



Voice quality strengthening and glottalization[☆]



Marc Garellek

Department of Linguistics, UC San Diego, 9500 Gilman Drive #0108, La Jolla, CA 92093-0108, USA

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ABSTRACT

Prominence and phrase-initial position strongly favor the presence of word-initial glottalization in English and other languages. This suggests that word-initial glottalization may arise from prosodic strengthening – the phenomenon by which sounds are more ‘strongly’ articulated in stronger prosodic positions. However, if word-initial glottalization is due to prosodic strengthening, what exactly is being strengthened? The goal of this study is to determine whether voice quality is strengthened in vowels and sonorants, and whether this type of strengthening is consistent with word-initial glottalization. Prominent and/or phrase-initial voicing in English and Spanish was analyzed articulatorily using electroglottography. The results reveal that voicing during word-initial vowels in English and Spanish has increased contact under prominence, but not at phrasal onsets. Non-prominent initial vowels and sonorants are characterized by a decrease in contact, which I argue is inconsistent with both word-initial glottalization and voice quality strengthening. Based on the results, a prominence-driven account of word-initial glottalization is proposed and motivated.

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1. Introduction

Glottalization of vowel-initial words (e.g., English ‘apple’ pronounced as [ʔæpɪ]) occurs in many languages. In some languages (e.g., Arabic, Ilokano) glottalization is thought to obligatorily mark word-initial vowels, whereas in others, like English, its occurrence is more variable (Boroff, 2007; Hayes, 2009; Lombardi, 2002). In this study, I will refer to this variable phonological phenomenon as ‘word-initial glottalization,’ where ‘glottalization’ may be realized phonetically as a full glottal stop ([ʔ]) preceding the initial vowel, or as voicing characterized by increased glottal closure (laryngealized voicing) during the initial vowel.

1.1. When does word-initial glottalization occur?

Although cross-linguistically widespread, it is clear that the frequency of occurrence of word-initial glottalization may differ across languages. For example, it is thought to be rare in Spanish, common in English and German, and almost across-the-board in Czech (Bissiri, Lecumberri, Cooke, & Volín, 2011; Bissiri & Volín, 2010; Pompino-Marschall & Žygis, 2011). Many researchers have investigated (for a variety of languages) the factors that promote the occurrence of word-initial glottalization. (Here I discuss only word-initial glottalization. For factors that affect coda glottalization or glottal replacement, see Eddington & Channer, 2010; Eddington & Savage, 2012; Huffman, 2005; Milroy, Milroy, Hartley, & Walshaw, 1994; Pierrehumbert, 1995, among others.) Predictors of word-initial glottalization may be segmental, lexical, prosodic, or sociolinguistic. In English, segmental factors include hiatus (V#V) environments (Davidson & Erker, 2012; Dilley, Shattuck-Hufnagel, & Ostendorf, 1996; Garellek, 2012a; Mompeán & Gómez, 2011; Pierrehumbert, 1995; Umeda, 1978) and word-initial back vowels are found to glottalize more frequently than non-back vowels (Umeda, 1978). As for lexical factors, content words exhibit more frequent glottalization than function words (Umeda, 1978). Women are known to use glottalization more than men (Byrd, 1994; Dilley et al., 1996). Most studies of word-initial glottalization reveal that prosody is a key factor; the presence of lexical stress and/or a pitch accent on the word-initial vowel or later in the word, as well as a larger juncture with the preceding word, are known to be excellent predictors of word-initial glottalization in English (Dilley et al., 1996; Garellek, 2013; Pierrehumbert, 1995; Pierrehumbert & Talkin, 1992). In other languages, additional factors that promote the occurrence of word-initial glottalization include word length in Dutch (Jongenburger & van Heuven, 1991), presence of a preceding pause (Kohler, 1994) as well as speech rate (all of which are correlated with other prosodic factors), and low vowel quality (Brunner & Žygis, 2011; Pompino-Marschall & Žygis, 2011) for German.

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E-mail address: mgarellek@ucsd.edu

1.2. Why does word-initial glottalization occur?

In Garellek (2013), I showed that when many of the segmental, lexical, and prosodic factors are analyzed together, prominence (stressed and/or unreduced vowels) and phrasal position emerge as the most important predictors of word-initial [ʔ] in English, which is consistent with previous research that has shown that such prosodic factors are good predictors of word-initial glottalization (Dilley et al., 1996; Pierrehumbert, 1995; Pierrehumbert & Talkin, 1992). The fact that prominence and phrasal position play a primary role in predicting word-initial glottalization is important, because it can help explain why word-initial glottalization is so common across languages. Specifically, it is likely that the phenomenon is (sometimes) a form of prosodic strengthening of word-initial vowels (Boroff, 2007; Fougeron, 2001). Prosodic strengthening is the process by which articulations are ‘strengthened’ in prosodically strong environments, notably phrase-initially and under prominence (Keating, 2006). By ‘strengthening’, the articulation itself can become more forceful (Fougeron, 2001), or the contrast between the target and neighboring sounds can be enhanced (Cho, 2005; Hsu & Jun, 1998).

But if word-initial glottalization is a form of prosodic strengthening, it is unclear what in fact is being strengthened. In the studies mentioned above, word-initial glottalization is associated only with word-initial vowels, suggesting that glottalization is a form of prosodic strengthening unique to vowels in the initial position. However, it is also possible that voice quality in general is more forceful in strong environments. A certain degree of vocal fold adduction is required in order to sustain voicing (Zhang, 2011), so more forcefully articulated voicing should result in voicing with increased glottal closure – laryngealization, and in extreme cases, a glottal stop. The relationship between glottal stops and voice quality is clearly represented in Ladefoged’s glottal continuum model of phonation types, which are defined in terms of the aperture between the arytenoid cartilages (Gordon & Ladefoged, 2001; Ladefoged, 1971). Modal voicing is the phonation type that is characterized by an average glottal opening, whereas breathy voicing has a larger average glottal opening and laryngealized voicing, a smaller average glottal opening. Not surprisingly, a glottal stop is at the extreme of the continuum. Thus, if modal voicing is produced more forcefully, laryngealization should ensue. In the extreme case, the laryngealization could be produced even more forcefully, yielding a glottal stop.

Thus, the main goal of the present study is to determine whether voice quality is strengthened in prosodically strong environments. If confirmed, this could provide a straightforward account of why word-initial glottalization is cross-linguistically common; a more forceful articulation of voicing should (all else equal) result in laryngealization in every language. Indeed, there is some evidence that the start of an English utterance has tenser voice quality compared to later portions (Epstein, 2002), though it is unclear where such tenseness precisely occurs, or if it corresponds in fact to increased vocal fold closure and therefore to glottalization. Nonetheless, if voicing in general is strengthened, then two important facts should be considered. First, in terms of theory, glottal stops in English should then not be regarded as distinct segments, but as the extreme result of voicing strengthening, as discussed by Pierrehumbert and Talkin (1992), Dilley et al. (1996), and Boroff (2007, footnote 39), among others. Thus, laryngealization should not be regarded as a form of lenition of [ʔ], because it is stronger than the default, which is modal voicing. Rather, a full [ʔ] is the extreme case of this fortition (see discussion of similar issues regarding English /t/ affrication by Buizza & Plug (2012)). Second, in terms of theory prediction, if word-initial glottalization is a form of voice quality strengthening, then all voiced sounds, including voiced consonants, are expected to show increased laryngealization or even glottal stops in strong environments. However, if vowels are strengthened differently than other voiced sounds, then word-initial glottalization can be specific to word-initial vowels, either as a form of prosodic strengthening or as inserted segments.

1.3. The current study

The goals of this paper are therefore to determine whether voice quality is strengthened by means of increased vocal fold adduction, and if so, whether such strengthening occurs for all voiced sounds. I address these goals in an articulatory (electroglottographic or EGG) study of word-initial voicing in English and Spanish read speech. Spanish was chosen because word-initial glottalization is thought to be rare (Bissiri et al., 2011; Valentín-Márquez, 2006), which suggests that prosodic strengthening of voice quality should rarely occur (if at all) in that language. Specifically, the three hypotheses to be tested in this study are whether (1) both prominence and phrase-initial strengthening results in increased EGG contact; (2) word-initial sonorants (and their following vowels) show the same effects as word-initial vowels; and (3) voice quality strengthening is weaker in Spanish than in English. Prosodic strengthening of voice quality will therefore be determined by whether voicing shows an increase in EGG contact, which is taken to be an articulatory correlate of laryngealization. Although laryngealization has other articulatory correlates (e.g., irregular pitch periods), these are less clearly tied to articulatory strength than EGG contact.

2. Method

2.1. Stimuli

The target words in both languages consisted of vowel- or sonorant-initial proper nouns with two or three syllables. Each target sound appeared with and without primary stress. Target word-initial vowels were [æ, i, ə, ou] in English and [a, e, o] in Spanish, and target word-initial sonorants were [m, n, l, j] and (only in English) [w]. Sonorant-initial words were followed by the vowels [ou], [o], or [i] in English and by [a], [o], or [au] in Spanish. Stressed syllables were intended to attract phrasal prominence by means of a pitch accent, whereas unstressed syllables were considered non-prominent. In total, there were 16 English target names and 14 Spanish names. The complete list of target words in both English and Spanish is shown in Table 1.

Each target word was placed in four distinct positions: Utterance-initially (after a breath), IP-initially after a high boundary tone (H%), ip-initially after a high phrase accent (H-), and ip-medially. In the three Utterance-medial conditions, the target words always followed a fixed vowel ([ə] in English and [a] in Spanish). Additionally, in both languages the number of syllables preceding the target word (when utterance-medial) was held constant, as was the total number of syllables (per stress condition), with the exception of the trisyllabic English names *Yolanda* and *Winona*. Thus, in both stress conditions the target syllable was the seventh syllable in the utterance if it occurred utterance-medially. Utterances with stressed target sounds had a total of 15 syllables, whereas those with unstressed target sounds had 15 or 16 in English and 16 in Spanish. The target syllable, if stressed, never bore the nuclear pitch accent of the phrase. The sentence frames in both English and Spanish are shown in Table 2. The expected breaks and preceding tones in Mainstream American English (MAE)-ToBI (Beckman & Ayers Elam, 1997) and Mexican Spanish ToBI (de-la-Mota, Butragueño, & Prieto, 2010) are indicated.

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