this to be true, this would likely imply that the shared language-internal constraints cross-dialectally reflect that the change began well before the varieties began to diverge.

6 Conclusion

This paper has presented a variationist analysis of participle leveling that employed three unique corpora, each with its own strengths. We have shown that in both the United States and the United Kingdom, leveling is more frequent among men, younger speakers, and those who are of a lower social class and/or have less education. We investigated structural factors as well: there is more leveling when there is more phonological similarity between the participle and the preterite, with less frequent verbs, when negation intervenes between the auxiliary and the verb, and when the auxiliary of the perfect construction is not in the present tense (i.e., non-tensed or past tense). The variable appears to be stable, and is a broad feature of English as opposed to being an Americanism.

To close, we reiterate that the type of leveling discussed in this paper—where the preterite form is used in place of the participle—is not the only kind that the verbs studied here are involved in. As summarized in §2.1, also attested is leveling in the reverse direction, i.e., use of the participle form in place of the preterite (e.g. simple past *seen, come*). We suggest that this direction of leveling similarly demands renewed attention, particularly given Janda's (2020, 580–583) indication that such participle-for-preterite leveling is an incipient change in progress among the *-ing*/*-ink* verbs, with forms like *rung* and *sunk* hypothesized to replace their counterparts *rang* and *sank* by the end of the century. This subsequently raises the question of how the findings presented in this paper may hold up in the face of countervailing trends driving leveling in the opposite direction. In our data, we find relatively high rates of preterite-for-participle leveling among the *-ing*/*-ink* verbs. But among those speakers who do not extend, say, *rang* into the perfect, do we instead find extension of *rung* into the simple past? That is, might we find conflicting leveling strategies within the same speech community, both with the ultimate effect of preterite/participle syncretism, but from opposite directions? Or might the direction of syncretism

instead be consistent within communities, but variable across them? Widening the envelope of variation to incorporate these alternations will likely be necessary to fully understand the patterns we have uncovered here.

Notes

[1]The English data actually necessitates its own discussion for Dammel, Nowak and Schmuck (2010). Because Swedish maintains the preterite/ participle forms for strong verbs, Dammel et al. suggest the aspectual distinction explains the lack of ablaut leveling. The immediate question for them is why English maintains the aspectual distinction but tends toward ablaut leveling. We have no further thoughts on this and refer the interested reader to Dammel et al.'s discussion of this.

[2]It should be noted, however, that Tieken-Boon van Ostade and Kostadinova's (2015) discussion of *go* includes clear awareness of the variable extending to other verbs.

[3]The verb *get* is one that required more care in determining relevance. It can operate in two different ways, which differ in their past participle possibilities. As a dynamic type, where *get* means something like *obtain*, it can take the past participle *gotten* (e.g. *I haven't* ***got/gotten*** *a haircut in a while*). However, the stative type, where *have got* is synonymous with *have* (Tagliamonte et al. 2010), cannot alternate in this way (e.g. *I've* ***got/*gotten*** *a question*). Because only the dynamic type can show variation within the past participle, this is the type that we keep in our data set for analysis. Tokens of the stative possessive form were excluded.

[4]The most frequent verb in both the US and UK English data sets is *do* (US Zipf = 7.211, UK Zipf = 7.09). In the US English data set, the least frequent verb is *mow* (Zipf = 3.585); in the UK English data set, the least frequent verb is *sink* (Zipf = 4.389). Neither of these verbs appears in the data set for the other variety.

[5]Centering the values around the median allows us to interpret the intercept value of the model as reflecting the predicted log odds of participle leveling for a speaker of median age, rather than for a speaker of age 0 (the default interpretation, when age is not centered). Rescaling the predictor to decades allows us to interpret the beta coefficient of the year of recording parameter in the model as showing the increase in log-odds associated with each decade, rather than each year, of age, a more interpretable output when investigating language change, which is more likely to proceed by larger time units like decades or generations than by individual years.

[6]Specifically, this was the case for the predictors NEGATION, QUESTION, and INTERVENING MATERIAL, where the reference level was "absent"; NUMBER, where the reference level was "singular"; and DIFFERENCE FROM PRETERITE, where the reference level was "affix only," the default means of forming the participle of regular verbs in English.

[7]The inclusion in this model of by-corpus interactions complicates performing pairwise post hoc comparisons on the predictor CORPUS, because the main effect of CORPUS in our model reflects the influence of this predictor only in the reference levels of the predictors it interacts with. When we carry out the pairwise comparisons of the different corpora separately across the various levels of the predictors that corpus significantly interacts with, we find that PNC and Switchboard significantly differ ($p < 0.05$) in 10 out of 12 comparisons, while PNC and DECTE significantly differ in only 2.

[8]Affix+vowel verbs are also more frequent in our data, as the numbers at the top of the bars in Figure 3 make clear, but since our models also include verb frequency as a separate predictor, this effect of phonological difference is not reducible to frequency.

[9]In fact, two verbs—*drink* and *mow*—level 100% of the time in our data, but token counts are very low for them: seven and three, respectively.

[10]These are *draw, ride, rise, shrink, sink, steal,* and *tear*. Indeed, all of these verbs have nonzero attestations in their leveled form in the Google Ngram Viewer (Michel et al. 2011). We found these attestations by searching for *have* + preterite and *should have* + preterite.

[11]It seems likely that the lack of leveled *do* in DECTE is related to differences in American and British English with respect to ellipsis: whereas American English favors eliding material following *have*, British English favors eliding material following *do*.

(i) Question: Did you finish your homework?
AmE answer: Ugh, I should have.
BrE answer: Ugh, I should have *done*.

Most of the instances of perfect *do* in DECTE occur in this kind of ellipsis. Thoms and Sailor (2018) argue that this *do* in British English is an enclitic that is distinct from the *do* that appears in *do*-support and as a main verb. As such, it is quite possible that this *do* lies entirely outside of the envelope of variation, in which case the lack of leveled tokens is less surprising because there are far fewer tokens of *do* in DECTE than meets the eye.

[12]This excludes constraints that are grounded in universal principles of articulation or similar shared physiological or psychological factors; see Tamminga, MacKenzie and Embick (2016) for discussion.

[13]Switchboard: 33% *proved* (N = 12); DECTE: 100% *proved* (N = 3); no data on this verb from PNC.

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Appendix A: Data retrieval details

We searched Switchboard and PNC for the following search query:

```
"(have|has|had|'ve|'s|'d|n't|ta|da) (\w+\s)?("+'|'.join(participles)+")\W"
```

where 'participles' are the two forms paired with each verb in the following list:

verbs = "beat": ["beat", "beaten"], "become": ["became", "become"], "begin": ["began", "begun"], "bite": ["bit", "bitten"], "blow": ["blew", "blown"], "break": ["broke", "broken"], "choose": ["chose", "chosen"], "come": ["came", "come"], "do": ["did", "done"], "draw": ["drew", "drawn"], "drink": ["drank", "drunk"], "drive": ["drove", "driven"], "eat": ["ate", "eaten"], "fall": ["fell", "fallen"], "fly": ["flew", "flown"], "forget": ["forgot", "forgotten"], "freeze": ["froze", "frozen"], "get": ["got", "gotten"], "give": ["gave", "given"], "go": ["went", "gone"], "grow": ["grew", "grown"], "hide": ["hid", "hidden"], "know": ["knew", "known"], "mow": ["mowed", "mown"], "prove": ["proved", "proven"], "ride": ["rode", "ridden"], "ring": ["rang", "rung"], "rise": ["rose", "risen"], "run": ["ran", "run"], "see": ["saw", "seen"], "shake": ["shook", "shaken"], "show": ["showed", "shown"], "shrink": ["shrank", "shrunk"], "sing": ["sang", "sung"], "slide": ["slid", "slidden"], "speak": ["spoke", "spoken"], "steal": ["stole", "stolen"], "stink": ["stank", "stunk"], "swear": ["swore", "sworn"], "swim": ["swam", "swum"], "take": ["took", "taken"], "tear": ["tore", "torn"], "throw": ["threw", "thrown"], "wake": ["woke", "woken"], "wear": ["wore", "worn"], "weave": ["wove", "woven"], "write": ["wrote", "written"]

We excluded *lie/lay* due to confusion over what the standard form of the past participle was. As a result, we only included verbs for which we could definitively say what the prescriptively expected participle was, so that participle leveling was clear when it occurred.

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