

Categorical and gradient patterns of lenition in ultrasound data
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Lenition of the liquid consonant /l/ is found in many varieties of English to some extent (Cruttenden 2001; Wells 1982). The majority of studies focus on the process of /l/-darkening, whereby /l/ is produced with a delayed tongue-tip gesture. It is often said that light [l] occurs in onsets (e.g. *light*) and dark [ɫ] in codas (e.g. *dull*; Giegerich 1992; Halle & Mohanan 1985). However many studies report varying distributions of light and dark /l/ in different morphosyntactic environments. Table 1 summarises the outcome of previous studies on /l/-darkening in American varieties, alongside the pattern reported in RP.

	<i>light</i>	<i>yellow</i>	<i>heal-ing</i>	<i>heal it</i>	<i>heal</i>	
RP	[l]	[l]	[l]	[l]	[ɫ]	Cruttenden (2008)
Am. Eng. 1	[l]	[l]	[l]	[ɫ]	[ɫ]	Sproat & Fujimura (1993)
Am. Eng. 2	[l]	[l]	[ɫ]	[ɫ]	[ɫ]	Olive et al. (1993)
Am. Eng. 3	[l]	[ɫ]	[ɫ]	[ɫ]	[ɫ]	Hayes (2000)

Table 1: /l/-darkening in different environments. Adapted from Bermúdez-Otero (2007)

Existing analyses of /l/ lenition patterns tend to argue for either a purely gradient, or a purely categorical analysis of the darkening data. A gradient interpretation concludes there is no categorical distinction between discrete light and dark allophones, i.e. [l] vs [ɫ], but only a gradient continuum of darkness. This claim has been argued for by, amongst others, Sproat & Fujimura (1993), who state that darkness depends on duration (the longer the pre-boundary rime, the darker the /l/), and Lee-Kim et al. (2013), who say that the morphosyntactic parameter of boundary strength directly affects gestural coordination. Categorical interpretations (such as Hayes 2000) focus on category mixture as the locus of variation. That is, they may acknowledge there are some low-level duration-driven effects, but argue that the main distributional facts reflect the probabilistic application of variable, morphosyntactically sensitive, categorical phonological processes.

The current paper argues that both approaches make compelling arguments, but are flawed in places. This argument is supported with ultrasound data which demonstrate that processes such as /l/ lenition involve both a categorical phonological and a gradient phonetic component. Firstly, Sproat & Fujimura (1993) claim that darkening is gradient as it is correlated with duration, but fail to show that duration solely accounts for darkness. Furthermore, their data support findings by Yuan & Liberman (2009, 2011) which show that only dark [ɫ]s are correlated with duration. Secondly, Lee-Kim et al. (2013) find a continuum of darkness within three phonological contexts (represented by the words *flaw-less*, *cool-est* and *cool*) and conclude that three categories is not possible, so it must all be gradient. Not only do they sample the distribution too coarsely to make such a claim but, in addition, three categories of lenition in /l/ realisations is not surprising given the idea of lenition trajectories (Bermúdez-Otero 2011). Successive steps in a lenition trajectory give rise to a series of separate phonological rules entering the grammar one after the other e.g. /r/ lenition in present-day English results in lenited /r/ prevocally in a phrase such as *the car appeared*, but complete vocalisation pre-pausally or pre-consonantly in *the car crashed*. The process of /l/-vocalisation, where the tongue-tip fails to make contact altogether (giving [fi:ɹ̥] for *feel*) would provide the third stage of the /l/ lenition trajectory. /l/-vocalisation has been documented for many varieties of English, not only descriptively

The present study provides data from many dialects of English, focussing on two which show the same contextual patterning of /l/ lenition distributions, but with different phonetic realisations. Speakers of various varieties of English (including RP, American English and other non-standard dialects of British English such as the vocalising dialects of the South-East) were recorded producing /l/ in five contexts: word-initial, word-medial before a vowel in the same stem, word-medial before a suffixal vowel, word-final prevocalic, and phrase-final, corresponding to the headings in Table 1, plus pre-consonantal contexts.

Statistical tests show that, for both dialects in Figures 1 and 2 (Essex and American English), the *leap*-type and *helium*-type tokens are significantly different from *heal-ing* and *heal it* type tokens. These again are different from *heal*-type tokens. However, it can be observed that the Essex pattern in Figure 1 is clearer in terms of a three-way distribution. Furthermore, the Essex realisation of phrase-final /l/ is audibly very different to that in other positions, giving a sound closer to [ʏ]. For this speaker, it seems there are three categories of the lenition trajectory: $l > l̥ > ʏ$. On the other hand, although the American speaker in Figure 2 has additional tongue root retraction in non-prevocalic position which is statistically significant, it is argued that this is an additional gradient phonetic effect of duration, rather than a third category.

In summary, the Essex pattern could reflect the operation of two overlaid categorical phonological processes: one controlling tongue-root retraction, the other linguo-alveolar contact. The American pattern may be down to categorical darkening, superimposed on a gradient duration-driven adjustment in final position. In both scenarios, we have two processes synchronically overlaid in the grammar. To conclude, it is argued that /l/ lenition in English shows effects of synchronically overlaid processes, including both categorical phonology and gradient phonetics and that a model which considers both of these factors can best account for this observed variation.

