

17 December 2018

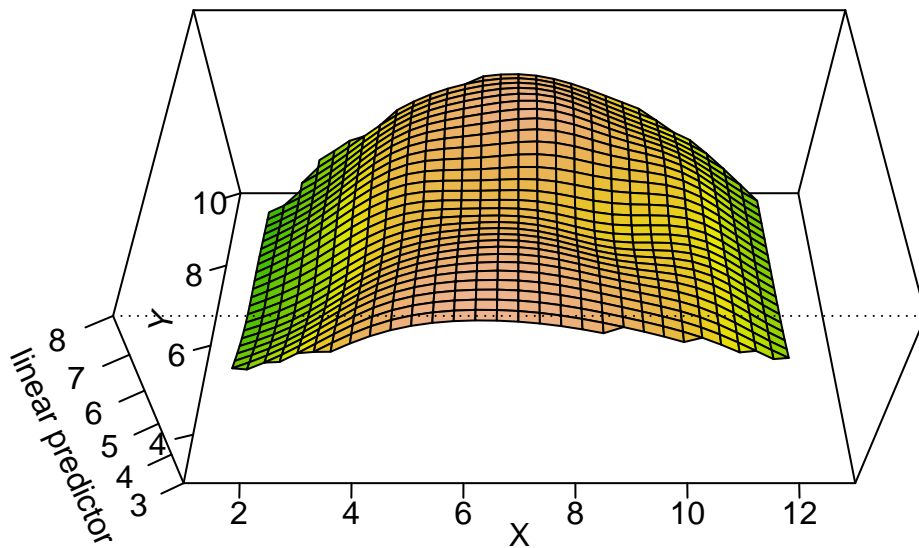
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*12/12/2018*

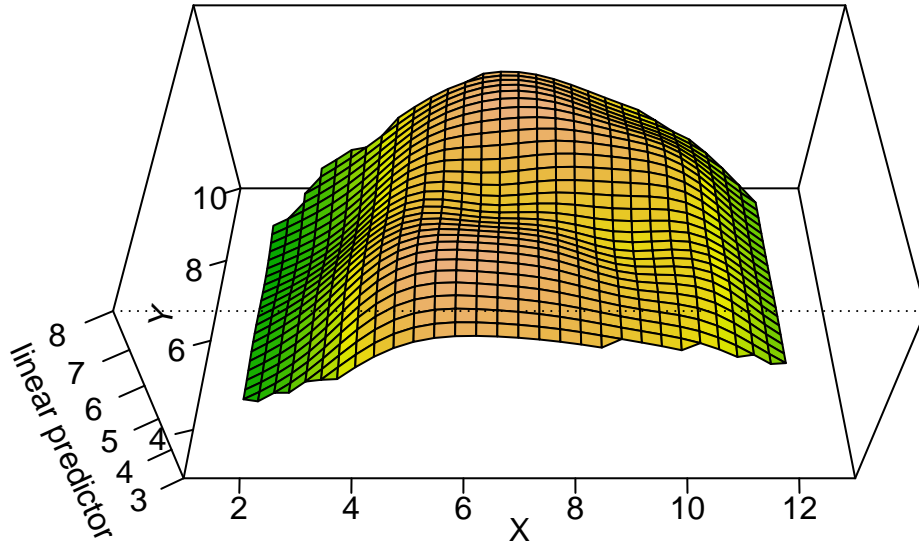
## 1 3D tongue surface of [s] and [z]

I recorded myself in Bloomington with the 3D ultrasound machine while uttering five tokens of sustained [s] and five tokens of sustained [z]. A single 3D frame has been extracted from each token. The following plots show the output of a 3D GAM fitted to the tongue surfaces of [s] and [z].

**[s]**



**[z]**



There is a shallower groove in [z] compared to [s], and some lowering/advancing of the tongue root. Note that the tongue data have not been rotated.

## 1.1 Volume increase

The volume increase of [z] relative to [s] is 12.08 cm<sup>3</sup>. This estimate is based on the predicted GAM data on a surface which corresponds to the actual imaged surface. If I remember correctly, Steven Lulich estimated that a volume increase of 20 cm<sup>3</sup> is ideal for maintenance of voicing in a voiced fricative.

## 2 Italian EGG: vowel and voicing duration

