

**GEORGE MASON UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
EDUCATIONAL PSYCHOLOGY**

EDEP 655- 001: The Neuroscience of Learning and Cognition

3 Credits

Fall 2015

Thursday 7:20-10:00 pm

Thompson, RoomL019

Name: Dr. Mary Guckert

Phone: (703) 930-0367

Office hours: Thursdays, 5:30-6:30 and by appointment, please email

Email address: mguckert@gmu.edu, mary.guckert@gmail.com



CATALOG DESCRIPTION:

A. Prerequisites: EDEP 550

B. UNIVERSITY CATALOG COURSE DESCRIPTION:

Focuses on research regarding the development of cognitive processes in children and adults of various ages, their neurobiological substrates, and the imaging technology used to explore the functioning brain.

C. EXPANDED COURSE DESCRIPTION:

This course focuses on the development of cognitive processes related to learning, creating, and problem solving across the lifespan. Key questions this course is designed to explore include: How do children learn to pay attention? Read? Perform mathematics? Learn critical thinking skills? Create? And how do these processes develop as people mature and age? In this course, we use the lens of cognitive neuroscience to address these questions. You will read and engage in research on the cognitive processes involved in learning, creativity, and problem solving. You will learn about human development and cognitive function based on data gathered using state-of-the-art neuroimaging techniques such as functional magnetic resonance imaging (fMRI). Through a variety of activities, you will consider the ethics and investigate ways this research may help us design and assess formal learning experiences and interventions that may remediate or accelerate people's abilities to learn, create, and solve problems.

D. NATURE OF COURSE DELIVERY

This course is structured around readings, reflections on readings, class projects, technology activities, and writing assignments. This course will be taught using lectures, discussions, and small and large group activities. The Blackboard site for the class can be accessed at: <https://mymasonportal.gmu.edu>.

For those in the Educational Psychology master's program, review the student Handbook:

<http://cehd.gmu.edu/documents/epsychology/edpsych-handbook.pdf>

LEARNER OUTCOMES OR OBJECTIVES:

This course is designed to enable students to:

1. Students will be able to analyze the psychological and cognitive neuroscience literatures about learning, creativity, and problem solving using approaches and methods discussed in lectures and readings.
2. Students will be able to display knowledge of the development of cognitive processes and their neurobiological substrates involved in learning, creating, and solving problems.
3. Students will be able to interpret, critique, and synthesize cognitive neuroscience research on learning, development, creativity, and problem solving.

4. Students will be able to assess the potential of cognitive neuroscience research to inform the design and assessment of formal educational experiences and interventions.
5. Students will understand the basic principles of functional magnetic resonance imaging (fMRI) and the ethics associated with its ability to explore the biological bases of learning and development in children.
6. Students will be able to envision ways to pursue their interests in the cognitive neuroscience of learning and development in graduate study or careers.
7. Students will synthesize and present the integration of their learning in a formal literature review.

PROFESSIONAL STANDARDS (American Psychological Association Presidential Task Force in Education (APA, Division 15) :

Principle 1: The Nature of Learning Process

Principle 2: Goals of the Learning Process

Principle 3: Construction of Knowledge

Principle 4: Strategic Thinking

Principle 5: Thinking about Thinking

Principle 6: Context of Learning

Principle 7: Motivational and Emotional Influences on Learning

Principle 8: Intrinsic Motivation to Learn

Principle 9: Effects of Motivation on Effort

Principle 11: Social Influences on Learning

Principle 13: Learning and Diversity

For more information please see:

American Psychological Association (2015). *Top 20 Principles from Psychology for PreK-12 Teaching and Learning*. (<http://www.apa.org/ed/schools/cpse/top-twenty-principles.pdf>)

American Psychological Association (1997). *Learner-Centered Psychological Principles: Guidelines for the Teaching of Educational Psychology in Teacher Education Programs*. (<http://www.apa.org>)

REQUIRED TEXTS:

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (2008). *Cognitive Neuroscience: The Biology of the Mind* (Third Edition). W.W. Norton & Co Inc.

Pinel, J.P.J. & Edwards, M. (2007). *A Colorful Introduction to the Anatomy of the Human Brain: A Brain and Psychology Coloring Book* (Second Edition). Allyn & Bacon.

Understanding the Brain - The Birth of a Learning Science, Second Edition. (2007). Organization for Economic Co-operation and Development - Centre for Educational Research and Innovation (OECD-CERI). Paris, France: Organisation for Economic Cooperation and Development Publication Office.

Learning, Arts, and the Brain. The Dana Consortium Report on Arts and Cognition. M Gazzaniga (organizer), C Asbury, B Rich (eds). The Dana Press <http://www.dana.org>

Selected sections of the books, articles and websites listed in the reading list (see end of syllabus) will be provided on the course website.

COURSE ASSIGNMENTS AND EXAMINATIONS:

1. Assignment Descriptions:

I. Article Critique –

Students will be given a choice between 2 or 3 research articles to critique outside of class. This will be in lieu of a formal mid-term assignment. Instructions and articles will be handed out two weeks prior to the due date. (20 points)

II. Experimental Design (Graduate Requirement Only) –

Students will be asked to create an experimental design with the goal of identifying a relevant translational research question and prospectively articulating how that question may be explored in both the neuroscientific and educational environments. (20 points)

III. Literature Review -

Students will be asked to write a scholarly review on a chosen topic. The paper should include a summary of the key constructs and the usefulness of the theory and relevant research in an area of interest to educators and policy makers. Research papers must be handed in on time and must adhere to the APA Publication Manual Guidelines. (40 points)

III. Class Participation -

Students will be prepared to make active contribution to small and large group discussions, presentations, and activities in class. Students will participate in online blackboard discussions and activities. (20 points)

2. Assignment and Examination Weighting:

Literature Review:	40%
Experimental Design	20%
Article Critique (3-5 pages)	20%
Class Participation and Attendance	20%
TOTAL GRADUATE	100%

Please note: Points in rubrics will be weighted to percentages.

Your final grade will be based on the following:

A+ 98-100%	A 93-97.49%	A- 90-92.49%
B+ 88-89.49%	B 83-87.49%	B- 80-82.49%
C 70-79.49%	F below 70%	

3. Grading Policy:

It is expected that each of you will:

1. Attend each class session
2. Participate in classroom activities, laboratories, and assignments
3. Read all assigned materials
4. Prepare and submit an article critique (see details in course assignments and evaluation)
5. Prepare and submit a literature review (see details in course assignments and evaluation)
6. Participate in online Blackboard activities

4. Other Expectations:

Class participation and attendance policy:

Attendance, punctuality, preparation, and active contribution to small and large group efforts in class and online are essential. Students who must miss a class must notify the instructor (preferably in advance) and are responsible for completing any in-class activities in the missed session, and all assignments and readings for the next class. Late assignments will be marked 10% down by the day.

Technology Policy: *When you are using cell phones, laptops, etc., please be respectful and do not engage in activities that are unrelated to class. Such disruptions may affect your participation grade.*

ADDITIONAL CLASS POLICIES

Format for written work

- 1-inch margins on all sides, double-spaced, 12-point Times New Roman font.
- Include the following information: title, name, date, professor, course number.
- Fully proofread for spelling, grammar, and clarity errors and citation and references in APA format.

COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT STATEMENT OF EXPECTATIONS:

- a. GMU Policies and Resources for students
Students must adhere to the guidelines of the George Mason University Honor Code [See <http://oai.gmu.edu/the-mason-honor-code/>]
- b. Students must follow the university policy for Responsible Use of Computing [See <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>]
- c. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All

communication from the university, college, school, and program will be sent to students solely through their Mason email account.

- d. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu/>].
- e. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See <http://ods.gmu.edu/>].
- f. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- g. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See <http://writingcenter.gmu.edu/>].

PROFESSIONAL DISPOSITIONS

Students are expected to exhibit professional behaviors and dispositions at all times.

CORE VALUES COMMITMENT

The College of Education & Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles. <http://cehd.gmu.edu/values/>

FOR GSE SYLLABI:

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See <http://gse.gmu.edu/>] For RHT Syllabi:

PROPOSED CLASS SCHEDULE:

CLASS SCHEDULE		
DATE	TOPIC	READING & ASSIGNMENTS
09/03	Introduction and Overview	<ul style="list-style-type: none"> • Introduction to Neuroscience of Learning and Cognition Research • Introduction to Neuroimaging • Review course syllabus
09/10	Cognitive Neuroscience and Educational Psychology	Read: <ul style="list-style-type: none"> • Kalbfleisch (2008), • Dana CH 6, • OECD-CERI CH 1

09/17	Brain Architecture, Learning, and the Environment	Read: <ul style="list-style-type: none"> • OECD book, CH 1-3 • Crone, Poldrack, & Durston (2008), • Goswami, U. (2006)
09/24	Interplay between Arts and Basic Skills	Read: <ul style="list-style-type: none"> • Dana Report, CH 1 & 4 • Take home assignment – Scientific Literacy – interpretation and translation of cognitive neuroscience
10/01 (Online Class)	2 of the 3 R's: Reading and 'Rithmetic - The Brain and Learning in Early Childhood	Read: <ul style="list-style-type: none"> • OECD book, CH 4-5, • Article A, Holloway et al (2010), • DeSmedt (2010) <p>Learning about the MRI images See Blackboard for assignment/learning module</p>
10/08	The Brain and Learning in Adolescence	Read: <ul style="list-style-type: none"> • OECD, Article B <p>Characterizing ability and performance outside of the MRI</p>
10/15	Long-Term Memory and Learning and Reasoning in Adulthood	Read: <ul style="list-style-type: none"> • OECD Article C; • Semb et al. (1993), • Kalbfleisch et al., (2007), • Forgeard et al (2008) <p>Assessing reasoning using fMRI</p>
10/22	*Article Critique Presentations*	Due: Article Critique paper Activity: Individual student presentations I
10/29	Gray Matter, White Matter, and IQ	Read: <ul style="list-style-type: none"> • Schmithorst et al., (2005). • Shaw et al., (2006); • Kumra et al. (2006) • <p>Activity: Individual student presentations II</p>
11/05 (online class)	The Functional Anatomy of Talent	Read: <ul style="list-style-type: none"> • Kalbfleisch (2004); • Franco-Watkins et al (2010) <p>*See Blackboard for assignment and learning module</p>

11/12	Neuromyths and Neuroethics	Read: <ul style="list-style-type: none"> • OECD, CH 6-7 • Fenton, Meynell, and Baylis (2009)/ • Connors & Singh (2009)
11/19	Music and Cognitive Development	Read: <ul style="list-style-type: none"> • Schlaug et al. (2005) • Dana Report Ch 2-3, 9 • <p>Due: Experimental Design (graduate student assignment)</p>
11/26	Thanksgiving	No Class
12/03	The Neurobiology of Creativity	Read: <ul style="list-style-type: none"> • Green and Goswami (2007), • Kalbfleisch (2009)
12/10	Last Class - Final Paper Peer Review	Due electronically to Blackboard by Wednesday, Dec 16, 2015, 7:00pm EST

ASSESSMENT RUBRIC(S):

I. ASSESSMENT FOR ARTICLE CRITIQUE (20 POINTS)

CRITERIA: SEE DESCRIPTORS IN THE RUBRIC FOR LITERATURE REVIEW – RUBRIC III).

Required Elements	Addressed in the Critique
Hypothesis [4 points]	What is the main hypothesis behind the study? What did it seek to accomplish or discover?
Literature Review [4 points]	What is the quality of the literature review in the introduction?
Spelling and Grammar (4 points)	Prose reads well, very few grammatical and spelling errors.
Methods	What kind of a study is it? (quantitative or

[4 points]	<p>qualitative?)</p> <p>Who are the subjects of the study?</p> <p>How many of them are there? Describe the experimental design of the study.</p> <p>How is the information presented best (are there tables that show a lot of information at a glance?</p> <p>Or do the authors explain everything in their prose?</p> <p>Which medium communicated the results best?</p>
Overall Impact [4 points]	<p>How clear was the paper to understand?</p> <p>What did you learn that you didn't know before?</p> <p>How did reading this article contribute to your understanding of how a good journal article is put together?</p>

II. ASSESSMENT FOR EXPERIMENTAL DESIGN (start with a 2 point base, 20 points total)

Criteria	Excellent	Adequate	Needs Significant Changes
Peer-Reviewed Research	Contains references to relevant empirical studies setting clear precedent for the study (3)	Contains references to relevant empirical studies that relate to the topic of the study (2)	Does not include relevant work connecting the study to credible neuroscience (1)
APA Style & Grammatical	No significant format errors Contains NO major misspellings or repetitive grammatical mistakes (3)	Contains few significant errors in style, reader can still interpret and appreciate the content of the paper Contains few major misspellings or repetitive grammatical mistakes (2)	Paper does not adhere to APA-Style format Contains major misspellings and repetitive grammatical mistakes (1)
Discussion of the Literature (Education)	Clearly spoken, all topicspecific jargon are welldefined, author does not rely	Clearly spoken, all topic-specific jargon are defined, author includes quotes from	Too much reliance on quotes taken directly from the literature so that it interrupts the flow of

	on quotes from papers or includes them strategically (3)	papers, but quotes are lengthy (2)	the content and leaves out room for student's own synthesis of the topic (1)
Discussion of the Literature (Neuroscience)	Clearly spoken, all topic specific jargon are well defined, author does not rely on quotes from papers or includes them strategically (3)	Clearly spoken, all topic-specific jargon are defined, author includes quotes from papers, but quotes are lengthy (2)	Too much reliance on quotes taken directly from the literature so that it interrupts the flow of the content and leaves out room for student's own synthesis of the topic (1)
Writing	Paper flows coherently, language is concise, thesis and discussion are well structured, purpose of the paper is evident (3)	Paper conveys the main points of the topic (2)	Errors in style format make it difficult to appreciate the content of this paper (1)
Technical Merit	Experimental design aligns education and neuroscience metrics in specific and feasible methods (3)	Experimental design identifies appropriate foci in education and in neuroscience but do not lead to direct translation (2)	Experimental design does not appropriately identify a focus on one side or the other – education and neuroscience –or demonstrates major issues with alignment between the two domains (1)

III. ASSESSMENT RUBRIC FOR LITERATURE REVIEW (40 PTS):

Criteria	Excellent	Adequate	Needs Significant Changes
Peer-Reviewed Research	Contains references to 10 or more empirical studies (5)	Contains references to 10 studies (4)	Does not include at least 10 peer reviewed studies (3)
APA Style	No significant errors (5)	Contains few significant errors in style, reader can still interpret and appreciate the content of the paper (4)	Paper does not adhere to APA-Style format (3)
Length	Paper adheres to 12 page limit (5)	Paper length is 2 pages above the ascribed limit (4)	Paper is much too long, writer needs to learn to conserve (3)
Abstract	Conveys clearly and sequentially the content of paper (5)	Gives a general overview of paper topic, but no sequential elaboration of contents (4)	Key information is not included in the summary, or abstract does not provide a clear representation of paper contents (3)
Discussion of the Literature	Clearly spoken, all topic-specific jargon are well-defined, author does not rely on quotes from papers or includes them strategically (5)	Clearly spoken, all topic-specific jargon are defined, author includes quotes from papers, but quotes are lengthy (4)	Too much reliance on quotes taken directly from the literature so that it interrupts the flow of the content and leaves out room for student's own synthesis of the topic (3)
Writing	Paper flows coherently, language is concise, thesis and discussion are well structured, purpose of the paper is evident (5)	Paper conveys the main points of the topic (4)	Errors in style format make it difficult to appreciate the content of this paper (3)
Technical Merit	Contains NO major misspellings or repetitive grammatical mistakes (5)	Contains few major misspellings or repetitive grammatical mistakes (4)	Contains major misspellings and repetitive grammatical mistakes (3)

Interpretations	Insightful, original synthesis, goes beyond the scope of the literature (5)	Analytical, draws logical conclusions based upon evidence from literature (4)	Discussion does not summarize well the main points of the thesis or provide evidence from peer reviewed studies to support conclusions (3)
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IV. ASSESSMENT RUBRIC FOR PARTICIPATION AND ATTENDANCE (20 PTS)

ELEMENT	LEVEL OF PERFORMANCE			
	Distinguished (18-20 pts.)	Proficient (16-17 pts.)	Basic (14-15 pts.)	Unsatisfactory (13 or less pts.)
Attendance & Participation 20 pts. Possible	The student attends all classes, is on time, is prepared and follows outlined procedures in case of an absence, the student actively participates and supports the members of the learning group and the members of the class. The student participates in all online blackboard activities and discussions and provides reflective feedback to peers online. Attends peer review for final paper.	The student attends all classes, is on time, is prepared and follows outlined procedures in case of absence; the student makes active contributions to the learning group and class. The student participates in online activities and discussions.	The student is on time, prepared for class, and participates in group and class discussions. The student attends all classes and if an absence occurs, the procedure outlined in this section of the syllabus is followed.	The student is late for class. Absences are not documented by following the procedures outlined in this section of the syllabus. The student is not prepared for class and does not actively participate in discussions.

REQUIRED READINGS – BIBLIOGRAPHY

- Blakemore S, Frith U (2005). The learning brain: Lessons for education: a précis. *Developmental Science*, 8 (6): 459-465.
- Connors, C.M., Singh, I. (2009). What we should really worry about in pediatric functional magnetic resonance imaging (fMRI). *The American Journal of Bioethics*, 9 (1), 16-18.
- Crone, E.A., Poldrack, R.A., Durston, S. (2010). Challenges and methods in developmental neuroimaging. *Human Brain Mapping* 31 (6), 835-837.

- DeSmedt, B., Taylor, J., Archibald, L. & Ansari, D. (2010). How is phonological processing related to individual differences in children's arithmetic skills? *Developmental Science* 13 (3), 508-520.
- Fenton, A., Meynell, L., Baylis, F. (2009). Ethical challenges and interpretive difficulties with non-clinical applications of pediatric fMRI. *The American Journal of Bioethics*, 9 (1), 3-13.
- Forgeard, M., Winner, E., Norton, A., Schlaug, G. (2008). Practicing a musical instrument in childhood is associated with enhanced verbal ability and nonverbal reasoning. *PLoS One*, 3 (10):e3566.
- Franco-Watkins, A.M., Rickard, T.C., & Pashler, H. (2010). Taxing executive processes does not necessarily increase impulsive decision-making. *Experimental Psychology*, 57 (3), 193-201.
- Goswami, U. (2006). Neuroscience and education: from research to practice? *Nature Reviews Neuroscience*, 7 (5): 406-11.
- Green, J.A., Goswami, U. (2007). Synesthesia and number cognition in children. *Cognition*, 106 (1), 463-473.
- Holloway, I.D., Price, G.R. & Ansari, D. (2010). Common and segregated neural pathways for the processing of symbolic and nonsymbolic numerical magnitude: an fMRI study. *NeuroImage* 49 (1), 1006-1017.
- Kalbfleisch, M.L. (2004). The functional anatomy of talent. *Anat Rec B New Anat.* 277 (1):21- 36. Review.
- Kalbfleisch, M.L., Van Meter, J.W., Zeffiro, T.A. (2006 online, 2007 print). The Influences of Task Difficulty and Response Correctness on Neural Systems Supporting Fluid Reasoning. *Cognitive Neurodynamics*, 1 (1), 71-84.
- Kalbfleisch, M.L. (2008). Getting to the Heart of the Brain: Using Cognitive Neuroscience to Explore the Nature of Human Ability and Performance. In L.Kalbfleisch (ed.) Special Issue on the Cognitive Neuroscience of Giftedness. *The Roeper Review*, 30 (3): 162-170.
- Kalbfleisch, M.L. (2009). The Neural Plasticity of Giftedness. In Shavanina, L. (Ed.) International Handbook on Giftedness. Springer Science (pps. 275-293).
- Kumra, S., Ashtari, M., Anderson, B., Cervellione, K.L., Kan, L. (2006). Ethical and practical considerations in the management of incidental findings in pediatric MRI studies. *J Am Acad Child Adolesc Psychiatry*, 45 (8):1000-6.
- Schlaug, G., Norton, A., Overy, K., Winner, E. (2005). Effects of music training on the child's brain and cognitive development. *Ann N Y Acad Sci.* 1060:219-30.
- Schmithorst, V.J., Wilke, M., Dardzinski, B.J., Holland, S.K. (2005). Cognitive functions correlate with white matter architecture in a normal pediatric population: a diffusion tensor MRI study. *Human Brain Mapping*, 26 (2):139-47.
- Semb, G. B., Ellis, J. A., & Araujo, J. (1993). Long-term memory for knowledge learned in school.

Journal of Educational Psychology, 85, 305-316.

Shaw, P. et al (2006). Intellectual ability and cortical development in children and adolescents. *Nature*, 440 (7084), 676-679

Additional sources:

In preparation for class meetings, you may find these resources useful

- *American Psychological Association*: <http://www.apa.org/ed/schools/cpse/>
- *What Works Clearinghouse* (reviews of studies with judgments of quality): <http://ies.ed.gov/ncee/wwc/ReviewedStudies.aspx>
- *Society for Neuroscience*: <http://www.sfn.org/>
- *NPR's Science Friday*: www.sciencefriday.com/
- *Scientific American 60 Second Mind Podcast*: www.scientificamerican.com/podcasts/podcasts.cfm?type=60-second-mind
- *NeuroPod*: www.nature.com/neurosci/neuropod/index.html.