

# CGL 150 SUBCORTICAL BRAIN BASES OF LANGUAGE AND THOUGHT -- 2007

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Some of the "creative" aspects of human behavior that differentiate us from apes appear to derive from neural circuits linking cortical regions and subcortical structures. Some aspects of these circuits are species specific to humans, perhaps explaining some aspects of why we differ from apes and archaic, extinct hominid species. The material bears on current debates concerning the specificity of the neural bases of human language, particularly the argument made by Hauser, Chomsky and Fitch, that a language specific "faculty" confers the recursive property that marks human language.

We will review the findings of primary research papers that suggest that subcortical basal ganglia structures, which can be traced back to frogs, are key elements of neural circuits regulating language. The traditional Broca-Wernicke "language area" theory is, at best, incomplete. The basal ganglia function as a "sequencing engine", allowing humans to speak and to create new patterns of thought and to create a potentially limitless number of novel sentences by permuting ("reiterating") a finite number of words and syntactic processes. Cognitive flexibility also derives from these neural circuits. Recent findings have identified FOXP2, a regulatory gene that governs the neural expression of the striatal components of these circuits. The human form of FOXP2 differs from that of chimpanzees by two mutations, that were subjected to intense selection about the period associated with the evolution of modern humans, sometime after 200,000 years ago. Other circuits involving cortex and the hippocampus appear to be critical in consolidating and retrieving memories and the information coded by words in the brain's dictionary. The behavioral deficits of hypoxia (which we study on Mount Everest), and neurodegenerative diseases such as Parkinson's and Alzheimer's involve damage to the subcortical components of these neural circuits.

The material on ORCA will include current studies that bear on nature of these circuits and their evolution. We will focus on the basal ganglia; the contributions of the cerebellum and the hippocampus will also be noted. Comparative studies of the brains of other species will be integrated with the data of human "experiments-in-nature" which explore the behavioral consequences of trauma, disease, or genetic anomalies involving basal ganglia and other subcortical structures. The findings of studies using imaging techniques allow insights on cortical and subcortical activity in neurologically intact human subjects. These studies will be integrated with material from Lieberman (2000), *"Human language and our reptilian brain: The subcortical bases of speech syntax, and thought."*

The course will meet twice each week Tuesday and Thursday between 1 and 2:20 PM. The text and several papers will be the focus of discussion each week. Course credit will be based on participation in these discussions, a midterm examination, final examination and a relatively short term paper.

Text:

Lieberman, P. 2000. "Human language and our reptilian brain: The subcortical bases of speech, syntax, and thought." Cambridge MA: Harvard University Press. (2002 Paperback Edition)

The primary research papers that will be discussed are noted below. Additional papers will be added as the course progresses to meet the suggestions of participants.



## CG0150: Subcortical Brain Bases of Language and Thought (Spring 2007)

Date Due/ Sequence	Citation	E-Reserve
01	Cummings, J L FRONTAL-SUBCORTICAL CIRCUITS AND HUMAN BEHAVIOR, <i>Archives Of Neurology</i> 50 1993-00-00: p.873-880	<a href="#">PDF</a>
02	Kotz, Sonja A ON THE LATERALIZATION OF EMOTIONAL PROSODY:AN EVENT- RELATED FUNCTIONAL MR INVESTIGATION, <i>Brain And Language</i> 86 2003-00-00: p.366-376	<a href="#">LINK</a>
03	Just BRAIN ACTIVATION MODULATED BY SENTENCE COMPREHENSION, <i>Science</i> 274 1996-00-00: p.114-116	<a href="#">LINK</a>
04	Alexander, Michael P CORRELATIONS OF SUBCORTICAL CT LESION SITES AND APHASIA PROFILES, <i>Brain</i> 110 1987-00-00: p.961-991	<a href="#">PDF</a>
05	Marsden C. D., J. A. Obeso THE FUNCTIONS OF THE BASAL GANGLIA AND THE PARADOX OF STEROTAXIC SURGERY IN PARKINSON, <i>Brain</i> 117 1994-00-00: p.877-897	<a href="#">PDF</a>
06	Aldridge, J W NEURONAL CODING OF SERIAL ORDER: SYNTAX OF GROOMING INTHE NEOSTRIATUM, <i>Psychological Science</i> 4(6) 1993-11-00: p.391- 395	<a href="#">PDF</a>
07	Cunnington, Ross MOVEMENT-RELATED POTENTIALS IN PARKINSON, <i>Brain</i> 118 1995-00-00: p.935-950	<a href="#">PDF</a>
08	Middleton ANATOMICAL EVIDENCE FOR CEREBELLAR AND BASAL GANGLIA INVOLVEMENT IN HIGHER COGNITION, <i>Science</i> 266 1994-00-00: p.458-461	<a href="#">LINK</a>

09	Kimura, M ROLE OF BASAL GANGLIA IN THE ACQUISITION AND INITIATION OF LEARNED MOVEMENT, IN: <i>Role Of The Cerebellum And Basal Ganglia In Voluntary Movement</i> 1993: p.83-87	<a href="#">PDF</a>
10	Mirencwicz PREFERENTIAL ACTIVATION OF MIDBRAIN DOPAMINE NEURONS BY APPETITIVE RATHER THAN AVERSIVE STIMULI, <i>Nature</i> 379 1996-00-00: p.449-451	<a href="#">LINK</a>
11	Monchi, O WISCONSIN CARD SORTING REVISITED, <i>Journal Of Neuroscience</i> 21 2001-00-00: p.7733-7741	<a href="#">LINK</a>
12	Scott GLOBAL ATTENTIONAL EXECUTIVE SEQUELAE FOLLOWING SURGICAL LESIONS TO GLOBUS PALLIDUS INTERNA, <i>Brain</i> 125 2002-00-00: p.562-574	<a href="#">LINK</a>
12	Tettamani, Marco BASAL GANGLIA AND LANGUAGE: PHONOLOGY MODULATES DOPAMINERGIC RELEASE, <i>Brain Imaging</i> 16(4) 2006-03-00: p.397-401	pending
13	Pickett SELECTIVE SPEECH MOTOR, SYNTAX AND COGNITIVE DEFICITS ASSOCIATED WITH BILATERAL DAMAGE TO THE HEAD OF THE CAUDATE NUCLEUS AND PUTAMEN: A SINGLE CASE STUDY, <i>Neuropsychologia</i> 36 1998-00-00: p.173-188	<a href="#">LINK</a>
14	Harrington, Deborah L SEQUENCING IN PARKINSON, <i>Brain</i> 114 1991-00-00: p.99-115	<a href="#">PDF</a>
15	Illes, J LANGUAGE PRODUCTION IN PARKINSON, <i>Brain And Language</i> 33 1988-00-00: p.146-160	pending
16	Lieberman, Philip SPEECH PRODUCTION, SYNTAX COMPREHENSION, AND COGNITIVE DEFICITS IN PARKINSON, <i>Brain And Language</i> 43 1992-00-00: p.169-189	<a href="#">PDF</a> <a href="#">PDF</a>
17	Grossman, M SENTENCE COMPREHENSION AND PRAXIS DEFICITS IN PARKINSON, <i>Neurology</i> 41 1991-10-00: p.1621-1628	<a href="#">PDF</a>
18	Flowers, K A THE EFFECT OF PARKINSON, <i>Journal Of Neurology, Neurosurgery, And Psychiatry</i> 48 1985-00-00: p.517-529	<a href="#">PDF</a>
19	Lange, K W L-DOPA WITHDRAWAL IN PARKINSON, <i>Psychopharmacology</i> 1991-09-06	<a href="#">PDF</a>
20	Owren SPATIAL AND NON-SPATIAL WORKING MEMORY AT DIFFERENT STAGES OF PARKINSON, <i>Neuropsychologia</i> 38 1997-00-00: p.519-531	<a href="#">LINK</a>
21	Lieberman, Philip	

	ON THE NATURE AND EVOLUTION OF THE NEURAL BASES OF HUMAN LANGUAGE, <i>American Journal Of Physical Anthropology</i> 45 2002-00-00: p.36-6	<a href="#">LINK</a>
22	Lieberman, Philip MOUNT EVEREST: A SPACE-ANALOGUE FOR SPEECH MONITORING OF COGNITIVE DEFICITS AND STRESS, <i>Aviation, Space And Environmental Medicine</i> 76 2005-00-00: p.198-207	<a href="#">PDF</a>
23	Swaminath, Pazhayannur V PARKINSINISM AND PERSONALITY CHANGES FOLLOWING AN ACUTE HYPOXIC INSULT DURING MOUNTAINEERING, <i>Movement Disorders</i> 21 2006-05-12: p.1296-1297	<a href="#">LINK</a>
24	Yonelinas EFFECTS OF EXTENSIVE TEMPORAL LOBE DAMAGE OR MILD HYPOXIA ON RECOLLECTION AND FAMILIARITY, <i>Nature Neuroscience</i> 5 2002-00-00: p.1236-1241	<a href="#">LINK</a>
25	Vargha-Khadem NEURAL BASIS OF AN INHERITED SPEECH AND LANGUAGE DISORDER, <i>Proceedings Of The National Academy Of Sciences</i> 95 1998-00-00: p.2695-2700	<a href="#">LINK</a>
26	Watkins MRI ANALYSIS OF AN INHERITED SPEECH AND LANGUAGE DISORDER: STRUCTURAL BRAIN ABNORMALITIES, <i>Brain</i> 2002-00-00: p.465-478	<a href="#">LINK</a>
27	Enard MOLECULAR EVOLUTION OF A GENE INVOLVED IN SPEECH AND LANGUAGE, <i>Nature</i> 418 2002-00-00: p.869-872	<a href="#">LINK</a>
28	Lai FOXP2 EXPRESSION DURING BRAIN DEVELOPMENT COINCIDES WITH ADULT SITES OF PATHOLOGY IN A SEVERE SPEECH AND LANGUAGE DISORDER, <i>Brain</i> 126 2003-00-00: p.2455-2462	<a href="#">LINK</a>
29	Fisher, Simon E TANGLED WEBS; TRACING THE CONNECTIOS BETWEEN GENES AND COGNITION, <i>Cognition</i> 101 2006-00-00: p.270-297	<a href="#">LINK</a>
30	Lieberman, Philip THE EVOLUTION OF HUMAN SPEECH: ITS ANATOMICAL AND NEURAL BASES, <i>Current Anthropology</i> 48 2007-00-00: p.39-66	<a href="#">LINK</a>