Today’s Outline

- Questions about sign language…
- Last lecture
  (Review for final at 9a.m., talks start 9:30a.m.
   Talks content will be on the exam)
- Final Exam: Dec 5 (Wednesday) 2-5 p.m.
  YH B204 & B206
- The research paper
- Language Evolution
- Student presentation

Research Paper

- 10-12 pages, due next Tuesday in the beginning of class
- Literature review on 5-8 articles
- Suggest a research method for further investigation
- APA format

Theories

- Formal theories
- Functional theories
- Language and Evolution
Formal Theories

- Analysis of the abstract underlying structure of language
- Language is domain-specific, i.e., autonomous from other cognitive processes
- Universal template for grammar in our mental structure
- Linguistic input is necessary to trigger the template, but experiential impact is minimal
- Language is a set of abstract rules

Formal Theories

- Nativist approach
- Noam Chomsky
- Language Acquisition Device (LAD): an "organ" necessary for language acquisition → species-specific
- Poverty of the stimulus in children does not prevent them from acquiring language → language acquisition relies on innate mechanisms
- Universal Grammar: A set of rules governing grammar of all languages in the world
- Focus on syntax

Functional Theories

- Language in context and how language structures develop from usage (or interaction)
- Language and other cognitive domains are interrelated
- Linguistic input from social interactions → specific language structures
- Linguistic rules start as specific and contextual

Functional Theories

- Interaction approach
- Tomasello, Bruner, Halliday, (Piaget)
- Language acquisition begins as an interaction between biology (the organism) and social surroundings (nature vs. nurture??)
- Intentional use of language as a communicative tool
- Language acquisition is a consequence of accumulating cultural and social experience
An analogy

The dichotomy

Is there a converging point?

Language and Evolution

• Philip Lieberman
• Focuses on the user’s biological organ that is involved in language usage
• Brain and speech organ
• Looks into how this organ gradually evolves
• Relate language to primitive motor acts
• Draws large body of research from linguistics, anatomy, biology, (cognitive) neuroscience and evolution
Broca-Wernicke model

(a) Pronouncing a word after hearing it

- motor cortex
- arcuate fasciculus

Broca's area
primary auditory cortex

From Aphasia...

- Although clinical observations have always pointed to specific cortical regions that are the sources of aphasia, subcortical damage is often observed with these cases
- No case demonstrated a pure and isolated lesion of the Broca’s and Wernicke’s areas
- Examine the cortical-striatal-cortical circuits
- Lesion in basal ganglia results in Parkinson’s disease ➔ motoric, linguistic and cognitive deficits in behaviour

Basic Functions of Basal Ganglia

- Sequencing
  regulate motor control
  automatic routine movements
  reorder of motor actions
- Reward-based learning
  goal-directed behaviour
  internalized pools of smaller units to be ordered
  ➔ Observed to be active in motoric, linguistic and cognitive activities

Circuit models

- The brain functions as a network
- Deficit in one brain area results in behavioural syndrome

http://www.benbest.com/science/anatmind/anatmd2.html
When lesion is in subcortical areas...

- **Speech**
  - Broca’s aphasics can’t put /b/ and /p/ in the correct sequence
- **Syntax**
  - Skip abstract function words in sentences
  - Comprehending syntactical complicated sentences
- **Motor and Cognitive set-shifting**
  - Cognitive perseveration

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**Family KE**

- Dyslexic family
- Fail to handle regular past tense and plural nouns
- Speech and orofacial movement problems, more general linguistic and cognitive problems
- Problems are similar to sequencing deficits
- Smaller bilateral caudate nuclei

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**General Functions of Basal Ganglia**

- Reward-based learning
- Sequencing units that constitute a motor or cognitive “pattern generator”
- Make “online” changes to currently active motor acts – based on knowledge and external triggers

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**Evolution of Brain and Language**

- Language is complex and no single factor can explain language
- Human nature changes from generation to generation → look at our ancestors
- Prerequisites
  - Identify primitive characteristics shared by modern and ancestral species
  - Lexical ability
  - Syntax: evolution of Cortical-striatal circuits
- Brain size: human > chimpanzee
Language and Evolution

- Speech: specifically human
  Other species may also produce language, but their vocal ability is not as flexible. Also, human vocal signal ranges more than other species
- Selective advantages of human speech
  Efficient communication: speech rate
  Human anatomy and physiology makes sound as an effective meaning-encoding medium

Language and Evolution

- The supralaryngeal vocal tract
  Originally used for eating, swallowing, and breathing
  Accommodates for speech production as well

Language and Evolution

- Grammar as product of the pattern generator?
- Similar syntax between motor control and language
- Relation to walking?
- Sequencing is involved in many different activities. Recruitment of basal ganglia is observed in other species (without language)
- Speech and human evolve together as adaptation to environment

A proposal

- Cortical-striatal-cortical projection
  Experience?
  Functional?
  Innate pattern generator?
  Formal?