Redevelopment of a Morphological Class

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1 Introduction

Coronal stop deletion (henceforth 'TD Deletion') is the paradigm sociolinguistic variable. It was first described in African American English (Labov et al., 1968) as a rule whereby word final /Ct/ and /Cd/ clusters simplify by deleting the coronal stop. It has since been found in many dialects and varieties of English (e.g., White Philadelphian English (Guy, 1991), Chicano English (Santa Ana, 1992), Jamaican Creole (Patrick, 1991), Scottish and British English (Tagliamonte and Temple, 2005; Smith et al., 2009), *inter alia*).

Aside from the very regular phonological and phonetic factors which condition whether TD Deletion applies, morphological structure also appears to have an effect. The three morphological categories of primary interest are *monomorphemes*, *regular past tense* verbs and *semiweak* past tense verbs. These categories are defined in (1).

(1) a. **Monomorpheme**
The /t/ or /d/ is not an exponent of an independent morpheme.
ex. mist, pact

b. **Regular Past Tense**
The /t/ or /d/ is an exponent of the regular past tense morpheme.
ex. missed, packed

c. **Semiweak**
The /t/ or /d/ is an affix on a past tense verb which also undergoes a stem change.
ex. kept, told

In almost every dialect studied, the order of morphological classes from least favoring deletion to most favoring deletion is as given in (2).[1]

(2) monomorphemes > semiweak > regular past tense

In this paper, I will be focusing on the difference between semiweak and regular past tense. I will pursue a revised version of the analysis in Guy and Boyd (1990), casting it in terms of Competing Grammars (Kroch, 1989) and Distributed Morphology (Halle and Marantz, 1993). Specifically, I will propose that the rate of phonological TD Deletion is the *same for the regular past and the semiweak*. What leads to higher TD Absence in the semiweak verbs is variable *morphological absence of /t/*, i.e., there is a competing morphological analysis where the past tense of *keep* is simply /kɛp/, instead of /kɛpt/.

I draw upon sociolinguistic literature for evidence in support of my analysis, where it has been found that (a) there is a pattern of development whereby young speakers have nearly categorical absence of /t d/ in semiweak verbs, and older speakers have about the same rate of /t d/ absence in both semiweak and regular past tense verbs, and that (b) while children match their caretakers' probability of TD Deletion almost exactly for monomorphemes and regular past, they diverge markedly for the semiweak past tense verbs. I also draw upon evidence from adult speech (extracted from the Buckeye Corpus Pitt et al., 2007), where there is both more inter-speaker variation, and inter-word variation in the rate of deletion in semiweak past tense verbs than for both monomorphemes and regular past tense verbs.

*Thanks to David Embick, Charles Yang, and the attendees of PLC 35 for their thoughtful comments. All errors or omissions are my own.

[1] The size of the morphological effect, however, has been found to be somewhat mitigated in the British Isles (Tagliamonte and Temple, 2005; Smith et al., 2009).

2 TD Deletion

The phonological process of TD Deletion can be described as the variable deletion of a /t/ or /d/ in a syllable final cluster (3).

(3) $C\left\{\begin{matrix} t \\ d \end{matrix}\right\}]_\sigma \rightsquigarrow C\emptyset]_\sigma$

The rate at which this process applies in the different morphological contexts under question is displayed in Table 1. Table 1 also compares deletion rates from Guy (1991) and Santa Ana (1992) to the Buckeye Corpus (Pitt et al., 2007), which is the data source for quantitative analysis in this paper.

	Monomorphemes	Semiweak	Regular Past
Guy (1991)	0.38	0.34	0.16
Santa Ana (1992)	0.58	0.41	0.25
Buckeye Corpus	0.49	0.37	0.22

Table 1: Proportion of TD Deletion across morphological classes.

There is both a difference in over-all rates of deletion, and in the size of the differences between morphological contexts between the Buckeye data, Guy (1991) and Santa Ana (1992), but the general pattern illustrated in (2) still holds for all three data sets.

There are numerous approaches to account for the morphological effects on TD Deletion, among them functional accounts (past tense /t d/ delete less often because they carry important tense information) and usage based accounts (Bybee, 2002). I will briefly review here those approaches which make explicit reference to morphological structure. They fall into two basic categories: Boundaries analyses, and Cycles and Domains analyses.

2.1 Boundaries Analyses

The first approaches to the morphological effects on TD Deletion appealed to the fact that the primary trigger for deletion (namely, the preceding C) was separated from the target (/t d/) by morphological boundaries of different sorts. The structural description in (4) is the one proposed in Labov et al. (1968).

(4) a. mɪst (*mist*)
b. kɛp $+_\alpha$ t (*kept*)
c. mɪs $+_\alpha$ $+_\beta$ t (*missed*)

In this case, the morphological boundaries $+_\alpha$ and $+_\beta$ have the effect of reducing the probability of TD Deletion. $+_\alpha$ is present in both the regular past and the semiweak, and $+_\beta$ is only present in the regular. This boundaries analysis posits a formal, and quantitative relationship between the deletion rates in the semiweak and the regular past. Specifically, both the semiweak and the regular past are differentiated from monomorphemes by the effect of the $+_\alpha$ boundary. The effect of the $+_\beta$ boundary then differentiates the semiweak and regular past.

2.2 Cycles and Domains

Guy (1991) proposes an alternative approach to a boundaries type analysis, which instead describes the rate of TD Deletion in terms of strata. Kiparsky (1993) takes a similar approach with syllable well formedness constraints evaluated over different domains. The morphological structures assumed by Guy (1991) and Kiparsky (1993) are given in (5).

(5) a. mɪst$]_{root}]_{stem}]_{word}$ (*mist*)

b. kɛp]$_{root}$ t]$_{stem}$]$_{word}$ (*kept*)
c. mɪs]$_{root}$]$_{stem}$t]$_{word}$ (*missed*)

Guy's (1991) analysis brings together Variable Rules and Lexical Phonology, and posits that a variable process of deletion with probability p of applying can apply within each level. What differentiates the morphological classes in this analysis is the number of levels in which a /t d/ is adjacent to a C. For monomorphemes, a /Ct/ cluster is present at three levels (*root, stem, word*), for semiweak verbs, two levels (*stem, word*), and for regular past tense, a /Ct/ cluster is only present at one level (*word*). For Kiparsky (1993), a similar situation obtains with syllable well formedness constraints which are evaluated over the same domains.

If the process of TD Deletion applies with probability p, then the probability that /t d/ remain after a given level is $r = (1 - p)$. A consequence of this model is the well known *exponential pattern*, where the expected observed TD Retention for regular past tense forms is r^1 (one chance at application), for semiweak past tense verbs, r^2 (two chances at application), and for monomorphemes r^3 (three chances at application).

If we anchor the expected retention rate to be r^1 for the regular past tense, we can say that the retention rates for the other two morphological classes are r^i, for some values of i. We can then, using a complementary log-log link function, use regression to estimate r, and the values of i. The results of this regression are displayed in Table 2.[2]

	Estimate	Standard Error	$(x\|\text{Speaker})_\sigma$	$(x\|\text{Word})_\sigma$
semiweak i	1.38	0.30	0.32	
mono i	1.93	0.10	0.19	
r	0.83	0.11	0.42	0.72

Table 2: Regression estimates, for r and values of i, and random effects variance.

	Low	Hi	Prediction
semiweak i	0.76	2.48	2
mono i	1.59	2.35	3

Table 3: 95% confidence intervals for estimates from Table 2,
compared to the predictions of the exponential model.

The 95% confidence intervals for the values of i are given in Table 3, and compared to the predicted values from the exponential model (namely, $i = 2$ and $i = 3$). Only the interval for the semiweak past tense contains the prediction of the exponential model. Figure 1 displays the distribution of exponent estimates across speakers. It does not appear that the exponential model is well supported by the Buckeye Data.[3]

3 Redevelopment of a Morphological Class

As I hope to have made clear with the preceding discussion, the quantitative predictions of the models above are dependent upon, and derived from the proposed morphological structure of the past

[2]The estimated values for i in Table 2 are actually exponentiated versions of the coefficients returned by the regression. When interpreting the Standard Error or the by-speaker variance, they should be compared to log(i). Similarly, the estimate for r presented is actually the inverse logit of the coefficient returned by the regression, so interpretation of its standard error and by-speaker variance should be compared to logit(r).

[3]I should add that the fixed effects estimates *do* approximate the predictions of the exponential model when by-word random effects are excluded. I would interpret this to mean that to a large degree, the exponential patterns reported in the literature are driven by lexical effects of some sort, which here could be segmental context, or word frequency.

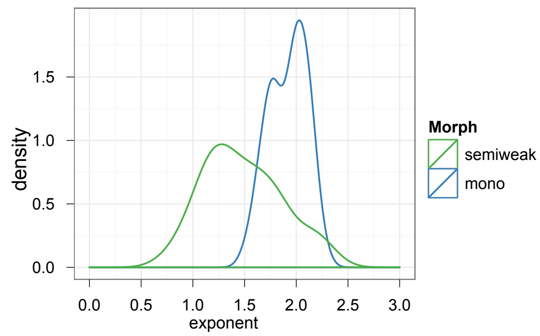


Figure 1: Distribution of exponents over speakers.
Estimates derived from speaker random effects from the model presented in Table 2.

tense affixes. The exponential model in particular makes very strict predictions about the quantitative relationships between the three morphological contexts. In this section, I'll discuss some other evidence which problematizes these analyses, specifically with regards to the structural difference between the semiweak and the regular past tense.

3.1 Age Graded Patterns in the Semiweak

Guy and Boyd (1990) show that in Philadelphia, the rate of TD Deletion for the semiweak past tense is age graded, meaning that speakers around the age of 10 have semiweak deletion rates of approximately 85%, while speakers in their 50s and later have deletion rates closer to 55%. This age graded pattern was found only for the semiweak past tense, meaning that the size of the difference in TD Deletion rates between semiweak and regular past tense is greatly reduced in older speakers. Figure 2 reproduces the relevant graphs from Guy and Boyd (1990).

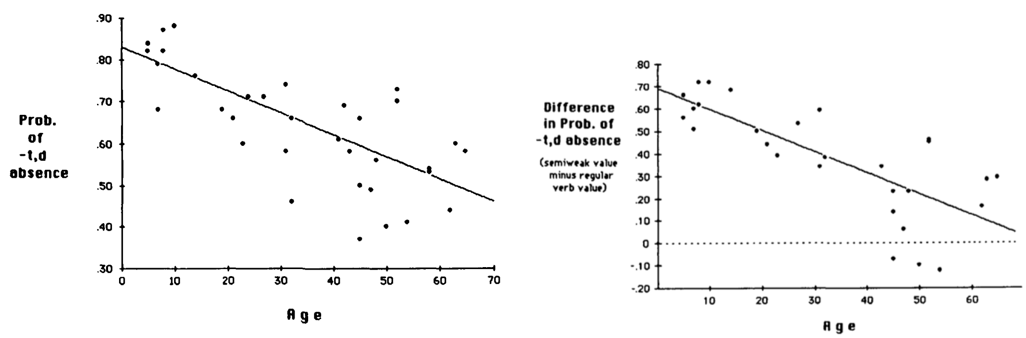


Figure 2: From (Guy and Boyd, 1990).
Left: Probability of TD Deletion over Age.
Right: Difference between Semiweak and Regular Past Deletion Rates.

When faced with a pattern like those in Figure 2, it is necessary to ask whether we are actually observing a change in progress. Guy and Boyd (1990) conclude that this is unlikely, since this pattern only shows up for the semiweak past tense, which would be a strong violation of the Constant Rate Effect (Kroch, 1989), which would generally hold for a change of this sort. Additionally, it has been found that for changes in progress, early adolescent speakers are relatively conservative (Labov, 2001; Tagliamonte and D'Arcy, 2009), which is not the case here.

Unfortunately, a replication of the fine age grading of the semiweak TD Deletion from Guy and Boyd (1990) has not been reported in the literature, and there is insufficient age data in the Buckeye Corpus to attempt a replication here. However, what has been replicated multiple times is the divergence of young children from the patterns of their caretakers for the semiweak past tense, and only the semiweak past tense. In a study of a single family, Labov (1989) found that their 7 year old child probability matched his parents' rate of deletion in all morphological contexts *except* the semiweak past tense (called "derivational" in Figure 3), where he had a much higher rate of deletion. In fact, he had more deletion in the semiweak past tense than in any other context, while both of his parents had almost the exact same rate of deletion in both the semiweak past tense and the regular past tense.

This pattern was replicated in a larger study of many children and their caretakers in King of Prussia, PA, a suburb of Philadelphia (Roberts, 1997), and in Buckie, a small town in Scotland (Smith et al., 2009). The result of these studies is presented in the right side of Figure 3 (taken from (Smith et al., 2009)). Again, the children match their caretakers almost exactly for monomorphemes and for the regular past tense, but have the highest rates of deletion for semiweak past tense, while for their parents, this context is almost the same as the regular past.

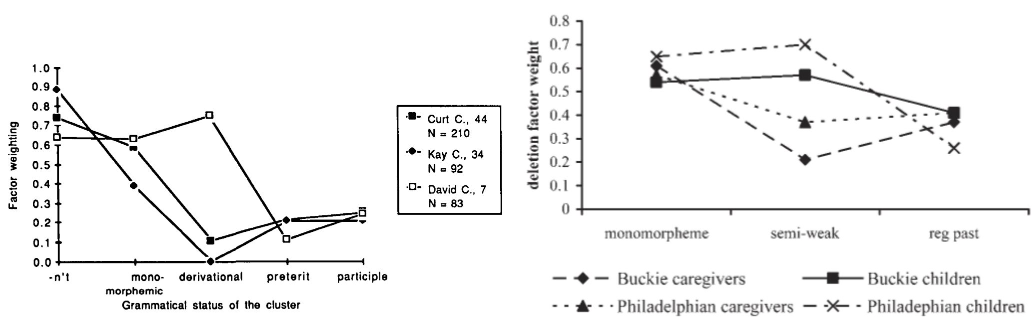


Figure 3: Divergence of Children from Cartakers
Left: One family from King of Prussia (Labov, 1989)
Right: Comparison of Philadelphia and Buckie Caretakers and Children (Smith et al., 2009; Roberts, 1997)

To account for the age-sensitive pattern of TD Deletion in the semiweak past tense, Guy and Boyd (1990) propose that speakers move through a three stage development in their analysis of the structure of the semiweak past tense.

(6) a. Adolescence:
keep + T_{PST} → kɛp
b. Early Adulthood:
keep + T_{PST} → kɛpt
c. Late Adulthood:
keep + T_{PST} → kɛp + t

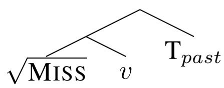
At the earliest stage, (6a), children analyze the past tense of *keep* as being /kɛp/, with no final /t/. In early adulthood, (6b), they analyze the past tense of *keep* as /kɛpt/, where the word final /t/ is part of the stem. Finally, at (6c), they analyze the past tense of *keep* as /kɛp+t/, where the word final /t/ is an affix. Guy and Boyd (1990) predict that at stage (6b), semiweak verbs should undergo deletion at rates equivalent to monomorphemes, and at stage (6c), they should undergo deletion at a rate comparable to regular past tense verbs.

In the following subsection, I will argue that it is possible to reduce this three stage development of morphological analysis into one with only two stages, which look similar to (6a) and (6c). For speakers whose behavior appears to fall between these two stages, I argue that they simply vary between these two morphological analyses in a way typically described as grammar competition (Kroch, 1989).

3.2 Structure of the Past Tense in Distributed Morphology

To move forward with my analysis, I will be adopting the formal machinery of Distributed Morphology (DM). DM is a piece based morphological theory, which builds morphological structure using the syntactic component of the grammar (Halle and Marantz, 1993). Following DM, I will be assuming the structure in (7) for past tense verbs. Featured in (7) is an acategorical root, $\sqrt{\text{MISS}}$, a category defining head, v, and the past tense head, T_{PST}.

(7)



Phonological material is introduced to the structure in (7) via *Vocabulary Insertion* (VI), as laid out in (8).

(8) a. $\text{T}_{\text{PST}} \leftrightarrow \emptyset$ / ___ $\{\sqrt{\text{SING}}, \sqrt{\text{HIT}}, \ldots\}$
b. $\text{T}_{\text{PST}} \leftrightarrow$ t / ___ $\{\sqrt{\text{KEEP}}, \sqrt{\text{LEAVE}}, \sqrt{\text{BEND}},\ldots\}$
c. $\text{T}_{\text{PST}} \leftrightarrow$ d

(9) Tense → Lax / T_{PST} $\{\sqrt{\text{KEEP}}, \sqrt{\text{LEAVE}}, \ldots\}$

Irregular forms of the past tense are formed, in part, via lexically indexed VIs. The VI (8a) is selected for past tense forms which don't appear to take an affix, and the VI (8b) is selected for the semiweak past tense verbs (along with other verbs like *bent*). If a root does not appear in a specified VI, then (8c), the default, is selected. The additional stem changes which most irregular verbs also undergo is handled by *Readjustment Rules*. A schematic version of the readjustment rule involved in the formation of semiweak past tense verbs is given in (9).

Therefore, two processes are involved in the formation of the semiweak past tense.[4]

(10) $\sqrt{\text{KEEP}}$ + T_{PST}
a. $\text{T}_{\text{PST}} \rightarrow$ /t/
b. /iː/ → /ɛ/

While only one is involved in the regular past.

(11) $\sqrt{\text{MISS}}$ + T_{PST}
a. $\text{T}_{\text{PST}} \rightarrow$ /d/

The primary consequence of adopting this morphological model for the past tense is that there is no longer a structural difference between the semiweak and regular forms. Therefore, the difference in TD Deletion between these two morphological contexts cannot be related to morphological structure.

3.3 There is Morphological Variation in the Semiweak Verbs

The data and machinery that I have presented up to this point is briefly summarized in (12).

(12) a. There is no structural difference between regular and semiweak past tense in DM.
b. There is no difference in TD Deletion between semiweak and regular past tense for older speakers.
c. Semiweak past tense is the context of highest deletion for children.

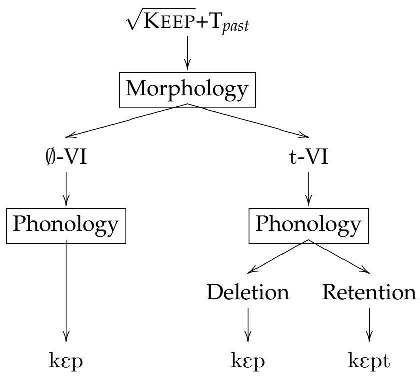
To account for these facts, I propose that children initially specify the semiweak verbs as selecting a $\emptyset$-VI for T_{PST}. This grammar could be written out as in (13), and should be contrasted with (8).

(13) a. $\text{T}_{\text{PST}} \leftrightarrow \emptyset$ / ___ $\{\sqrt{\text{SING}}, \sqrt{\text{HIT}}, \sqrt{\text{KEEP}}, \sqrt{\text{LEAVE}},\ldots\}$
b. $\text{T}_{\text{PST}} \leftrightarrow$ t / ___ $\{\sqrt{\text{BEND}},\ldots\}$
c. $\text{T}_{\text{PST}} \leftrightarrow$ d

[4] It is true that the semiweak past tense is *unproductive*, but this is not synonymous with *ungenerated*.

Under a *Competing Grammars* approach to variation, the grammar in (13) competes for usage with the grammar in (8), leading to variation in the rate at which /t/ is morphologically present in the semiweak verbs. The interaction between competing morphological grammars ($\emptyset$-VI $\sim$ t-VI) and the competing phonological grammars (TD Deletion $\sim$ TD Retention) is illustrated in (14).

(14)



Importantly, there are two ways to arrive at the surface form [kɛp]: (i) morphological absence of the /t/, (ii) phonological deletion of a /t/ which was present morphologically.

This morphological absence analysis is similar to the one given for Jamaican Creole by Patrick (1991). He found that TD Deletion appeared to occur at the highest rate in regular past tense verbs. However, on the basis of past tense forms like *wanted*, where TD Deletion is blocked by epenthesis, and *died*, where the preceding segment is not a C, Patrick (1991) concluded that the past tense itself was variably marked, because tense marking only surfaced on these forms approximately 50% of the time. Taking into account this rate of morphological absence, the rate of TD Deletion for regular past tense in Jamaican Creole lines up exactly like it does in other dialects.

Based on the model in Table 2, we can estimate the rate of morphological variation in the Buckeye Corpus. My prediction is that the rate of phonological TD Retention for semiweak and regular past tense verbs should be the same. The observed TD Presence for semiweak past tense can be estimated to be Phonological TD Retention $\times$ Morphological Presence. The rate of Morphological Presence is solved for in (15).

(15) $$\text{Morphological Presence} = \frac{\text{Observed Semiweak TD Presence}}{\text{Regular Past TD Presence}} = \frac{0.83^{1.38}}{0.83} = 0.93$$

In the Buckeye Corpus, then, the /t/ in the semiweak past tense is only morphologically absent approximately 7% of the time on average.

3.4 Evidence in Adult Speech

The proposal that apparently higher rates of TD Deletion in the semiweak is actually caused by morphological absence comes with the consequence that this morphological variation persists into adulthood. Therefore, there should be some kind of evidence for this analysis in adult speech. I believe that some evidence is forthcoming in the random effects from the regression model summarized in Table 2.

3.4.1 Inter-Speaker Variation

Figure 4 displays the speaker-level estimates for TD Retention as provided by the model in Table 2. Importantly, the degree of inter-speaker variation is greater for the semiweak past tense forms, than it is for the regular past and monomorphemes. This impression is borne out statistically. The results of three Ansari-Bradley tests for a difference in scale parameters are presented in Table 4.

These results indicate that there is a relatively uniform function which produces the difference between regular past tense and monomorphemes (this is another way of interpreting the results

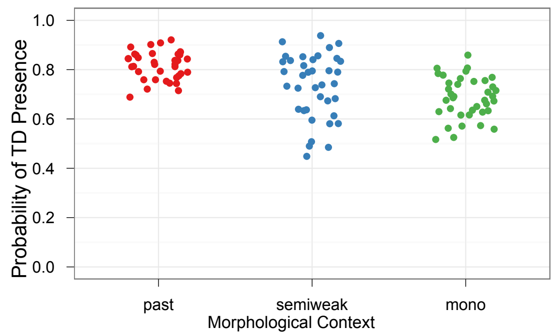


Figure 4: Speaker level TD Retention estimates from the model in Table 2.

	regular past	semiweak
semiweak	0.007	
mono	0.942	0.005

Table 4: p-values (Holm adjusted) from the Ansari-Bradley Test comparing scale parameters.

in Figure 1). There is some variation between speakers in the basic rate of TD Deletion, but the language internal effect is the same. The larger variance for semiweak verbs is a result of an additional intervening process, namely morphological variation. This inter-speaker dispersion for the semiweak verbs may be reduced if predictors relevant to the morphological variation (namely, the speaker's age) are included in the model.

3.4.2 Lexical Variation

Given the grammatical models in (8) and (13), it follows that the whether a verb takes a ∅-VI or t-VI for T_{PST} is a property of the root. Therefore, we would expect greater variation in lexical items for the semiweak past tense, since some roots may be biased towards t-VI, while others may be biased towards ∅-VI. This is borne out in the by-word random effects. Figure 5 displays the distribution of by-word random intercepts, broken down by morphological context. The random effects for semiweak verbs are spread more broadly across than for the regular past, or monomorphemes.

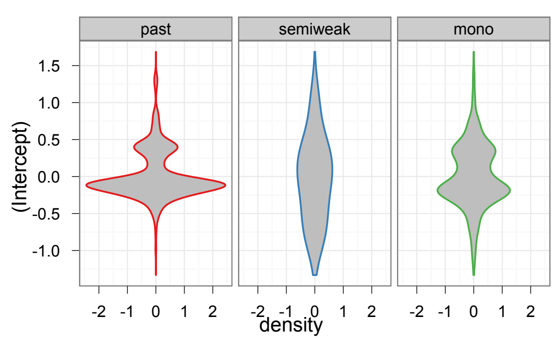


Figure 5: Distribution of by-word random intercepts, broken down by morphological context.

3.5 Why ∅-VI?

An important question to address is why a ∅-VI analysis is initially adopted by children. Even if one were to reject the analysis that I have put forward here, we would still be faced with an interesting Wealth of the Stimulus problem. The children in Figure 3 have been presented with relatively *robust, positive evidence* of a particular grammar. Yet, they diverge sharply from the presented evidence.

I have a preliminary suggestion that perhaps children initially adopt a countervailing mutual exclusivity generalization: past tense verbs can be marked with a stem change, or with an affix, but not both. Whether or not this is the case will have to be determined by future research, but we can establish whether mutual exclusivity could be a productive generalization. Yang (2005) argues that if the number of exceptions to a generalization do not exceed $\frac{N}{\log N}$, then it can be productive. Table 5 displays counts of verb types found in infant directed speech (drawn from Marcus et al. (1992)), broken down by whether they undergo affixation, stem changes, both, or neither. These counts will be used to test whether the exceptions to some formulation of a mutual exclusivity generalization exceed $\frac{N}{\log N}$.

	Affixation	No Affixation
Stem Change	18 (4%)	58 (12%)
No Stem Change	396 (82%)	8 (2%)

Table 5: Verb Types
From Marcus et al. (1992)

There are three ways to formulate the mutual exclusivity generalization I've proposed.

(16) a. Of all verbs, they either undergo affixation or a stem change in the past tense, but not both or neither.
b. Of all stem changing verbs, they cannot have an affix.
c. Of all affixing verbs, they cannot have a stem change.

We can see if the number of exceptions to these generalizations exceed a tolerable amount, following Yang (2005). If $T >$ exceptions, then the generalization could be productive.

(17) a. $T_a = \frac{\text{verbs}}{\log(\text{verbs})} = \frac{481}{\log(481)} = 77.9 > 27$ semiweak, no-change, and suppletive verbs
b. $T_b = \frac{\text{stem change verbs}}{\log(\text{stem change verbs})} = \frac{76}{\log(76)} = 17.5 < 18$ semiweak verbs
c. $T_c = \frac{\text{affixing verbs}}{\log(\text{affixing verbs})} = \frac{413}{\log(413)} = 68.6 > 18$ semiweak verbs

Two out of three of the formulations of the mutual exclusivity generalization are viable, and the third is just borderline.

4 Conclusion

I have proposed that classic analyses of TD Deletion ought to be revised to treat the semiweak and regular past tenses as being identical in terms of phonological deletion, and differing in morphological realization. The component parts of my analysis are not particularly radical. ∅-VI is independently motivated, and using competing grammars to explain variation has long been fruitful for studying syntactic change.

However, I hope to have substantially contributed to the project of using variation data to investigate linguistic structure. If the difference in TD Deletion between verbal morphology and monomorphemes is conditioned by morphological structure, then the semiweak and regular past tense should be treated as being structurally identical (contra Pinker and Ullman (2002)) since they pattern together. Additionally, I hope to have demonstrated that analyses of intra-language variation require sufficient abstraction, and explanation at multiple levels of the grammar.

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