

Language & Cognition

Speech Production & Perception

Tutorial

OVERVIEW

The process of speech perception might be approximated to the process by which readers perceive letters on a page. The phonetic cues available to the listener in deciphering the speech signal might bear the same relation to the spoken word as letters do to the written word. In fact, speech is not neatly packaged in this way.

Readings

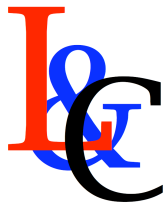
- *Whitney, P. (1998) *The Psychology of Language*. Boston, Houghton Mifflin. Chapter 2 (31–42), Chapter 5 (141–159), Chapter 10 (309–315).
- Altmann, G. T. M. (1997) *The Ascent of Babel*. Oxford. OUP. Chapters 1, 2, 3.
- Pinker, S. (1994) *The Language Instinct*. New York, Morrow. Chapter 6.
- Berko Gleason, J., and Bernstein Ratner, N. (Eds) (1993) *Psycholinguistics*, (1st or 2nd Ed.) Chapter 3 (90–131), Chapter 7.
- Osherson, D. N. and Lasnik, H. (1990) *Language: An invitation to Cognitive Science. Volume 1*. Cambridge, MA. MIT Press. Chapter 4.
- *Harley, T. (2001) *The Psychology of Language*. (2nd Ed), Hove, Psychology Press. Chapter 1 (27–33), Chapter 8 (219–228) or (2007) (3rd Ed) Chapters 2, 9 & 13.

Parallel Transmission

Information from consecutive phonetic segments overlap with each other. Strong context effects are the norm rather than the exception in speech perception. Artificial speech recognisers have extraordinary difficulty accommodating to this state of affairs.

Readings

- Liberman, A. M., Cooper, F., Shankweiler, D., and Studdert-Kennedy (1967). Perception of the speech code. *Psychological Review*, 74, 431–459.
- Mann, V. A., and Ripp, B. H. (1980). Influence of vocalic context on perception of the [sh]-[s] distinction. *Perception and Psychophysics*, 28, 213–228.



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Acoustic and Motor Theories of Speech Perception

Many of the complexities of speech perception can be understood if it is assumed that speech is perceived by matching the input against the output of an internal speech synthesiser that contains an abstract model of the mouth. The motor theory of speech perception contrasts dramatically with the view that speech is perceived by extracting acoustic properties from the input. Recently, studies using functional imaging and TMS have suggested a causal role for the motor cortex in speech perception.

Readings

- *Diehl, R.L., Lotto, A.J. & Holt, L.L. (2004) Speech perception. *Annual Review of Psychology* 55, 149–79.
- Kuhl, P. K., and Meltzoff, A. N. (1982). The bimodal perception of speech in infancy. *Science*, 218, 1138–1141.
- ✧ Liberman, A. M., and Mattingly, I. G. (1985). The motor theory of speech perception revised. *Cognition*, 21, 1–36.
- Massaro, D. W., and Cohen, M. M. (1983). Evaluation and integration of visual and auditory information in speech perception. *Journal of Experimental Psychology: Human Perception and Performance*, 9, 753–771.
- Mottronen R & Watkins KE (2009) Motor representations of articulators contribute to categorical perception of speech sounds. *Journal of Neuroscience*, 29(31), 9819-25.
- Watkins KE, Strafella AP, Paus T. (2003) Seeing and hearing speech excites the motor system involved in speech production. *Neuropsychologia*, 41(8), 989-94.
- Wilson SM, Saygin AP, Sereno MI, Iacoboni M. (2004). Listening to speech activates motor areas involved in speech production. *Nature Neuroscience*, 7(7), 701-2.

Categorical Perception

Many distinctions between phonemes depend upon detailed timing differences in the operation of the articulators in the vocal tract. There is substantial evidence that human speech perception is pre-wired to pick up these distinctions. This suggests that acoustic factors also play a key role in the perception of speech. Surprisingly, these perceptual skills do not seem to be limited to homo sapiens.



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Readings

- *Diehl, R.L., Lotto, A.J. & Holt, L.L. (2004) Speech perception. *Annual Review of Psychology* 55, 149–79.
- Eimas, P. D., and Corbit, J. (1973). Selective adaptation of linguistic feature detectors. *Cognitive Psychology*, 4, 99–109.
- Kuhl, P. K., and Miller, J. D. (1978). Speech Perception by the Chinchilla: Identification functions for synthetic VOT stimuli. *Journal of the Acoustical Society of America*, 63, 905–917.
- *Nakisa, R. C., and Plunkett, K. (1998). Evolution of a rapidly learned representation for speech. *Language and Cognitive Processes*, 13(2,3). For a quick overview see McLeod, P., Plunkett, K., and Rolls, E. T. (1998). *Introduction to connectionist modelling of cognitive processes*. Oxford: Oxford University Press. Chapter 14 (308–313)

Acquisition

Infants demonstrate precocious speech processing abilities, which prepare them for the complex process of language acquisition. How does the capacity for speech processing change during the first year of life?

Readings

- Curtin, S. and Werker, J.F. (2007) *Perceptual Foundations of Phonological Development*. M. Gareth Gaskell, G.T.M. Altmann, P. Bloom, A. Caramazza and P. Levelt (eds). *Oxford Handbook of Psycholinguistics*. Oxford University Press (available on the web as a pre-print)
- Eimas, P. D., Siqueland, E. R., Jusczyk, P., & Vigorito, J. (1971). Speech perception in infants. *Science*, 1971, 171, 303–306.
- Eimas, P. D., Miller, J. L., and Jusczyk, P.W. (1987). On infant speech perception and the acquisition of language. In S. Harnad (Eds.), *Categorical Perception*. Cambridge: Cambridge University Press.
- *Jusczyk, P.W. (1997) *The Discovery of Spoken Language*. Cambridge, MA: MIT Press. Chapters, 3 and 4.
- *Kuhl, P.K. (2004) Early language acquisition: Cracking the speech code. *Nature Reviews Neuroscience* 5, 831–843.



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- Maye, J., Werker, J. F., & Gerken, L. A. (2002). Infant sensitivity to distributional information can affect phonetic discrimination. *Cognition*, 82(3), B101–B111.
- McMurray, B., Tanenhaus, M. K., & Aslin, R. N. (2002). Gradient effects of within-category phonetic variation on lexical access. *Cognition*, 86, B33–B42.
- Pallier, C., Christophe, A., and Mehler, J. (1997). Language-specific listening. *Trends in Cognitive Sciences*, 1(4), 129–132.
- Werker, J.F. (1995) Exploring Developmental Changes in Cross-language Speech Perception. In Gleitman, L. R., and Liberman, M. (Eds.). (1995). *An Invitation to Cognitive Science: Language (2nd ed.). (Vol. 1)*. Cambridge, MA: MIT Press. Chapter 4.
- Werker, J.F., & Tees, R.C. (1984a). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant Behavior and Development*, 7, 49-63

The following website is very helpful:

http://www.psychology.uiowa.edu/labs/maclab/speech_perception.asp



Essay Questions or Presentation Topics

1. Evaluate the current status of the Motor Theory of Speech Perception. What are its primary drawbacks?
2. What are the difficulties involved in constructing an artificial speech recognition device? Do you think these difficulties can be overcome?
3. Is the categorical perception of speech a specifically linguistic skill?
4. How do you think the initial, universal speech categories of infancy might become modified as a particular language is learned?
5. How does the motor theory explain duplex perception? Could this phenomenon be explained by the FLMP?
6. How has the development of new experimental methodologies improved our understanding of speech perception in infancy?
7. What is the relationship between coarticulation and lack of invariance?