Spring Semester 2013

Neural Plasticity

NSC 4371

Meeting time: Monday and Wednesday 8:30-9:45 am **Meeting Place:** GR4.301

Instructor: **Dr. Michael P. Kilgard**
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Office hours: Wednesday 2-3 pm
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Course Description

This course will review the basic principles of neural plasticity with special emphasis on cortical plasticity related to development, recovery from injury and learning.

Lectures will provide students with the appropriate background for each topic, and discussions will explore classic and modern primary papers. Workload will consist of readings, class presentations, class participation, and weekly written critiques.

This first aim of the course is to provide a detailed and up-to-date understanding of the concepts and methods involved in a well-studied aspect of brain function: plasticity. The focused nature of this course will be a useful supplement to a general education of brain function based on surveys of many fields. Because similar plasticity principles apply throughout the brain the detailed description of cortical plasticity provided by this course will serve as a conceptual starting point for thinking about other brain regions. An additional aim of this course is to relate the discussed concepts to clinically relevant issues. This course assumes only a general understanding of basic neuroscience principles and will be useful to students interested in neuroscience, communication disorders, cognitive science, developmental psychology, biology, computer science, or neural networks. It is recommended that students have taken Cellular Neuroscience and Integrative Neuroscience.

Material Discussed

Concepts:

- Developmental plasticity
- Pathological plasticity
- Plasticity induced by peripheral injury
- Plasticity induced by central injury

Techniques/Approaches:

- Psychophysics
- Neurophysiology
- Functional imaging (MEG, fMRI, PET)
- Neuroethology

- Sensory deprivation
- Rehabilitation

Course Requirements

All assigned readings must be completed before each class.

Critiques – 20% of final grade.

Each week you will need to email a concise, thoughtful critique of one of the papers for discussion. Support your conclusions using concrete evidence and quotations, not merely your opinion. The following outline is suggested: (1) Summarize the key take-home message(s) of the paper. (2) Place the paper in context within the literature we have covered in class. What central problems does it address? How does it differ from other work we studied? How does it advance the field? (3) If necessary, critique the methods and conclusions. Are there any flaws in technique or logic? Are the experiments or conclusions believable? (4) Discuss the paper in terms of key concepts we have covered in class. (5) Describe open questions and suggest additional work. Critique assignments should be about a page long and should be on the primary research papers not the review articles.

Individual class participation – 50% of final grade

- Raise questions about unfamiliar or interesting terms and concepts.
- Actively discuss readings, critiques, and scientific issues, in class.
- Students will be called on in a pseudorandom fashion to explain the introduction, methods, figures, and discussion section of each paper.
- Letter grades will be assigned for every explanation.
    1. A for an clear and complete explanation
    2. B for an adequate explanation (i.e. missing 1 or 2 minor issues)
    3. C for a poor explanation (i.e. missing the key concepts)
    4. D/F for a completely wrong explanation or unexcused absence
- Discussion of papers and concepts with classmates outside of class is strongly encouraged.

In class presentation – 20% of final grade.

Attendance – 10% of final grade

Objectives

On completion of this course, students should be able to:

- Pick up a primary research article related to neural plasticity and understand the major new findings.
- Place new findings within the historical context of previous experiments.
- Critically evaluate the logic of experimental design.
- Effectively use library and internet resources to answer their own questions and expand on material presented in the introduction of the paper.
- Lead a coherent discussion of primary research articles.

Reading list (and chapters/papers for discussion)**:**

1-14 Course Introduction and advice on how to read neuroscience papers

1-16 Chapter 56 Principles of Neural Science – Developmental Plasticity

1-23 Chapter 63 Principles of Neural Science – Adult Plasticity

1-28 Plasticity of ocular dominance columns in monkey striate cortex. 1977 (986 citations)

1-30 Plasticity of ocular dominance columns in monkey striate cortex. 1977 (986 citations)

2-4 Topographic reorganization of somatosensory cortical areas 3b and 1 in adult monkeys following restricted deafferentation 1983 (575 citations)

2-6 Somatosensory cortical map changes following digit amputation in adult monkeys 1984 (767 citations)

Optional review article Plasticity of Sensory and Motor Maps in Adult Mammals 1991 (623 citations)

2-11 Modulation of visual cortical plasticity by acetylcholine and noradrenaline 1986 (572 citations)

2-13 Student Presentations

2-18 Rapid Reorganization of Adult Rat Motor Cortex Somatic Representation Patterns after Motor Nerve Injury 1988 (147 citations)

2-20 Classical conditioning induces CS-specific receptive field plasticity in the auditory cortex of the guinea pig 1990 (216 citations)

2-25 Plasticity in the frequency representation of primary auditory cortex following discrimination training in adult owl monkeys 1993 (717 citations)

2-27 Dependence of cortical plasticity on correlated activity of single neurons and on behavioral context 1992 (304 citations)

3-4 Functional MRI evidence for adult motor cortex plasticity during motor skill learning 1995 (924 citations)

3-6 Student Presentations

3-18 Cortical Map Reorganization Enabled by Nucleus Basalis Activity 1998 (588 citations)

3-20 Sleep Enhances Plasticity in the Developing Visual Cortex 2001 (196 citations)

3-25 Student Presentations

3-27 Pharmacological Modulation of Perceptual Learning and Associated Cortical Reorganization 2003 (120 citations)

4-1 The Basal Forebrain Cholinergic System Is Essential for Cortical Plasticity and Functional Recovery 2005 (61 citations)

4-3 Student Presentations

4-8 A synaptic memory trace for cortical receptive field plasticity 2007 (62 citations)

4-10 Neuromodulators Control the Polarity of Spike-Timing-Dependent Synaptic Plasticity 2007 (63 citations)

4-15 The Antidepressant Fluoxetine Restores Plasticity in the Adult Visual Cortex 2008 (80 citations)

4-17 Developmentally degraded cortical temporal processing restored by training 2009 (10 citations)

4-22 ***Paper to be determined***

4-24 ***Paper to be determined***

4-29 Reversing Pathological Neural Activity Using Targeted Plasticity, 2011 (see also link)

5-1 Group Discussion

Any schedule changes will be posted at: www.utdallas.edu/~kilgard/PlasticitySP13.htm

Student Conduct & Discipline The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

Email Use The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Withdrawal from Class The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

Student Grievance Procedures Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*. In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

Incomplete Grade Policy As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

Disability Services The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to

5:30 p.m. The contact information for the Office of Disability Services is: The University of Texas at Dallas, SU 22 PO Box 830688 Richardson, Texas 75083-0688 (972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

Religious Holy Days The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

These descriptions and timelines are subject to change at the discretion of the Professor.