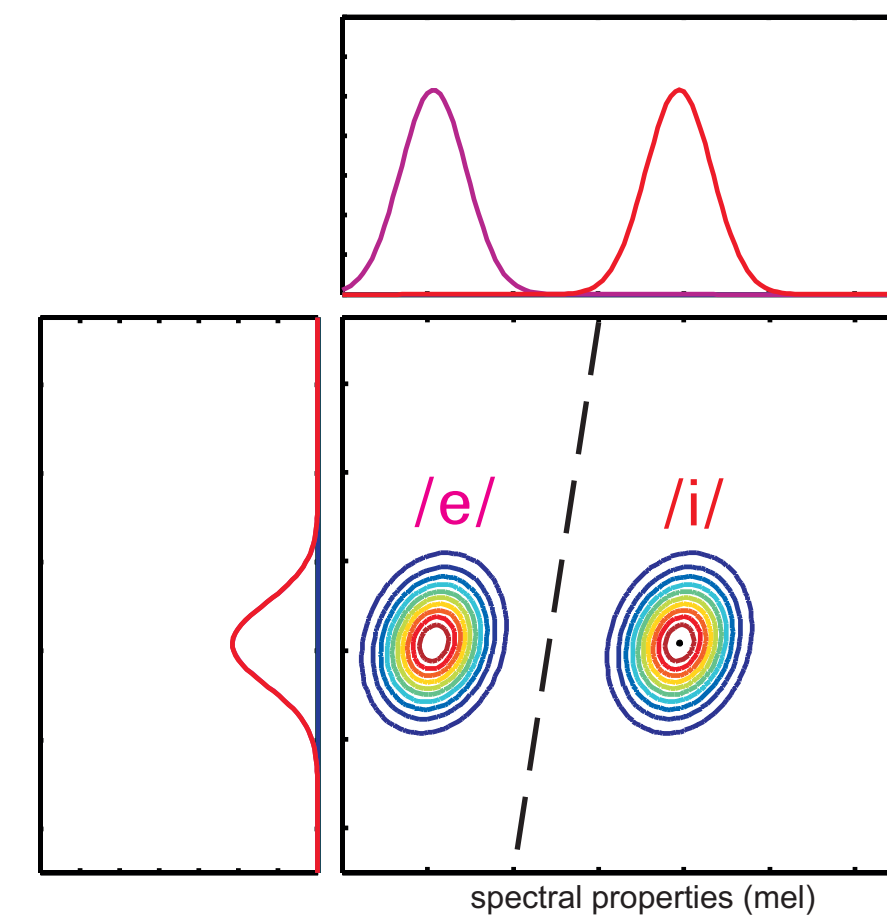


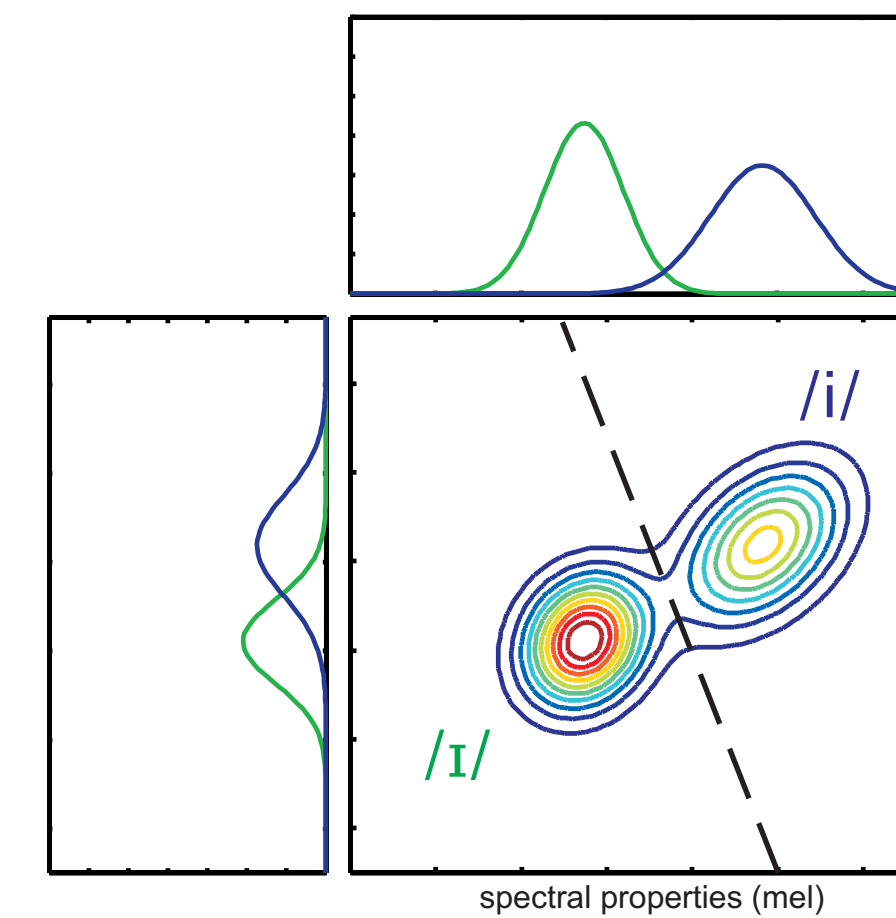
# Towards a Quantitative Speech Learning Model (QSLM)

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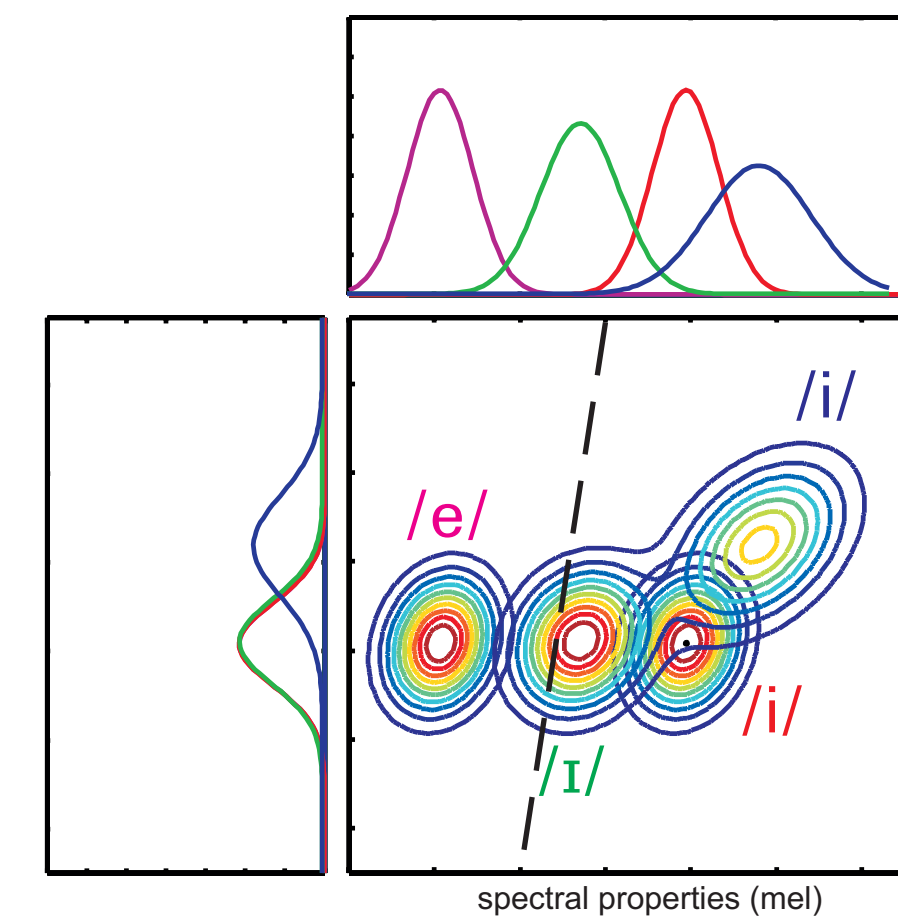
## L1-Spanish Distributions



## L1-English Distributions



## L1-Spanish & L1-English Distributions



## Mayne, Werker, & Gerken (2002):

Infants construct L1 speech perception categories based only on the total statistical distribution of the acoustic input.

Category formation precedes category labelling.

## Flege (1995) Speech Learning Model (SLM):

L2 learners have access to the same mechanisms and processes which they used in learning their L1 sound system.

## L1-Spanish L2-English learning

- Learners start with the Spanish distributions. Initial categories are Spanish /e/ and /i/.
- As they gain experience with English, English vowels contribute to the total distribution.
  - The contribution of the English vowels to the total distribution gradually increases.
- New categories are constructed on the basis of the total distribution.

## Diphones

- Boundaries shift to reflect the mixture of L1 and L2 distributions.
  - The /i/ diphone consists of Spanish /i/, English /i/, and some English /ɪ/.
  - The /e/ diphone consists of Spanish /e/, some English /ɛ/, some English /e/, etc.

## New Categories

- When a new peak (separated from other peaks by a col) emerges, a new category with stable boundaries is formed.

## Duration Based Categories?

- The model predicts the formation of a new /ɪ/ category differentiated by spectral cues, but, in the early stages of learning, L1-Spanish L2-English speakers use duration to distinguish English /ɪ/ and /i/ (Bohn, 1995; Escudero & Boersma, 2004; Morrison, 2005).
  - If speech sounds assimilated to the /i/ diphone are perceived according to category-goodness (See Best's, 1995, Perceptual Assimilation Model, PAM), then instances of vowels further from the prototype are more likely to be noticed as deviant members of the category.
  - The /e/ diphone – /i/ diphone boundary provides an upper limit on how far from the prototype a low vowel can be. If it is on the /e/ side of the boundary then it is not a deviant member of the /i/ category.
  - There is no Spanish vowel category to place an upper bound on how high or long a vowel can be and still be assimilated to the /i/ diphone.
  - Compared to instances of low short vowels, instances of high and long vowels can be further from the /i/ diphone prototype, and still be assimilated to the /i/ diphone, and thus be noticeably more deviant members of the /i/ diphone.
  - Because long vowels are noticeable, L1-Spanish L2-English speakers attempt to use duration to distinguish the English /ɪ/–/i/ contrast. They form a new /i:/ pseudocategory in addition to the /i/ diphone.
    - However, /i:/ does not form a peak separated from the /i/ diphone by a col, the L1-Spanish L2-English speakers are unable to form a stable boundary for the new pseudocategory. Hence, duration-based perception of English /ɪ/ and /i/ is of limited effectiveness.

## Future Work

- Additional production and perception data collection.
- Problem of dimension scaling.
- Computational implementation, possible model is Gunther & Gjaja's (1996) neural map model.

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