Course Syllabus
EDHD310: Educational Neuroscience: Learning, Development & Disability

Fall 2019 Tu-Th 11:00am-12:15pm Tawes 1310

Instructor: Dr. Donald J. Bolger Office: 3304N Benjamin Building
Phone: 301-405-9103 Email: djbolger@umd.edu
Hours: Mondays 1:00-2:00pm or by appt.
Teaching Assistant: Benjamin Rickles Office: 3238 Benjamin Building
Phone: Email: brickles@umd.edu

Texts: Selected readings from on Blackboard/Canvas (elms.umd.edu)

Course Description and Objectives:

Introductory survey into contemporary theory and research in brain science as it pertains to learning and development, including the neural basis of academic skills and achievement and applications to classroom learning. This course will focus on areas of education including language (spoken and written), conceptual change, numerical/quantitative processing, and social cognition as well as burgeoning areas of neuroscientific research in general cognitive processes such as attention, memory, and executive processing. These topics will be discussed with respect to typical and atypical development with some focus on developmental disabilities including autism, specific language impairment, reading and math impairment, and attention deficit disorders among others. This course will focus on both the theoretical perspectives and pragmatic issues of how evidence regarding brain development can or may be translated into useful or misleading information for educators, professionals, and parents/guardians of our children.

Course Goals:

By the end of this course, students should be able to:

- **I-Series #1.** ***Identify the major questions and issues with respect to how the brain develops throughout childhood and how experiences both inside and outside the educational context contribute to typical versus atypical development leading to individual differences in academic achievement and life outcome measures.***

- **I-Series #2.** ***Describe the sources the experts and scientists use to identify the structures of the brain and how those structures relate to behavioral changes specifically in the context of learning and social-emotional development.***

- **I-Series #3.** ***Demonstrate an understanding of basic terms, concepts, and approaches that experts in neuroscience and cognitive developmental/education employ in dealing with issues in academic achievement and learning.***

- **I-Series #4.** ***Demonstrate an understanding of the political, social, economic, and ethical dimensions of how the neurobiology of learning, development, and disability have been misinterpreted and misused.***

- **I-Series #5.** ***Communicate major ideas and issues in educational neuroscience through effective written and/or oral presentations.***

Evaluation & Course Grading:

1. **Preparation each class (5%)**
   Students should be in class and be prepared to participate in lecture and discussion.
2. **Blog Posts & Class Presentations (20%)**
   There will be a presentation/writing assignment due at the last week of classes.
3. **Group Presentation #1 (20%)**
   On Week 2, students organize into 6 groups of 8-10 each to plan and devise a multi-media presentation for **Week 5** in which each group presents an example of how the gene-environment interactions and the risk and resiliency of children exposed to extreme stress and trauma. This multimedia presentation should use multiple sources and examples to show the role of genes, the role of the environment, and the interaction between the two on a neurocognitive process or function that impacts learning or development. For example, evidence suggests that the "warrior gene" codes for increases in an enzyme, MAOA, in the brain leading to more violent behavior, yet evidence from studies of poverty suggest that environment is a strong predictor of trauma in the brain that leads to more aggressive behaviors. When researchers look at the effect of parenting in animal studies on the expression of MAOA, they found that the phenotypic expression of "warrior gene" was modulated leading to fewer overt aggressive behaviors.
   Group presentations should include scientifically sourced information and exhibit the relationships between genetics, environment, the brain, and behavior. This can include video clips, case studies, artifacts like model brains or creative pieces like animations, posters, cartoons, etc.
   Each student in the group will submit **a 2-3 page reflection on CANVAS** detailing what they learned, their contribution to the project, how this project changed their preconceptions of this topic, and what questions were left unanswered or what more would they like to know.

4. **Group Investigation and Presentation (30%)**
   Around Week 6, students will learn about the different technologies and tools that neuroscientists use to image the brain and to quantify measures of structural brain changes and changes in activation or response to a psychological function. They will again form 6 groups of 8-10 students to research a specific academic skill or ability that is discussed throughout the term (although some exceptions can be made for interests in topics such as MUSIC and the ARTS which are not directly covered).
   Group projects will be composed of the following components:
   A. Students will identify evidence from the literature in which learning in an educational context (e.g. reading, math, science, the arts, or social-emotional) has been demonstrated through some form of neural change or growth.
   B. Students will describe the sources of variability in the ability to learn within these contexts and how those sources lead to typical or atypical development. They will include

socio-economic sources, genetic sources, or other physical or psychological sources of variation.

C. Students will propose potential means of prevention or remediation for at-risk or atypical development.
D. Students will hypothesize how such intervention approaches may result in specific neural change or plasticity based on the previous literature on cortical regions of impairment or the effects of previous remediation approaches.

Groups will write a 5 page report with each of these components and post it on CANVAS. Each student will be asked to respond to at least 2 reports providing constructive feedback and academic questions that have emerged from this proposal. Final revisions of report will be due in Week 15.

Students will **present their proposal** in a format of a **scientific conference presentation before their peers** where they will field questions with respect to their question of interest and how the educational field may benefit from showing neural change from some prevention or remediation strategy.

5. <u>Final Exam (25%)</u>

There will be a final exam consisting of 40 multiple-choice and True/False question plus 5 short answer responses that will be given during finals week.

Please see the University's website for undergraduate course-related policies at http://www.ugst.umd.edu/courserelatedpolicies.html.

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Course Evaluations:

As a member of our academic community, you as a student have a number of important responsibilities. One of these responsibilities is to submit your course evaluations each term though CourseEvalUM in order to help faculty and administrators improve teaching and learning at Maryland. Please make a note of the dates for Fall 2019 and the link at which you can access the submission system (www.courseevalum.umd.edu). If you submitted all of your evaluations in the fall or are a new student, you can also access all posted results from Fall 2007 forward via Testudo under CourseEvalUM Reporting. To retain this access, you must submit all of your evaluations each semester. More information is at: www.irpa.umd.edu/Assessment/CourseEval/stdt_faq.shtml.

CLASS POLICIES

Academic integrity: The University of Maryland, College Park has a student-administered Honor Code and Honor Pledge. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. The code prohibits students from cheating, fabrication, facilitating academic dishonesty, and plagiarism. Instances of this include submitting someone else's work as your own, submitting your own work completed for another class without permission, or failing to properly cite information other than your own (found in journals, books, online, or otherwise). Any form of academic dishonesty will not be tolerated, and any sign of academic dishonesty will be reported to the appropriate University officials.

Special needs: If you have a registered disability that will require accommodation, please see the instructor so necessary arrangements can be made. If you have a disability and have not yet registered with the University, please contact Disability Support Services in the Shoemaker Building (301.314.7682, or 301.405.7683 TTD) as soon as possible.

Religious observances: The University of Maryland policy on religious observances states that students not be penalized in any way for participation in religious observances. Students shall be allowed, whenever possible, to make up academic assignments that are missed due to such absences. However, the must contact the instructor before the absence with a written notification of the projected absence, and arrangements will be made for make-up work or examinations.

Course evaluations: As a member of our academic community, students have a number of important responsibilities. One of these responsibilities is to submit course evaluations each term though CourseEvalUM in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to CourseEvalUM is confidential. Campus will notify you when CourseEvalUM is open for you to complete your evaluations for fall semester courses. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Missed single class due to illness: Once during a semester, a student's self-authored note will be accepted as an excuse for missing a minor scheduled grading event in a single class session if the

note documents the date of the illness, acknowledgement from the student that information provided in the note is correct, and a statement that the student understands that providing false information is a violation of the Code of Student Conduct. Students are expected to attempt to inform the instructor of the illness prior to the date of the missed class.*

Major scheduled grading events: Major Scheduled Grading Events (MSGE) are indicated on the syllabus. The conditions for accepting a self-signed note do not apply to these events. Written, signed documentation by a health care professional, or other professional in the case of non-medical reasons (see below) of a University-approved excuse for the student's absence must be supplied. This documentation must include verification of treatment dates and the time period for which the student was unable to meet course requirements. Providers should not include diagnostic information. Without this documentation, opportunities to make up missed assignments or assessments will not be provided.

Non-consecutive, medically necessitated absences from multiple class sessions: Students who throughout the semester miss multiple, non-consecutive class sessions due to medical problems must provide written documentation from a health care professional that their attendance on those days was prohibited for medical reasons.

Non-medical excused absences: According to University policy, non-medical excused absences for missed assignments or assessments may include illness of a dependent, religious observance, involvement in University activities at the request of University officials, or circumstances that are beyond the control of the student. Students asking for excused absence for any of those reasons must also supply appropriate written documentation of the cause and make every attempt to inform the instructor prior to the date of the missed class.

Late Assignments: All assignments are expected on the day indicated in this syllabus. Any assignment received after the due date will automatically receive a 5% lower grade for every day it is late.

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Date:	Topic	Student Assignments
8/27	**Week 1: Brain Development Basics**	
Instructor: Presentation on Neural Growth and Change across the lifespan		**Student Discussion**: Plasticity and experience. Students will work in pairs to discuss and find evidence of brain plasticity. Each week every student will post their ideas and the sources that they have found to support their ideas in a **blog via CANVAS**. These blog posts will serve as a running record or portfolio of what the students are working on with respect to the scientific hypotheses that they are investigating and the sources of support (using links) that support these arguments.
Read: Blakemore, S-J, & Frith, T. (2005) The learning brain: Lessons for education: a précis. Developmental Science, 8, 459-471. Dehaene-Lambertz, G., & Spelke, E. S. (2015). The infancy of the human brain. *Neuron*, *88*(1), 93-109. **Watch:** PBS's *The Secret Life of the Brain: The Baby's Brain.* https://www.youtube.com/watch?v=h3BoUpMjY-Y		
9/3	**Week 2: Genes**	
Instructor: 1. Role of genetics in brain development (neural tube development and embryonics) 2. How does environment interact with genes to shape brain development and behavior? 3. Multifinality and Equipotentiality		**Student Activity**: Students organize into 6 groups of 8-10 each to plan and devise a multi-media presentation for **Week 6** in which each group presents an example of how the gene-environment interactions and the risk and resiliency of children exposed to extreme stress and trauma. This multimedia presentation should use multiple sources and examples to show the role of genes, the role of the environment, and the interaction between the two on a brain function that impacts learning or development. Students will post their individual progress on their **blog** posts on CANVAS.
Read: Horgan, J (2011). Code rage: The "warrior gene" makes me mad! (Whether I have it or not). Scientific American, Online Blog: April 26, 2011. LENROOT, R. K., & GIEDD, J. N. (2008). The changing impact of genes and environment on brain development during childhood and adolescence: Initial findings from a neuroimaging study of pediatric twins. *Development and Psychopathology*, *20*(4), 1161–1175. http://doi.org/10.1017/S0954579408000552 National Scientific Council on the Developing Child (May 2010). Early Experiences Can Alter Gene Expression and Affect Long-Term Development. Center on the Developing Child at Harvard University		

http://developingchild.harvard.edu/resources/early-experiences-can-alter-gene-expression-and-affect-long-term-development/

9/10	Week 3: Environmental Influences

Instructor:	**Student Discussion:**
What is experience dependent plasticity? What is the evidence for enriched environments on brain development? What about models of deprivation? How does poverty impact brain development?	Students will organize in their groups formed in Week 3 and discuss how poverty and stress impact the brain. The students will post on their **blog** displaying how different factors of poverty might impact how the brain grows and changes.

Read: Kwon, D. (2015). Poverty Disturbs Children's Brain Development and Academic Performance. Scientific American: Mind, Online: July 22, 2015.
http://www.scientificamerican.com/article/poverty-disturbs-children-s-brain-development-and-academic-performance/

Reardon, S. (2015). Poverty Shrinks Brains from Birth. Scientific American: Mind, Online: March 31, 2015.
http://www.scientificamerican.com/article/poverty-shrinks-brains-from-birth1/

Ostrander, M. (2015). What poverty does to the young brain. The New Yorker, June 4, 2015.
http://www.newyorker.com/tech/elements/what-poverty-does-to-the-young-brain

9/17	Week 4: Social-Emotional Development

Instructor:	
What is the role of imitation or mirroring? What are mirror neurons and how do they explain everything? Emotional development and the links between anxiety and depression. What role does the amygdala play in emotional development?	Students will organize in their groups formed in Week 6 and discuss the following questions: How do deficits in the brain mirroring system explain disorders such as Autism Spectrum Disorder? How might lingering effects of trauma in the brain effect classroom performance and social development? What modes of interventions might be applied to intervene in these disorders? What neural systems would you monitor for responsiveness to treatment? Students will post their investigations on the **blogs**.

Read:

Meltzoff, A.N. & Decety, J. (2003). What imitation tells us about social cognition: a rapprochement between developmental psychology and cognitive neuroscience. The Royal Society, 358, 491-500.

Miller, G. (2010). The makings of anxious temperament. Science Online, August 11, 2010.
http://www.sciencemag.org/news/2010/08/makings-anxious-temperament

Marantz Henig, R. (2009). Understanding the anxious mind. New York Times Magazine, September 29, 2009. http://www.nytimes.com/2009/10/04/magazine/04anxiety-t.html?_r=0

Watch Video: Temple Grandin
https://www.ted.com/talks/temple_grandin_the_world_needs_all_kinds_of_minds?language=en

9/24	Week 5: Neurodevelopmental Disabilities: Executive functioning and ADHD

Instructor:
What are executive functions?
How is the brain wired for cognitive control?
How have genes been associated with executive functioning?
What are the biological roots of ADHD?

Student Discussion:
What are the links between genes, brain and behavior in the case of cognitive control and ADHD?

How might various experiences or environments change our neural systems of cognitive control?

Are there interventions that are effective for enhancing cognitive control? Which ones and why?

Students will post their investigations on the **blogs**.

Read:

Blair, C. & Diamond, A. (2008). Biological processes in prevention and intervention: Promotion of self-regulation and the prevention of early school failure. *Development and Psychopathology, 20,* 899-911.

Diamond, A. & Lee, K. (2011) Interventions shown to aid executive function development in children 4 to 12 years old. Science, 333, 959-964.

Diamond, A. (2006). The early development of executive functions. In E. Bialystok & F. Craik (eds.), *Lifespan Cognition: Mechanisms of Change (pp. 70-95).* NY: Oxford University Press.

10/1	Week 6: Student Activity on how nature and nurture (genes and environment) interact to shape brain development and behavior.

Each of the 6 groups formed in Week 3 will present their projects on how genes and the environment interact in the development of the brain and subsequent behaviors. These presentations will be multimedia presentation and can use video, music, powerpoint, or artifacts. These presentations will be 15 minutes per group with 5-10 minutes for discussion with the class. The presentations should be informative and illustrative (showing examples of the variables or factors that are postulated to affect change) and should pose stimulating questions to the audience/class requiring reflection on their own experiences or knowledge of current realities of society.

***Individual reflections** from each student are to be posted on CANVAS. ***

10/8	Week 7: Neuroscience & Education

Group Project
Break up into 6 groups and develop idea for neuroimaging experiment and report. Presentations will be given on **Week 13 and reports submitted to CANVAS**

Read:
Berninger, V & Richards, T. (April 18, 2011) "Reading, Writing, and Math Brains" and the relevance of brain research to teaching and learning. http://www.education.com/reference/article/brain-and-learning/

Gabrieli, John DE. "The promise of educational neuroscience: Comment on Bowers (2016)." (2016): 613-619.

10/15	**Week 8: Language & Literacy Development**
Instructor: How does language and literacy develop? What are the sources of variation in literacy development? How does the brain learn to read? What is the evidence from neuroscience that reading impairment is neurobiological in origin? How does instruction and intervention impact the brain?	**Student Discussion: Disability** Students will organize in their groups formed in Week 6 and discuss the development of language or reading disability. They will search the internet for examples of disability and they will be asked to demonstrate how damage to particular brain regions might result in such deficits. Students will post their investigations on the **blogs**.
Read: Perfetti, C. A., & Bolger, D.J. (2004). The brain might read that way. Scientific Studies in Reading, 8(3):293-304. Schlaggar, B.L. & McCandliss, B. D. (2007). Development of Neural Systems for Reading. Annual Review Neurocience. Dehaene, S. (2013). Inside the letterbox. *Cerebrum*. (Dana Foundation publication online) http://dana.org/Cerebrum/2013/Inside_the_Letterbox__How_Literacy_Transforms_the_Human_Brain/	

10/22	**Week 9: Mathematical Processing**
Instructor: What are the neurocognitive processes involved in mathematics? How does knowledge of number develop? What are the biological roots of number knowledge? How does the brain process mathematical problems? What are the neurobiological roots of math disability?	**Student Discussion: Disability** Students will organize in their groups formed in Week 6 and discuss the development of math disability. Groups will be asked to create interventions targeted at remediating deficits in math learning. Math learning can include early childhood to high school level subjects. Groups will discuss what neurocognitive systems that their interventions might putatitvely target (e.g. spatial processing, working memory, rule-based processing, etc.). They will find whether such evidence exists in the neuroscience literature. Students will post their investigations on the **blogs**.
Read: Carey, S. (2001). Bridging the gap between cognition and developmental neuroscience: The example of number representation. In C. A. Nelson & M. Luciana (Eds.), *Handbook of Developmental Cognitive Neuroscience 1st edition*. (pp. 415-431) Cambridge, MA: The MIT Press. Hartnett, K. (2015. This is your brain on math. Boston Globe, September 17, 2015. https://www.bostonglobe.com/ideas/2015/09/17/this-your-brain-math/WMrjRMIyyBmtJCLhb5m2FM/story.html	

10/29	**Week 10: Memory Systems**
Instructor: How does memory function with respect to learning?	**Student Discussion:** What are the processes of memory in the brain and how do they intersect with learning and achievement?

	How might difficulties with memory lead to impairments in learning? Students will post their investigations on the **blogs**.
Read: Miller, G. (2010) "How our brains make memories" Smithsonian Magazine.	
11/5	**Week 11: Fluid Intelligence and Reasoning**
Instructor: What is fluid intelligence? Historical overview. How is it measured? Is it culturally sensitive? Is it a stable trait or is it malleable? What are the neurobiological roots of fluid reasoning?	Students will organize in their groups formed in Week 6 and discuss the following questions: How might neurobiological evidence distinguish between models of fluid intelligence? What does "brain training" really train (if it trains anything at all)? How might the neurobiological evidence of fluid reasoning impact our cultural view of IQ? Students will post their investigations on the **blogs**.
Read: Ferrer, E., O'Hare, E. D., & Bunge, S. A. (2009). Fluid reasoning and the developing brain. *Frontiers in neuroscience*, *3*, 3. Gentner, D. (2010). Bootstrapping children's learning: Analogical processes and symbol systems. *Cognitive Science*, 34 (5). 752-775. Mason, R. A., & Just, M. A. (2015). Physics instruction induces changes in neural knowledge representation during successive stages of learning.*NeuroImage*, *111*, 36-48.	
11/12	**Week 12: Adolescent Development**
What makes adolescence unique? What are the biological roots of adolescent behavior? How might environment play a role: parenting and peer influence? How does adolescence differ across cultures and SES?	**Student Discussion:** Students will work in pairs to discuss the theories of what drives adolescent behavior. They will pick at least one theoretical position and find support for or against that hypothesis. They should document whether such theories have impacts for the way in which society views or treats adolescent behavior. Individual work will be posted on **student blogs**.
Read: Steinberg, L. (2005). Cognitive and affective development in adolescence. Trends in Cognitive Science, 9, 69-74. Atkins, S., Bunting, M., Bolger, D.J., & Dougherty, M. (2013). The Adolescent Brain: Neural Plasticity and the Acquisition of Cognitive Abilities.	

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Watch: TED Talk: Adriana Galvan https://www.youtube.com/watch?v=LWUkW4s3XxY	
11/19	**Week 13: Broader Impacts**
Student discussion on controversial issues: 1. Should educators be required to learn basic educational neuroscience? 2. Should children and adolescents be held accountable legally for delinquent or illicit behavior? 3. Should cognitively enhancing drugs be available over the counter?	
12/3-5	**Week 14: Student Presentations**
Each of the groups formed in **Week 7** will present their project detailing the neural basis of an academic skill or ability and how atypical development (individuals with learning disabilities or struggling learners) is reflected in cortex with a proposal of how to intervene or remediate such skills or abilities. These presentations will be short 15 minute conference style presentations with discussion from the classroom audience.	
*****Final Exam: Finals Week*****	

* This schedule is flexible depending on students' interest and other timing factors.