PSY 621 Clinical Psychobiology: Stress Neurobiology and Prevention Science

Instructor: Philip Fisher, Ph.D.
Office: 346-4868, philf@uoregon.edu
Time: Tuesdays 9:00 -11:50
Location: Straub 143
Office Hours: By appointment (contact kyndalh@uoregon.edu)
Office Location: LISB 427

Course Overview:

Research in prevention science is increasingly embracing the methods of developmental neuroscience to address the needs of vulnerable populations. These integrative or "translational" approaches may have a number of complementary goals, including (1) characterizing the vulnerabilities of high-risk populations with greater precision than previously possible, (2) identifying sensitive periods when interventions are most likely to be effective, (3) specifying individuals who are more or less likely to respond to preventive interventions (and why), (4) identifying "biomarkers" that can be used to assess the effects of interventions, and (5) answering larger questions about the limits of neural plasticity over the course of development for children growing up in adverse conditions that include such challenges as poverty, trauma, and maltreatment.

Research that focuses on the effects of adverse childhood experiences on the developing brain (referred to as stress neurobiology) is particularly germane to work in this area. Basic science investigations in this area, involving humans, as well as non-human primates and other animal models has been ongoing for over half a century. Moreover prevention science, which seeks to improve the life-course trajectories of high-risk individuals has been around since the early 1980s. However, the integration of stress neurobiology and prevention science is relatively new—most of it has been conducted within the past decade. This work originally concentrated primarily on neuroendocrine systems and brain regions known to be affected in individuals with PTSD and other forms of extreme stress (e.g., hippocampus, amygdala). More recently, great interest has centered on regions of the prefrontal cortex involved in executive functioning as well as limbic reward circuitry (e.g. VTA, ventral striatum) and other subcortical limbic systems (e.g. amygdala). Emerging methods of neuroimaging are allowing for assessment not only of regions of interest but also of the connections among these focal neural systems.

This course has the overarching goal of providing advanced doctoral students with an overview of the neural systems that are the focus of research in stress neurobiology, and considering how measures of these systems can be applied to prevention research. We will cover how stress has been defined and operationalized in psychology—an area that has been a subject of controversy for decades. We will review the anatomy and function of some (but definitely not all!) stress regulatory neural systems. We will consider how knowledge of these systems can inform prevention research designs. Finally, we will consider the implications of this work for public policy related to vulnerable children and families.

The course presupposes no prior in-depth study of neurobiology. However, because there is likely be a good deal of variation among students in how much prior exposure they have had to brain science, I have designed some **extra credit** assignments (important for those with little or no prior experience, hopefully fun and interesting for those with experience). These assignments should help get all students on the same page, and I think it is the best way for us to create a group learning experience that will prove most optimal for all. *If this is your first exposure to neurobiology and you do not complete the extra assignments, I suspect that you will get much less out of the course (but I leave that up to you!).*

Course objectives:

1. Understand and be able to discuss contemporary conceptualizations of stress as they relate to populations that are the focus of current prevention science research.

2. Understand the structure and function *(and dysfunction)* of key stress regulatory neural systems, and have the ability to investigate and learn about new areas relevant to your future research.

3. Become familiar with the research methodology and measures employed to assess functioning in these neural systems, and be able to articulate the advantages and disadvantages of assessment different approaches.

4. Understand the benefits and limits of incorporating stress neurobiology concepts and measures into prevention research.

5. Use your knowledge of psychological theory and science to critically evaluate the research in stress neurobiology and prevention. We will focus on advanced research methodology in our class discussions of empirical articles that comprise the assigned readings.

6. Be able to competently debate either side of a controversial topic in this area.

7. Develop skills to work with colleagues on an NIH format research proposal in this area.

Format:

We will begin each class meeting with a lecture/presentation. The lecture portion of the class each week will last approximately 80 minutes, followed by a brief break. The second half of each class meeting will comprise "learn by doing" group activities. Students will be assigned to groups at the first meeting of the term, and each group's composition will remain the same for the duration of the term. There will be 3 types of group activities:

1. Discussion groups (4X during the term): The purpose of discussion groups is to involve you actively in learning about, presenting, and critiquing studies that are typical of research in this area. Each discussion group will consist of 3-4 students, and there are a number of readings on the syllabus (below) for each the discussion group meetings from which you may choose. Students are expected to read all the readings that their group members have selected for that week in advance of the class meeting. In addition, every discussion group each student will take primary responsibility for one reading for their group. Students will create an outline of their assigned reading (1 page) and bring copies of this to class (one for each member of their group and 1 copy for me). The outline should include 2 discussion questions that you will use to guide the discussion of the article in your group. You should plan for the discussion of each article to take 20 minutes; however I am flexible! If your group decides in advance that you want to devote more time to one of the articles *and you notify me of this before the class meeting,* I am fine with some readings taking up more of the discussion than others. In the absence of this advance notice, you will be responsible as a group for making sure you have sufficient time to discuss all readings. I will "visit" with one or more of the groups each week, and also be available to answer questions from any group. NOTE: The topics for the discussion group readings are often different from the lecture topics for that week).

2. Debates: , Week 7 of the term we will have a debate tournament on controversial topics in stress neurobiology and prevention science. The debate tournament will consist of 3 debate rounds. Debate teams will be the same composition as discussion groups. Class time will be devoted week 3 of the term to providing information about the debate topics, the structure and format of debates, the procedures for the tournament, and criteria for judging; there will also be time in week 3 for beginning to prep for the debates. The winning team will receive a fabulous prize!

3. Collaborative grant workshop: The purpose of this course component is to provide students with experience working with colleagues to develop and write an NIH R21 grant proposal on a topic of relevance to the course content. *Each group will produce a single grant application.* We will spend one class period (week 5) discussing the content of grant applications and review criteria, and beginning to formulate ideas. Completed grant applications will be turned in on or before week 8 of the class. Week 9 will consists of a mock grant review.

Requirements:

1. Attendance: This is a doctoral level class. Attendance is mandatory. Do not turn in reading outlines unless you attend class.

2. Class participation: All students are expected to participate fully in class discussion.

3. Assignments: Assignments include written outlines for discussion group, debate performance, and the grant application.

Grading:

Readings outlines:	5 points each	X 4 =	20 points
Debate performance:			30 points
Grant application:			50 points
Total points:			**100**

90-100 – A, 80-89 – B, 70-79 – C, 60-69 – D, below 60 – F

Extra Credit:

There are three opportunities for extra credit. You may take advantage of any or all of these, but they should not be used in place of required assignments. Extra credit assignments must be turned in no later than the beginning of the last class meeting. As noted above, those with little or no experience with neurobiology may find the course content more accessible if they complete these assignments, They are as follows:

1. You may complete the coloring packet from *The Human Brain Coloring Book* that is in the course Extra Credit folder on Blackboard. I especially recommend this for students with less knowledge of neurobiology. You will receive 5 points for completing the packet. 1 extra point if your coloring is especially artistic!

2. Also for those wanting/needing more supplemental material, there are a number of chapters from Nelson and Luciana's text, *Handbook of Developmental Cognitive Neuroscience* (a book I strongly encourage you to purchase!) on Blackboard in the Supplemental Readings folder for the course. These include chapters about the development of key neural regions and the methods employed in stress neurobiology research. You can receive 2 points for each chapter outline (1 page) you submit.

3. You may read and complete a 3 page review of Robert Sapolsky's book *Why Zebra's Don't Get Ulcers.* This is a non-fiction book for the general public that synopsizes the field of stress neurobiology in a very interesting and engaging manner. You will receive up to 5 points for the book review.

Support for students:

If you have a documented disability and anticipate needing accomodations in this course please make an appointment with the instructor during the first week of the term. Please request that the Counselor for Students with Disabilities send a letter verifying your disability. Disabilities include (but are not limited to) neurological impairment, orthopedic impairment, traumatic brain injury, visual impairment, chronic medical conditions, emotional/psychological disabilities, hearing impairment, and learning

disabilities. The University of Oregon is an equal-opportunity, affirmative-action institution committed to cultural diversity and compliance with the Americans with Disabilities Act.

Class Meeting Dates, Topics, and Readings

A note about the readings: *Lecture readings* are designed to be supplemental, and to provide background information on specific topics. They also should be good references for your future work. My strong recommendation is that you at a minimum look over the lecture readings each week, as the lectures will contain information from them. On weeks when we are having discussion groups, additional readings will be listed from which each group member will choose one article to present. I have posted lecture topic readings on the Blackboard course website. Group discussion readings should be obtained via the UO library PsychInfo database website or on the websites listed on the syllabus.

Week 1, April 2

Organizational Meeting

Week 2, April 9

Lecture topic: Stress definitions/early adversity

Lecture Readings

Levine, S (2003). Stress: An Historical Perspective. In T. Steckler, N. Kalin & J. M. H. M. Reul (Eds.), *Handbook on Stress, Immunology and Behavior,* (pp. 3-23)

Fox, S.E., Levitt, P., & Nelson, C.A. (2010). How the Timing and Quality of Early Experiences Influence the Development of Brain Architecture, *Child Development, 81*, 28-40.

Discussion group topic: stress and early adversity

Discussion Group Readings

Anda, R. F., Butchart, A., Felitti, V. J., & Brown, D. W. (2010). Building a framework for global surveillance of the public health implications of adverse childhood experiences. *American Journal of Preventive Medicine, 39*(1), 93-98.

Anda, R. F., Felitti, V. J., Bremner, J. D., Walker, J. D., Whitfield, C., Perry, B. D., . . . Giles, W. H. (2006). The enduring effects of abuse and related adverse experiences in childhood: A convergence of evidence from neurobiology and epidemiology. *European Archives of Psychiatry and Clinical Neuroscience, 256*(3), 174-186

Ellis, B. J., Jackson, J. J., & Boyce, W. T. (2006). The stress response systems: Universality and adaptive individual differences. *Developmental Review, 26*(2), 175-212.

Korte, S. M., Koolhaas, J. M., Wingfield, J. C., & McEwen, B. S. (2005). The Darwinian concept of stress: Benefits of allostasis and costs of allostatic load and the trade-offs in health and disease. *Neuroscience and Biobehavioral Reviews, 29*(1), 3-38.

Pollak, S.D. et al. (2010). Neurodevelopmental effects of early deprivation in postinstituionalized children. *Child Development, 81,* 224-237.

Shonkoff, J.P. et al. (2009). Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities: Building a New Framework for Health Promotion and Disease Prevention. *JAMA. 301*, 2252-2259.

Week 3, Apr 16

Lecture topic: Hypothalamic-Pituitary-Adrenal (HPA) Axis

Lecture Readings

Joëls M. & Baram T.Z. (2009) The neuro-symphony of stress. *Nat Rev Neurosci*, *10*, 459-66

Gunnar, M.R. & Vazquez, D. (2001). Low cortisol and a flattening of expected daytime rhythm: Potential indices of risk in human development. *Development and Psychopathology, 13*, 515-538.

Cone, R. D., Low, M. L., Elmquist, J. K., & Cameron, J. (2003). Neuroendocrinology. In P. R. Larsen, H. M. Kronenberg, S. Melmed, K. S. Polonsky & W. B. Saunders (Eds.), *William's Textbook of Endocrinology* (10th ed.). NOTE: READ ONLY pgs: 81-87; 95-98; 105-112.

Schreier, A., & Evans, G. W. (2003). Adrenal cortical response of young children to modern and ancient stressors. *Current Anthropology, 44*(2), 306-309.

Week 4, Apr 23

Lecture topic: Adolescent Risk Taking *(Guest Lecture by Jenn Pfeifer or Shannon Peake)*

Lecture Readings
TBA

Discussion group topic: Epigenetics of Early Adversity

Discussion group readings

Tyrka, A. R., Price, L. H., Marsit, C., Walters, O. C., & Carpenter, *L. L. (2012). Childhood adversity and epigenetic modulation of the leukocyte glucocorticoid receptor: Preliminary findings in healthy adults. PLoS ONE, 7*(1).

McCrory, E., De Brito, S. A., & Viding, E. (2010). Research review: The neurobiology and genetics of maltreatment and adversity. *Journal of Child Psychology and Psychiatry, 51*(10), 1079-1095.

Roth, T. L., Lubin, F. D., Funk, A. J., & Sweatt, J. D. (2009). Lasting epigenetic influence of early-life adversity on the BDNF gene. *Biological Psychiatry, 65*(9), 760-769.

Essex, M. J., Boyce, W. T., Hertzman, C., Lam, L. L., Armstrong, J. M., Neumann, S. M. A., & Kobor, M. S. (2013). Epigenetic vestiges of early developmental adversity: Childhood stress exposure and DNA methylation in adolescence. *Child Development, 84*(1), 58-75.

Bick, J., Naumova, O., Hunter, S., Barbot, B., Lee, M., Luthar, S. S., . . . Grigorenko, E. L. (2012). Childhood adversity and DNA methylation of genes involved in the hypothalamus–pituitary–adrenal axis and immune system: Whole-genome and candidate-gene associations. *Development and Psychopathology, 24*(4), 1417-1425.

McEwen, B. S. (2012). Brain on stress: How the social environment gets under the skin. *PNAS Proceedings of the National Academy of Sciences of the United States of America, 109*(Suppl 2), 17180-17185.

Labonté, B., Suderman, M., Maussion, G., Navaro, L., Yerko, V., Mahar, I., . . . Turecki, G. (2012). Genome-wide epigenetic regulation by early-life trauma. *JAMA Psychiatry, 69*(7), 722-731.

Kinnally, E. L., Feinberg, C., Kim, D., Ferguson, K., Leibel, R., Coplan, J. D., & Mann, J. J. (2011). DNA methylation as a risk factor in the effects of early life stress. *Brain, Behavior, and Immunity, 25*(8), 1548-1553.

Week 5, Apr 30

Lecture Topic: Executive Functioning and Brain Training

Lecture Readings

Benes, F.M. (2001). The development of prefrontal cortex: The maturation of neurotransmitter systems and their interactions. In Charles A. Nelson & Monica Luciana (Eds)., *Handbook of Developmental Cognitive Neuroscience* (pp. 79-92). Cambridge, MA, MIT Press.

Bryck, R. L., & Fisher, P. A. (2012). Training the brain: Practical applications of neural plasticity from the intersection of cognitive neuroscience, developmental psychology, and prevention science. *American Psychologist, 67*(2), 87-100.

Center on the Developing Child at Harvard University (2011). *Building the Brain's "Air Traffic Control" System: How Early Experiences Shape the Development of Executive Function: Working Paper No. 11*. Retrieved from www.developingchild.harvard.edu

Durston S. et al., (2002). A neural basis for the development of inhibitory control. *Developmental Science, 54,* F9-F16

Week 6, May 7

Lecture Topic: The built environment: Effects and Interventions

Lecture Readings

Evans, G. W., & Kim, P. (2007). Childhood poverty and health: Cumulative risk exposure and stress dysregulation. *Psychological Science, 18*(11), 953-957. doi:

Evans, G. W., Lercher, P., Meis, M., Ising, H., & Kofler, W. W. (2001). Community noise exposure and stress in children. *Journal of the Acoustical Society of America, 109*(3), 1023-1027.

Evans, G. & Kim P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives, 7,* 43-48.

Ludwig, J., Sanbonmatsu, L., Gennetian, L., Adam, E., Duncan, G. J., Katz, L. F., . . . McDade, T. W. (2011). Neighborhoods, obesity, and diabetes: A randomized social experiment. *The New England Journal of Medicine, 365*(16), 1509-1519.

Matthews, S. A., & Yang, T.-C. (2010). Exploring the role of the built and social neighborhood environment in moderating stress and health. *Annals of Behavioral Medicine, 39*(2), 170-183.

Discussion group topic: Prenatal ATOD Effects and Interventions

Discussion Group Readings

Coles, C. D., & Li, Z. (2011). Functional neuroimaging in the examination of effects of prenatal alcohol exposure. *Neuropsychology Review, 21*(2), 119-132.

Fisher, P. A., Lester, B. M., DeGarmo, D. S., Lagasse, L. L., Lin, H., Shankaran, S., . . . Higgins, R. (2011). The combined effects of prenatal drug exposure and early adversity on neurobehavioral disinhibition in childhood and adolescence. *Development and Psychopathology, 23*(3), 777-788.

Lebel, C., Roussotte, F., & Sowell, E. R. (2011). Imaging the impact of prenatal alcohol exposure on the structure of the developing human brain. *Neuropsychology Review, 21*(2), 102-118

Lester, B. M., Lin, H., DeGarmo, D. S., Fisher, P. A., LaGasse, L. L., Levine, T. P., . . . Higgins, R. D. (2012). Neurobehavioral disinhibition predicts initiation of substance use in children with prenatal cocaine exposure. *Drug and Alcohol Dependence, 126*(1-2), 80-86.

Monk, B. R., Leslie, F. M., & Thomas, J. D. (2012). The effects of perinatal choline supplementation on hippocampal cholinergic development in rats exposed to alcohol during the brain growth spurt. *Hippocampus, 22*(8), 1750-1757.

Thomas, J. D., Abou, E. J., & Dominguez, H. D. (2009). Prenatal choline supplementation mitigates the adverse effects of prenatal alcohol exposure on development in rats. *Neurotoxicology and Teratology, 31*(5), 303-311.

Week 7, May 14

Lecture Topic; Stress, immune function, and health in developing countries *(Guest Lecture by Josh Snodgrass)*

Lecture Readings:

http://www.pinniped.net/McDadebiomarkers.pdf

http://www.pinniped.net/mcdade2012.pdf

http://www.pinniped.net/mcclure2010jbs.pdf

Discussion group topic: SNAP Policy

Discussion group readings:

Fishbein, D. (2000). The Importance of Neurobiological Research to the Prevention of Psychopathology. *Prevention Science, 1,* 89-106.

Gunnar, M. R., Fisher, P. A., & The Early Experience, Stress, and Prevention Science Network. (2006). Bringing basic research on early experience and stress neurobiology to bear on preventive intervention research on neglected and maltreated children. *Development and Psychopathology, 18*, 651-677.

Shonkoff, J. (2010). Building a New Biodevelopmental Framework to Guide the Future of Early Childhood Policy, *Child Development, 81*, 357-367.

Shonkoff, J. P., & Bales, S. N. (2011). Science does not speak for itself: Translating child development research for the public and its policymakers. *Child Development, 82*(1), 17-32.

Shonkoff, J. & Fisher, P.A. (in press). Rethinking evidence-based practice and two-generation programs to create the future of early childhood policy. *Development and Psychopathology.*

Or any of the following: Center on the Developing Child at Harvard University *Working Papers No. 1-12*. Retrieved from www.developingchild.harvard.edu

Week 8, May 21

Lecture Topic: Baby Stress and Amygdala Connectivity *(Guest Lecture by Alice Graham)*

Lecture Readings

Blasi, A. et al., (2011). Early Specialization for Voice and Emotion Processing in the Infant Brain. *Current Biology* 21, 1–5.

Fox, M.D. & Raichle, M.E. (2007). Spontaneous fluctuations in brain activity observed with functional magnetic resonance imaging. *Nature Reviews Neuroscience. 8,* 700-711.

Gao, W., Zhu, H., Giovanello, K. S., Smith, J. K., Shen, D., Gilmore, J. H., & Lin, W. (2009). Evidence on the emergence of the brain's default network from 2-week-old to 2-year-old healthy pediatric subjects. *PNAS Proceedings of the National Academy of Sciences of the United States of America, 106*(16), 6790-6795

Week 9, May 28

Lecture Topic: Stress and the Obesity Epidemic

Lecture Readings

Evans, G. W., Jones-Rounds, M. L., Belojevic, G., & Vermeylen, F. (2012). Family income and childhood obesity in eight European cities: The mediating roles of neighborhood characteristics and physical activity. *Social Science & Medicine, 75*(3), 477-481. doi:10.1016/j.socscimed.2012.03.037

Evans, G. W., Fuller-Rowell, T. E., & Doan, S. N. (2012). Childhood cumulative risk and obesity: The mediating role of self-regulatory ability. *Pediatrics, 129*(1),

Sinha, R., *& Jastreboff*, A. M. (2013). Stress as a common risk factor for obesity and addiction. *Biological Psychiatry.*

Groesz, L. M., McCoy, S., Carl, J., Saslow, L., Stewart, J., Adler, N., . . . Epel, E. (2012). What is eating you? Stress and the drive to eat. *Appetite, 58*(2), 717-721.