Phonological representations and the brain

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Announcements

No office hours on Thursday 4/21.

» Email me if you want to chat!

Happy Hour today at 5:30
Agenda

» Phonological processing within 0.1 sec
» Feature geometry and a phonological place-code
» Mismatch effects and feature structures
» Evidence for underspecified features
First, a reminder of how we think about vowels in terms of features and formants.
Extends **place-coding** from last time: codes are shaped by feature structure, not acoustics.

Adds timing: phonological information active by 100 ms!
Summary so far A place-code for phonological features (not just acoustics) is apparent within 0.1 sec after stimulus onset in the superior temporal gyrus
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The "oddball" experimental paradigm and the mis-match effect
No phonological deviants = No mismatch effect (acoustic deviance not enough)

(Left: Exp 1, Middle: Exp 2, Right: Comparison)
Illusory vowels can arise in perception to satisfy phonotactic constraints of a language: [ɛbdi] → 🕵️ [ɛbʌdi]

» Japanese CV syllable constraint, ebzo → "ebuzo"
Mismatch effect for *French* listeners to "ebuzo" following "ebzo" 0.1 – 0.2 sec.

But, not for *Japanese* listeners – perceptual epenthesis blocks mismatch effect!
Where are we now

» Phonological features are place coded in the *superior temporal gyrus* around the *auditory cortex* and shape brain responses around 0.1 sec

» Place-coding is feature-based, not acoustic. May provide clues to phonological feature structure (tentative)

» Mismatch effects show primacy of phonological features in speech perception

**Next** The mismatch effect can reveal aspects of phonological representations
Agenda

» Phonological processing within 0.1 sec
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» Mismatch effects and feature structures
» 🔔 Evidence for underspecified features
Mismatch negativity indicates feature underspecification

MMN is bigger when oddball stimulus mismatches a *fully specified* feature (like DORSAL) but not when mismatch is with an *underspecified* feature (like CORONAL)

Eulitz & Lahiri, 2004 J Cog Neurosci
Scharinger et al., 2012, PLoS ONE
Summary so far

» Place-code for speech reflected by about 0.1 s after stimulus onset (M100, MMN)

» Place-code structured by phonological information

» Phonological mismatches drive predictive processing above-and-beyond acoustic properties

» Mismatches show evidence for *underspecified* feature representations…

…and also evidence *against* detailed exemplar-based representations in favor of efficient and abstract symbols.
**Big Question** What memory representations encode knowledge of speech?

The classic *abstractionist* view is that phonological knowledge is comprised of something a-lot like grides of distinctive features (these could be acoustically organized, or articulatory / gestural).

The alternative *exemplar* viewpoint is that long-term memory is populated by individual traces of experience.

Good overview in Pisoni & Levi 2007 *Oxford Handbook of Psycholinguistics*
Simple prediction from abstractionist models is that sub-phonemic information is removed during perception view normalization and is thus not stored in long-term memory.

…but the simple prediction is false
Serial recall is U-shaped. High recall of first item reflects long-term storage without interference; high recall of last item(s) reflects working memory.

Talker-specific effect on first-item recall suggests talker information is encoded in long-term representation.

Nygaard et al. 1995 *Percep Psychophys*
Exemplar theories capture speaker-specific effects like these any many others.

But... they do not allow for underspecification; challenge to explain mismatch asymmetries

Alternatives and ongoing debate

» Layers of representation and abstraction over co-represented exemplars? (problem: inefficient!)

» Dimensions of abstraction: features for talker and other "exemplar" information
If time… can return to *analysis–by–synthesis* from last time.