Processing consonant length in Bengali: ERP and behavioural evidence

About half of the world's languages use consonantal length, i.e. geminate versus singletons, to contrast words; e.g., Bengali [pata] 'leaf', [pat:a] 'whereabouts, location'. The most salient acoustic cue to differentiate such consonants is the duration of closure, geminates being almost twice as long as single consonants (e.g., Bengali voiceless stops: geminates = 190msec, singletons = 70msec, Hankamer et al. 1989). Phonological evidence suggests that geminates and singletons are single consonants, represented by single sets of features, but differing in their representation of structural length, where medial geminates are part of two syllables; i.e., the [t:] in [pat:a] belongs to the coda of the first syllable as well as the onset of the second.

Since duration contrasts are invariably relative ('long' is longer than 'short' but with no absolute value), the question we ask here is how do listeners process consonantal length if there are no other acoustic cues to differentiate between them. That is, how do they process mispronounced pseudowords which differ from corresponding real words only in consonantal duration? To investigate this question, we used both behavioural and brain-imaging techniques examining the productive word medial geminate-singleton contrast in Bengali.

Our predictions are as follows: if no deviation in length is acceptable, then the mispronounced nonword primes with the incorrect duration will not activate the real word. If, however, a syllable parsing overlap does play a role in acceptability, we predict an asymmetry. A geminate mispronunciation has an additional coda but no missing syllable units in comparison to the real word singleton which would not preclude its activation. In contrast, the parsing of a singleton mispronunciation leads to the building of a coda-less first syllable with an onset of the second syllable which is insufficient to activate the real word geminate. Does this difference in syllable structure parsing lead to a difference in acceptability of nonwords that are formed by substituting longer segments for shorter ones and vice versa?

Two sets of cross-modal semantic priming experiments were run in Kolkata, India with auditory primes and visual targets (ISI for behavioural: 0msec; ISI for EEG: 250msec). We chose two sets of disyllabic words as auditory primes; lexical singletons with no geminate counterparts, and underlying geminates with no corresponding word with a singleton. Pseudoword primes were created by shortening or lengthening this medial consonant to create the corresponding (fake) geminate or singleton, e.g., [bina] 'veena'~ *[bin:a]; [g^{h}en:a] 'annoyance' ~*[g^{h}ena]. Both ERPs (specifically N400) and reaction times were measured.

***Semantic priming**: Experiment 1 (SHORT - LONG)*					
Condition	Prime	Target	Parsing predictions	Priming results (RT)	N400 results
Singleton (word)	[bina] 'veena'	[ʃetar] 'sitar'	√	20ms**	low
Geminate (nonword)	*[bin:a]		√	32ms**	low
***Semantic priming**: Experiment 2 (LONG - SHORT)*					
Condition	Prime	Target	Parsing predictions	Priming results (RT)	N400 results
Geminate (word)	[g^{h}en:a] 'disgust'	[birokti] 'annoyance'	√	15ms**	low
Singleton (nonword)	*[g^{h}ena]		N	3ms	high

Significant semantic priming confirms lexical activation resulting in faster RTs (indicated by **) and lower N400 for real words in comparison to unrelated controls. However, we also find significant priming and lower N400 with pseudowords, but only when the real word is a singleton. That is, *[bin:a] primes [ʃetar] and a lower N400, but *[g^{h}ena] does not prime [birokti]. These results show that a perfect match of consonantal length was not necessary for lexical activation. However, while more information facilitates the recognition of the semantic associate of the real word, less information does not result in facilitation, thus confirming our predictions for asymmetric activation due to differences in parsing.