Fabricating Reality Through Language
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Fabricating Reality Through Language

“…..Trying to make sense out of incomplete messages.”

Zebras have black and white _______. Did you eat yet?
Making Sense From Incomplete Messages
STRESS
STRESS
DRESS
DRESS
STRESS
From *Thinking and Speech* (1934).
Publisher: M.I.T. Press, 1962;
Speech – Just as Variable
Babies Can Do It

THE SCIENTIST IN THE CRIB
WHAT EARLY LEARNING TELLS US ABOUT THE MIND

Alison Gopnik, Ph.D.
Andrew N. Meltzoff, Ph.D.
Patricia K. Kuhl, Ph.D.
Washoe (1965-2007) – Chimps Can Do It
Roughly 13 dB SNR Loss with low-context sentences comparing HI subjects to NH subjects. Automatic speech recognition more closely resembles HI performance: requires a very favorable SNR to reach 100% and falls off quickly in noise.
You Don’t Have To Have A Hearing Loss To Having Trouble Understanding Speech

• Not all noise exposures lead to hearing loss as defined by the audiogram

• Common noise sources
  • Concerts
  • Firing range
  • Leaf blowers

• Usually after 24-48 hours, hearing thresholds return to normal
Listening Experience Can Modify the Way We Hear

- Musicians versus non-musicians encode acoustic features differently (pitch, timing, and timbre) – better speech recognition performance in noise
- cABR is a brainstem response to a complex waveform (/da/)
- cABR waveform, possibly generated in the inferior colliculus, is modified by experience
- cABR is modulated by past experience

N Kraus, S Anderson (2014). Hearing Review, August, 18-21
Everyday Environments Require Segregation of Sound Sources and Attention

- Multiple speakers
- Auditory cues to separate sound sources
- Focus attention on the target speaker
- What happens in the brain that allows us to do this?

Our wonderful colleagues at BU
Processing Speed, working memory, attention and Continuous Speech

Processing words in connected speech requires a minimum processing speed (must handle roughly 220 words/min)

Words are usually recognized before end of word occurs (lexical context)

Time after recognition point and before next word starts can be used to store words in memory, rehearse previously stored words, activate next most likely lexical items
What happens when the next word comes before the previous word was fully processed (noise, hearing loss)?

- Abort processing of current word or delay processing of incoming word
- Error rates increase (little is known about the kinds of errors made in this situation)

Nonsense syllable tests typically do not have this dependence on processing time
Communication Breakdown

- Hearing loss
- Signal distortion (with or without hearing loss)
- Listening history
- Attention
- Memory
- Processing speed

- Source separation
  - Pitch
  - Timbre
  - Spatial separation
  - Timing
A New Challenge: Blast-Exposed Normal Hearing Service Members

- Clinically normal hearing thresholds
- Trouble understanding speech in complex environments
- Effortful listening
- Tired
- Depression
- Isolation

- Distortion?
- Auditory processing?
- Cognitive processing?
- Assessments
- Low-gain hearing aids
- Brain exercises
• Prevalence – just how big is this problem
  – Need to know how many resources to devote to the problem

• Assess the communication breakdown from several simultaneous angles
  – Early processing stages
  – Central processing; binaural integration
  – Cognitive processes

• Recommend course of action – brain fitness
• Things we know
  – Audiogram doesn’t explain difficulties in speech understanding
  – Problem requires a multi-pronged attack
    • Hidden hearing loss – distortion
    • Central processing
    • Cognitive processing

• Things we’re not sure of
  – How big a problem is this really (initial estimates suggest up to 20% of all deployed to Iraq and Afghanistan)
  – Can training regimens be optimized if we target the stages of processing where the breakdown occurs
Stay Tuned

Thank You