

# Biological Specialization for Speech

## The Ideas:

- 1) Some aspects of speech/language may reflect biological (neural & anatomical) specialization.
- 2) These specializations may be “modules” that are exclusive to speech and language.
- 3) These modules may be innate, learned or a hybrid.

# Anatomical Specialization

The human articulatory apparatus is unique.

The historical record shows evidence of human physiology and/or the genetic markers of language for tens of thousands of years.

Thus, it is possible that evolution has resulted in specialized neural adaptations for spoken language.

# Evidence for Specialized “Modules”

Our focus will be on phonetic coding.

1. Do listeners show evidence of neural specialization for language (and other) processing?
2. Does phonetic coding somehow invoke processes that are unavailable to other auditory perception? Is this evidence for a speech module?

# Dichotic Listening

Rather than discussing neuroimaging or anatomical/damage/lesion studies, we'll consider behavioral data.

The basic task: Play two speech sounds to the listener simultaneously, one to each ear. They are asked to report both or can be asked to report the sound in just one ear. The data we'll consider are for reporting both.

# Dichotic Listening Data

For CV (stop-vowel) syllables where the consonant varies in place and voicing, listeners are typically more accurate for the syllable presented to the right ear. This is the “right ear advantage” (REA).

It is thought to occur because the sound presented to the right ear gets to the left hemisphere first (direct route via contralateral pathway). The sound to the left ear goes to the right hemisphere and then via the corpus callosum to the left hemisphere. The left hemisphere has specialized processing (or control of processing) so the sound that gets there first is processed more accurately.

# Details

An REA is found for stops. Not found for vowels. The data somewhat mirror categorical perception (generally, the sounds that produce an REA would also be more categorical). Maybe the left hemisphere has specialization for the dynamics (recover the gestures) of articulation?

There are lots of other data on specialized areas of the brain (Brocca's area, Wernicke's area, visual areas that handle faces, etc).

# “Specialized” Speech Processing

Listeners can learn to accurately categorize complex, speech-like nonspeech sounds. However:

Best et al showed that phonetic trading relations (how cues trade against one another to yield a phonetic percept) occurs for speech processing but not non-speech processing of the same stimuli.

This claim was extended to the processing of the /r/ - // contrast.

## Some Details

Listener performance for the “non-speech” /r/ - /l/ stimuli group was awful and showed no evidence that listeners had learned what to listen for. Is this failure to classify the stimulus due to inadequate training for the nonspeech listeners or to the necessity to use the phonetic module to process the sounds?

Sawusch and Gagnon (1995) showed that with a different training regime, nonspeech listener performance was not reliably different from speech listener performance and that training on one set of items (/ra/ -/la/) generalized to a new set (/ri/ - /li/).



# Speech Module?

Trading relations have been found for “speech mode” listeners. When multiple cues are present, listeners trained with nonspeech instructions (both human and animal) seem to use one cue but not to integrate them. The trading relations may be evidence of phonetic coding (specific to speech).

As an aside, this does not imply that nonspeech coding would not show cue trading IF the listener had sufficient experience and the trading occurred as part of the “normal” occurrence of the sounds.