**Neurophonetics**

1. Definitions of neurophonetics

* “Neurophonetics deals with neurogenic impairments of the motor act of speaking and of the perceptual processes of spoken language understanding, with the aim of unravelling the neural organization of speech motor control and speech perception.” (Ziegler 2008: 491)
* “Neurophonetics aims at the elucidation of the brain mechanisms underlying speech communication in our species” (Hertrich & Ackermann 2012)

1. Basics of neuroanatomy
   1. Central nervous system – Peripheral nervous system
   2. The neuron; synaptic transmission
   3. Cerebrum, cerebral cortex
   4. Left and right cerebral hemispheres (LH / RH), and some (broad) functions:
      1. LH: language, mathematics
      2. RH: visual, spatial, musical, artistic
   5. Lobes: frontal (“planning/control”), temporal (“recognition, including hearing”), parietal (“association, spatial attention”), occipital (“vision”)
   6. Primary motor and sensory areas
   7. Central sulcus; Sylvian fissure
   8. Cerebellum
   9. Basal ganglia, thalamus
   10. Limbic system, hippocampus
2. Localisation of brain functions
   1. Certain brain areas relate to certain functions (BUT ongoing questions about details)
   2. Tension between “the fact that language is rooted in a huge network across the entire brain” and “the focal nature and high specificity of certain brain areas as shown in brain imaging studies as well as in clinical linguistics and phonetics” (Hertrich & Ackermann, 2012)
   3. Techniques for investigation: lesion studies; neurosurgery; dichotic listening; neuroimaging techniques (haemodynamic – fMRI, PET; electrophysiological – EEG, MEG; diffusion tensor imaging); transcranial magnetic stimulation (TMS)
3. Functionality and disorder: Early studies
   1. Phineas Gage: frontal trauma ~ personality
   2. Oliver Sacks “The man who mistook his wife for a hat”: visual area damage ~ *prosopagnosia*
   3. Broca “Tan”: cyst above Sylvian fissure in LH (Brodmann 44, 45) ~ spoke only “tan”
   4. Wernicke: lesion at temporal-parietal-occipital junction (Brodmann 22) ~ could produce but not comprehend speech
   5. Aphasias:
      1. Broca’s (also called non-fluent; motor)

*Cookie jar …fall over…chair…water…empty*

* + 1. Wernicke’s (fluent; receptive; types: jargon, anomia)

*Well this is .... mother is away here working her work out o'here to get her better, but when she's looking, the two boys looking in other part. One their small tile into her time here. She's working another time because she's getting, too. So two boys work together and one is sneakin' around here, making his work an' his further funnas his time he had.*

* + 1. Conduction

1. Neuroimaging evidence about language processing
   1. Neural pathways for intelligible speech
      1. Scott (2000) manipulated intelligibility and phonetic content of speech separately, and identified different brain areas responding to: meaningful vs meaningless speech; different types of phonetic distortion; speech articulation
      2. concept of “what” vs “where/how” pathways (Scott & Johnsrude 2003):
   2. Lateralisation of language functions:
      1. LH dominant for language; more specifically for *intelligible* speech (Scott)
      2. RH dominant for music, environmental sounds, speaker characteristics (*phonagnosia*), some aspects of prosody, pragmatics
      3. Hemispheric processing differences according to both *form* and *function*
   3. Neural correlates of phonetic skill (Golestani et al. 2011)
      1. experience-dependent and experience-independent aspects
   4. Representation of words in the brain: as distributed, multimodal memory networks?
      1. Hebbian learning: “cells that fire together, wire together”
      2. lexical representations as “cell assemblies” distributed across the brain (Pulvermueller, 1999, 2002, 2003)
      3. Different patterns of activation for: action words vs vision words; arm words vs leg words vs face words (*pick – kick – lick*)
2. Language processing beyond the cortex
   1. Cerebellum: motor coordination, sensorimotor integration, timing. Damage > slurred speech
   2. Basal ganglia: muscular control; rhythm; interactions with cortex. Damage (e.g. Parkinson’s) > lack of coordination and facial expression; disruption to rhythm
   3. Thalamus: relays information to cortex; damage > deficits in memory, attention, reduced spontaneous speech
   4. Hippocampus: Long-term memory, language comprehension, word-generation; damage word-finding difficulties (relating to memory)

**Reading**

Kent, R. and Tjaden, (1997) Brain Functions underlying speech. In W. Hardcastle & J. Laver (eds) *The Handbook of Phonetic Sciences,* Wiley-Blackwell

(Ackermann & Ziegler 2010, in 2nd edition of *Handbook of Phonetic Sci.*, is more up-to-date, but less accessible.)

Ziegler, W. (2008) Neurophonetics. In M. Ball, M. Perkins, N. Mueller & S. Howard (eds) *The Handbook of Clinical Linguistics,* Wiley-Blackwell