Final Consonant Clusters in Majorcan Catalan Verbs: The Resolution of Sonority Sequence Principle Violations through Cluster Simplification

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1. Introduction

Majorcan (and Balearic) Catalan dialects lack an overt inflectional morpheme for first person singular present indicative verb forms. Many of these Majorcan Catalan (MC) verbs end with the consonants of the verb root with no further inflectional vowel (represented by the morphs /u/, /o/, /e/ or /i/ in other dialects of Catalan). This divergent morphological structure is illustrated in (1) from Pons (2007):

(1) Catalan dialect variation in first person singular of present indicative:

Orthographic Form and translation	Balearic	Central	North-Western	Southern	North-Eastern
Canto "(I) sing"	['kaṇt]	['kaṇtu]	['kaṇto]	['kaṇte]~ ['kaṇto]	['kaṇti(k)]
Temo "(I) worry"	['tem]	['temu]	['temo]	['tem]~ ['temk]	['temi]~ ['temu(k)]
Sento "(I) hear"	['seṇt]	['seṇtu]	['seṇto]	['seṇt]~ ['seṇk]	['seṇti]
Pateixo "(I) suffer"	[pə'təsk]	[pə'tɛʃu]	[pa'tiʃo]	[pa'tiʃo]~ [pa'tiʃk]	[pə'tɛʃi]

In addition, these present indicative first person singular verb forms in MC contain final clusters that are ill-formed at the phonetic level, e.g. *compr* '(I) buy' or *obr* '(I) open'. Thus, MC stems appear without additional morphology and maintain final consonant clusters that appear to violate the syllable restrictions imposed by the Sonority Sequencing Principle (SSP). Hence, these forms contain tautosyllabic consonant sequences with the same or increasing degree of sonority.

(2) Sonority Scale: from less to more sonorant (adapted from Pons 2006)

Obstruents			**Sonorants**		
Stops, Affricates < [p],[t],[k],[b],[ʧ] …	Fricatives < [s],[z],[f] …	Nasals < [m],[n] …	Liquids < [l],[ʎ],[r],[ɾ] …	Glides < [j],[w] …	Vowels

As Lloret (2005) argues, other dialects of Catalan historically added the vowel *e* to the verbs that contained the ill-formed final consonant clusters (e.g., *celebr-e, logr-e, sufr-e, entr-e*). This epenthetic vowel was then reanalyzed as the first person singular morpheme, and, as such, extended by analogy to

all the verbs of the first and third conjugations. This morpheme has been maintained without change in Valencian Catalan (e.g., *mat+e, cant+e, entr+e*), while it rose to *i* in Rosellonese Catalan (e.g., *mat+i, cant+i, entr+i*) and evolved to *o* in Central Catalan (e.g., (*mat+o, cant+o, entr+o*).[1] Majorcan (and Balearic) and Alguerese Catalan, on the other hand, maintained the ill-formed verb-final consonant clusters (i.e., they never epenthesized a vowel). Therefore, the present indicative first person singular verb forms in these two dialects continue to maintain these final consonant clusters. Table (3) provides the full paradigm of the present indicative forms in MC.

(3) Present indicative inflectional suffixes. A, B, and C indicate the different MC varieties Adapted from Lloret (2004):

	First Conjugation			Second Conjugation			Third Conjugation		
varieties	A	B	C	A	B	C	A	B	C
1s	Ø	Ø	[u]	Ø	Ø	[u]	Ø	Ø	[u]
2s	[as]	[əs]	[əs]	[s]	[s]	[s]	[is]	[s]	[s]
3s	[ə]	[ə]	[ə]	Ø	Ø	Ø	[i]	Ø	Ø
1p	[ém]	[ám]	[ɛm]	[ém]	[əm]/[ɛm]	[ém]	[ím]	[ím]	[ím]
2p	[aw]	[áw]	[ɛw]	[éw]	[əw]/[ɛw]	[éw]	[íw]	[íw]	[iw]
3p	[an]	[ən]	[ən]	[ən]	[ən]	[ən]	[in]	[ən]	[ən]

The remainder of this paper is organized as follows: In section 2, we will present previous studies that have considered the consonant clusters of the relevant verb forms. Note, however, that these previous studies do not entertain the possibility of cluster simplification. In section 3, we analyze the production of final consonant clusters in first person singular verb forms by thirty-five (35) MC speakers, taking into account language-internal as well as language-external factors. Section 4 presents and discusses the results obtained from the multivariate analysis of the data using the statistical analysis program GoldVarb X (Sankoff, Tagliamonte, & Smith, 2005). Finally, Section 5 summarizes the results, and presents conclusions and suggestions for future research.

2. Previous Studies

The special behavior of present indicative first person singular verb forms in MC has been analyzed from various perspectives. The first formal analysis of final consonant clusters is found in Dols (1993) who offers an autosegmental analysis. He analyzes these final consonant clusters in Majorcan (and Balearic) Catalan as onsets of an empty nucleus (based on the phonological licensing in Goldsmith, 1990). Thus, a verbal morpheme (M), corresponding to the first person singular present indicative, would license this semantically-empty syllabic position (e.g., *compr* '(I) buy'). On the other hand, similar structures without this morpheme (M) would resort to epenthesis (e.g., *compra* '(the) shopping').

(4) Compr '(I) buy'   Compra '(the) shopping'

       M   M
       | |
/compɾ+Ø/ ➔[com.pɾØ]   /compɾ+Ø/ ➔[com.pɾə]

Dols and Wheeler (1996) later propose an alternative analysis of these final consonant clusters. They simplify the syllabic structure of MC to the maximum degree by considering the syllable to be composed of an onset, a nucleus and a simple coda (as opposed to a complex consonant cluster as a coda). Therefore, an extra consonant in final position is considered an onset. In general terms, Dols and Wheeler suggest that MC final consonant clusters are limited to having a coda associated with one

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[1] In Central Catalan unstressed /o/ is pronounced /u/.

consonant and an onset associated with one or two consonants, as exemplified in (5), in which only the nasal consonant is syllabified in coda position, while the rest of the final consonants are syllabified as onsets. Thus, the authors claim that these final onsets are licensed by the right edge of a prosodic domain instead of a syllabic nucleus (universally attested) or a (M) verbal morpheme (Dols, 1993).

(5) From Dols & Wheeler (1996)

camp ʼk a m. p   *empr* ʼ ə m. p ɾ   *entr* ʼ ə n. t ɾ
        | | | \/ | \/
        C O   C O   C O
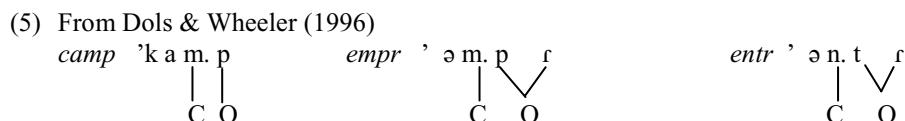
Serra's (1996) Optimality Theoretic account argues that final consonant clusters in the present indicative first person singular forms in the Catalan dialects in Majorca and L'Alguer contain an extrasegmental morpheme (a unit with prosodic structure but without segmental content). This morpheme is argued to license those syllabically ill-formed verbal forms. On the other hand, the absence of this extrasegmental morpheme in the nominal forms explains the insertion of the epenthetic vowel. Therefore, the analysis that Serra presents and defends places an extrasegmental morpheme at the end of every verbal form, e.g. [ʼkant] is [ʼkan.t■] and [ʼɔpɾ] is [ʼɔ.pɾ■][2]. In sum, in Serra's analysis, the formation of onsets is explained by the presence of an extrasegmental nucleus which he identifies as a *morfema de temps i mode* (morpheme of tense and mood).

Finally, Pons (2002, 2006, 2007) proposes another analysis. There, the present indicative first person singular forms are proposed to exhibit a different phonological behavior compared to noun forms because of the pressure exerted by other members of the inflectional paradigm (the third person singular of the verbs in the first conjugation). Pons maintains that the pressure can either work by contrast (in which case surface homophony within the same paradigm (third person singular forms) is avoided) or by analogy (in which case the shared stem by the paradigm members is inclined towards homogenization). Thus, to explain the lack of vowel insertion in the case of the present indicative first person singular forms, her hypothesis is that epenthetic [ə] (default vowel in Catalan) does not take place in these cases because this would produce a surface form identical to another surface form of the same paradigm. Thus, both Serra and Pons believe that the present indicative first person singular verb forms exhibit a different phonological behavior with respect to noun forms, as demonstrated in (6):

(6) Verbal vs. Nominal forms in MC

a) Nominal Forms   b) Verbal forms
Nombre [ʼnom.bɾə] 'number'   Compr [ʼkompɾ] '(I) buy'
Ample [ʼam.plə] 'wide/broad'   Umpl [ʼumpl] '(I) fill'
Centre [ʼsen.tɾə] 'center'   Entr [ʼəntɾ] '(I) enter'
Mascle [ʼmas.klə] 'male'   Mescl [ʼməskl] '(I) mix'

Pons claims that her analysis is superior to the "syllabically driven approaches" because the assumption behind such models is circular. That is, the presence of a morpheme without segmental content is justified by the special behavior of these consonant clusters and this special behavior is justified by appealing to the presence of an extrasegmental morpheme (Pons, 2007). Further, these models cannot account for the differences between verbal and nominal inflection.

As seen in the literature, the structure of MC syllables has long been controversial, particularly with respect to the status of word-final consonant clusters. Some researchers (Pons 2007) suggest that word-final consonant clusters are syllabified as codas, whereas others propose that these are onsets of empty-headed syllables (Dols, 1993, Wheeler and Dols, 1996, Serra, 1996) as illustrated in (7):
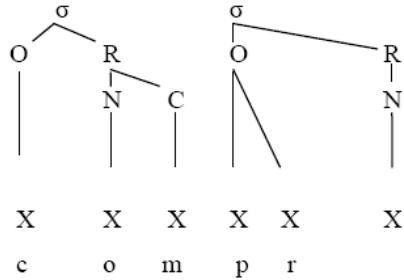
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[2] This black square (■) is the convention used in Serra (1996) to indicate the extrasegmental morpheme.

(7)   Coda vs. Onset Approach
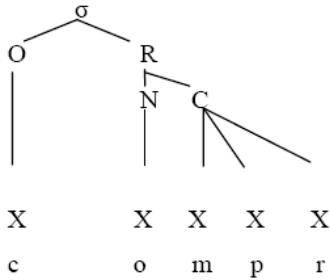
a)   Coda Approach   b) Onset Approach

Pons (2007) argues that these verbal forms undergo a series of phonological processes that are generally associated with the coda position and not with the onset position (e.g. the devoicing process that affects final obstruents). Pons claims that this devoicing process applies systematically in final clusters integrated by one, two or three consonants, for instance: *acab* [ə'kap], *enfang* [əɱ'faŋk], and *sembl* ['sɛmpl]. However, Serra (1996) builds upon an argument by Dols and Wheeler (1996) in which voicing contrasts are reported in this position (e.g. *compr* [-pɾ] and *escombr* [-bɾ]). Both Serra (1996) and Dols and Wheeler (1996) claim that neutralization is not created in the postnasal context. Therefore, these final obstruents are not always devoiced in final clusters integrated by three consonants consisting of a nasal+obstruent+liquid. Recasens et al. (2004) analyze electropalatographic and acoustic data of word-final clusters composed of an underlying voiced stop followed by non-syllabic /l/ or /r/ in Majorcan Catalan (e.g. *arregl* '(I) fix' or *assembl* '(I) resemble') and conclude that Catalan word-final devoicing does not apply to MC tautosyllabic stop+liquid clusters, and that phonetic voicing may affect just the stop or both the stop and the liquid.

While there has been extensive research on these verb forms, the previous studies have focused on how to rationalize the existence of final consonant clusters in verbs in MC (whether through ghost vowels, extrasegmental morphemes, or consonant assignment as onset or coda in the syllable structure). This body of work does not mention the overwhelming number of cases of cluster simplification present in naturalistic data and analyzed in this study. The results of the present study show a strong tendency for MC speakers to resort to cluster simplification to avoid rising or flat sonority sequences.

3.   Phonological and Sociolinguistic Study

Unlike the theoretical approaches offered by a number of researchers, naturalistic data suggest that MC speakers are quite often not violating the SSP – instead, these speakers simply do not fully articulate the verb-final consonant clusters in violation of the SSP.

Thirty-five Catalan-Spanish bilingual residents of Majorca participated in the present study. Their age at the time of testing ranged from 18 to 62 (M = 29.1) and included 25 women and 10 men. All participants (23 Catalan-dominant and 12 Spanish-dominant) were born and educated in the island of Majorca, had extensive exposure to Spanish and Catalan on a daily basis, and resided in both urban and rural areas of the island. The youngest participants (generally, those born in 1983 and later) had completed their secondary school and most of their primary school mainly in Catalan while older participants (those born before 1983) completed their education exclusively in Spanish. All participants spoke Catalan and/or Spanish in the household and were not native in another language.

Participants first completed a Language History Questionnaire, which included questions on language background, language use, and language of education. For the experimental section, participants silently read sentences written in Spanish and orally provided translations in MC matching the Spanish stimuli as closely as possible.

The stimuli consisted of eighteen (18) experimental (target) verbs in the first person singular present indicative form. Each appeared in two phonological contexts: once followed by a consonant (+C) and once by a vowel (+V). An equal number of filler verbs in first person singular form were

used. These appeared in two separate sentences (in +C and +V contexts) and contained no cluster sequences in violation of SSP, e.g. *tenc* '(I) have.' There were two versions of the task (Version A and B), and while both versions included all frequent verbs (e.g *compr* '(I) buy' or *obr* '(I) open'), the infrequent verbs (e.g., *idolatr* '(I) idealize/worship' or *involucr* '(I) involve') were divided between the two versions. Word frequency was determined using the frequency measure in the Catalan-English online dictionary DACCO.[3] Each participant saw five practice sentences written in Spanish and were asked to orally translate them into MC, and this practice session was followed by a total of 52 sentences (2 fillers were presented as the first two sentences, then 28 experimental items and 22 fillers pseudorandomized so that experimental items and fillers alternated).

Two coders, a native Catalan speaker and a native English speaker fluent in Spanish, transcribed and coded the sentences; a third coder, a native Spanish speaker, transcribed and coded a subset of the data to establish reliability.

4. GoldVarb X Analysis

The data were submitted to statistical analysis using the variable rule program GoldVarb X (Sankoff, Tagliamonte, & Smith, 2005). All instances of cluster simplification and cluster maintenance from the data were extracted for analysis, yielding 599 tokens, of the total 682 tokens collected. The remaining 12% of tokens (N=83) were discarded from the analysis due to -o insertion (e.g. /*entro*/ '(I) enter'), which is not expected in this dialect of Catalan: the Catalan epenthetic vowel is schwa, so the –o may demonstrate dialect switching or approximating. Therefore, the dependent variable for this analysis is cluster simplification vs. maintenance. Independent variables included the following phonological context (consonant, vowel), verb frequency (+ frequent, - frequent) and number of consonants in the cluster (two, e.g. *obr* '(I) open'*,* three, e.g. *compr* '(I) buy'). Social variables included language dominance (Spanish, Catalan) and gender.

We hypothesized that the results would indicate a general trend toward maintenance of clusters, if possible (i.e., in contexts before a vowel, in which consonants may be resyllabified), and toward cluster simplification where necessary (i.e., in contexts before a consonant, without resyllabification). Furthermore, many factors might mitigate the degree to which speakers simplify clusters, including word frequency (i.e., the clusters of infrequent words are more likely to be pronounced than in frequent words, particularly if the first person singular form is infrequent, such as *desintegr* '(I) disintegrate'), number of consonants in a cluster (i.e. three consonant clusters will favor simplification as there is an extra consonant to be articulated), language dominance (i.e., Spanish dominant speakers will tend to simplify the cluster since clusters in violation of the SSP do not exist word-finally in Spanish), and finally gender (i.e, based on previous sociolinguistic research, women are more likely to approximate prestige dialects – here, Barcelonese Catalan, in which the clusters are followed by the first person singular morpheme /u/).

5. Results and Analysis

The results show cluster simplification (CS) was more frequent (62.4% of tokens; N=374) than cluster maintenance (37.6% of tokens; N=225). MC speakers showed a strong tendency to simplify verb-final clusters to avoid rising or flat sonority sequences. Importantly, this result has been unconfirmed in previous research.

(8) Overall cluster simplification vs. cluster maintenance				
Cluster simplification			**Cluster maintenance**	
%	N		**%**	N
62.4	**374**		**37.6**	**225**
Total N		**599**		

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[3] DACCO Catalan-English online dictionary with frequency measure. URL: ttp://www.catalandictionary.org/eng/

Goldvarb X presented as significant the following factor groups: following phonological context (consonant or vowel) and number of consonants in a cluster (two or three), while the factor groups not selected as significant were word frequency, speaker language dominance, and gender.

(9) Multivariate analyses of the contribution of internal and external factors selected as significant to the probability of cluster simplification (CS); factor groups not selected as significant in square brackets

	Majorcan Catalan		
Corrected mean		**.635**	
Log likelihood		**-374.281**	
Total N		**599**	
	Factor weight	%	N
FOLLOWING PHONOLOGICAL SEGMENT			
Consonant	.64	76.7	194
Vowel	.38	52.0	180
Range	*26*		
NUMBER OF CONSONANTS IN THE CLUSTER			
C2	.54	68.1	213
C3	.44	56.3	161
Range	*10*		
FREQUENCY OF VERB			
-Frequent	[.52]	63.6	119
+Frequent	[.49]	61.9	255
SPEAKER LANGUAGE DOMINANCE			
Spanish	[.56]	67.3	144
Catalan	[.46]	59.7	230
SPEAKER GENDER			
Male	[.56]	68.4	119
Female	[.47]	60.0	255

As observed above, linguistic variables such as following phonological context and number of consonants in the final cluster are significant; however, there is no evidence that non-linguistic variables show significance in the analysis. The majority of participants in the study were Catalan-dominant (N=23), with a smaller number of Spanish-dominant speakers (N=12). The unbalanced nature of the participants in the study may have impaired the possibility of significant findings in other factor groups, such as language dominance or gender. Despite not being selected as significant, there is a weight of .56 favoring CS for Spanish-dominant bilinguals, simplifying these final clusters 67.3% of the times compared to 59.7% of instances for Catalan-dominant speakers.

As reported above, the presence of a consonant following the consonant cluster favors CS (.64) and a following vowel disfavors CS (.38), even though more than half of the instances of cluster + vowel results in cluster simplification (52.0%). Perhaps the most surprising result is that the fewer consonants in the cluster (two consonant combinations of obstruent + liquid) significantly favors simplification over groups of three consonants (nasal/lateral/sibilant + obstruent + liquid), which is contrary to our prediction and requires further analysis. In (10) we can see the differential behavior of the cluster depending on the particular consonants involved:

(10) Percentages of CS for postvocalic and postnasal clusters followed by +C and +V
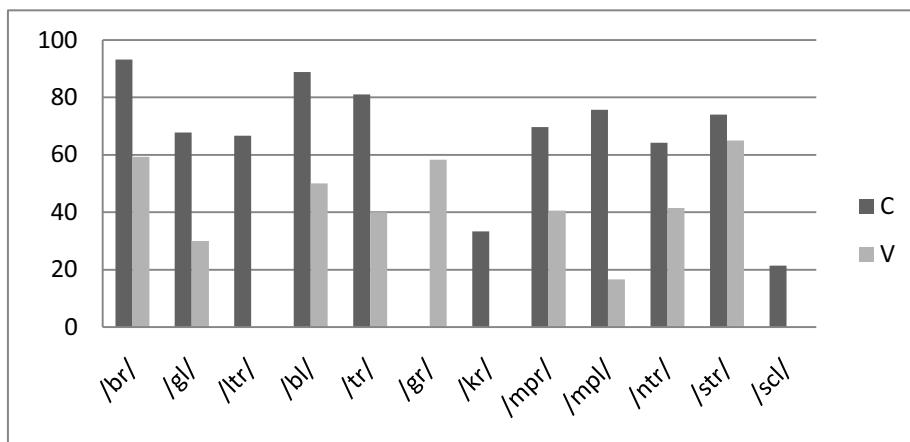
Behaviors of consonant clusters differ depending on the individual consonants in the verb-final cluster. Clusters composed of a voiced bilabial stop and a liquid (-*br* and -*bl*) are simplified more than other kinds of clusters. The next step was to consider the different phonological contexts of the /b+liquid/ sequences present in the data.

(11) The homogeneity of CS in /b+liquid/ phonological context

Verb	%CS	#CS	N Tokens	% Tokens of CS
Obr +C '(I) open'	99	32	33	16.4
Celebr +C '(I) celebrate'	95	19	20	9.7
Cobr +C '(I) charge/gain'	91.1	31	34	15.9
Amobl +C '(I) furnish'	88.8	8	9	4.1
Equilibr +C '(I) balance'	87.5	7	8	3.6
Subtotal /b+liquid/+C	93.2	97	104	25
Subtotal /b+liquid/+C and /b+liquid/+V	80.3	135	168	36
Total +C [all verbs]	76.7	194	253	51.8
Total +V [all verbs]	52	180	346	48.2
TOTAL CS [all verbs]	62.4	374	599	100

Table (11) presents the five /b+liquid/ verbs in the +C context, which were simplified at a rate of 93.2% (compared to 76.7% for all verbs in +C context). In fact, these five verbs, in the +C context, account for exactly half of all instances of CS in the +C context. These same verbs, in +C and +V contexts combined, account for over a third of the tokens of CS in the data.

The preceding discussion tells us that /b+liquid/ is the phonological context with the highest number of simplification cases in our data. Regardless of the following phonological context, these clusters were simplified (i.e., the liquid not pronounced) over 80% of the time. Thus, we must take into account that the individual consonants in each cluster, and not word frequency (as not all of these instances are frequent), will play an important role in favoring CS.

6. Conclusion and Discussion

This paper has argued for an extension in the analysis of phonological processes observed in MC first person singular present indicative verb forms. These forms, unlike other dialects of Catalan, do

not show an explicit inflectional morph, leaving the verb stem bare and often ending in a sequence of consonants in violation of the Sonority Sequence Principle. Naturalistic data demonstrated that speakers are often not articulating these ill-formed consonant clusters in verb-final positions. The analysis presented in this paper argues that MC speakers resort to cluster simplification to avoid rising or flat sonority within the syllable: overall (considering all verbs in all contexts), cluster sequences were simplified in 62.4% of all tokens. Finally, there are, indeed, instances in which speakers violate the restrictions of syllable structure imposed by the sonority scale and maintain the cluster. Cluster maintenance occurs in 48% of tokens preceding a vowel, where resyllabification can be expected, compared to cluster maintenance in only 23.3% of clusters before a consonant.

This article attempted to explain this variation between cluster simplification and articulation of the consonant by performing a multivariate analysis of the data using the statistical analysis program Goldvarb X to explain which extragrammatical factors affected the choice of one variant over the other, including social variables such as gender and language dominance, and linguistic variables such as phonological context, verb frequency, and number of consonants in a cluster. From the data collected, there is an inclination towards cluster simplification, which supports the speakers' linguistic awareness of the ill-formedness of these final clusters.

In addition to CS, some MC speakers, especially Spanish-dominant speakers, produce the inflectional morpheme [o] with infrequent verbs, even though this morph is not pronounced in the MC dialect (and would not be articulated as [o] in the standard Barcelonese Catalan dialect either; cf. footnote 1).

Further research should also focus on speaker age, presenting more data from older speakers (as the mean age of the speakers in this data is 29.1 years old). As we have not been able to accurately introduce age as a variable in this analysis, we have no evidence that there is a change occurring in Majorcan Catalan with respect to final consonant clusters in first person present indicative verb forms. Finally, a more stringent measure of frequency for the Catalan verbs would be desirable, as the frequency measure used for this project was a Catalan-English online dictionary with a frequency measure.

This study has introduced naturalistic data elicited through a translation task that challenge earlier accounts of the treatment of these clusters from theoretical perspectives of syllable structure. While previous studies have intended to develop theoretical solutions to the problem of these verb-final consonants (Dols (1993) supported an empty nucleus after the consonant cluster, Dols and Wheeler (1996) proposed a reanalysis of word-final consonants as onsets, Serra (1996) used an extrasegmental morpheme, and Pons (2002, 2006, 2007) cited paradigmatic pressures), no one has considered the possibility of cluster simplification – simply avoiding these ill-formed clusters. Our data, which include tokens from a relatively young portion of the population, demonstrate that cluster simplification is, indeed, pervasive in these controversial verb forms.

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