Psyc 469: **Evolution and Development of Biobehavioral Systems —**

Prerequisites: BIOL 101 and PSYC 101, 210, or 215.

Required Readings: Available on **Sakai**; see list on pages 5-6 below

Overview

This course provides an advanced introduction to research on questions and perspectives regarding the functional relations between processes of development and processes of evolution. Its general aim is to study how organismic activity, operating as it does at the interface of biological and environmental systems, provides for flexibility and diversity in adaptive patterns over the course of development and evolution. Research on how behavior is linked to its biological basis has been long divided on issues of causation—the roles genes and environment play in its organization, and how development and evolution integrate these two sources of influence. In this course we examine the controversies surrounding these questions and their resolution in contemporary developmental biology and psychobiology. At this juncture we proceed to study how organisms, understood as open systems (von Bertalanffy, 1969) impart direction to both development and evolution, and how ontogenetic adaptive activity functionally links the two processes of change. As such this course provides (1) a synoptic history of the ideas that shaped the study of evolution since Darwin first proposed a plausible mechanism for evolution, (2) a detailed examination of how the theoretical frameworks formulated to study these two process of change, themselves have changed, and (3) a review of the empirical research that prompted their reformulation.

We begin by examining the set of cosmological conditions that had to be brought together to make possible life and intelligent life in particular on planet earth. As evolution obviously took place on our planet, how do we understand this process, and how did this understanding change since Darwin (1859) proposed a theory of evolution by natural selection? An important event in biological thinking was the formulation of the evolutionary synthesis (ca. 1942) that purported to explain how, under the action of natural selection, mutated genes promote evolution and constrain development. This synthesis shaped the popular view that genes, not organisms, are the "inventors" of new traits over evolution; in developmental psychology, it consolidated the view that genes contain a blueprint for development, independent of additive environmental contributions. More recently a new synthesis has been in the making that places development and behavior in the driver's seat of evolutionary change, not as mere by-product of it. Although this proposal has been in the background for a while, new discoveries, including the probabilistic nature of epigenesis and new evidence for the experiential regulation of genomic activity have laid the foundation for a more comprehensive evolutionary synthesis that firmly incorporates development and organismic activity as the main drivers of evolutionary change. This important shift in biological thinking prompted an equally important shift in psychology whereby developmental-evolutionary perspectives have been introduced including the Differential Biological Sensitivity to Context and the Adaptive Calibration Models, both of which posit, alongside with the new evolutionary synthesis, that natural selection preferentially selects for thresholds of responding in the stress nervous system (and other systems as well) as opposed to selecting for fixed traits. Jointly, these models attempt to capture the evolutionary/developmental mechanisms that set individuals on different life-history trajectories.

This course is intended to familiarize the students with the historical contexts that shaped the evolution of those ideas, including the empirical evidence that prompted conceptual revisions, and the scientific methods used to generate this evidence.

Course Organization

The structure of this course precludes the use of a standard textbook. Thus I selected a number of chapters, research and review articles pertaining to the different sections described above. Here is how we proceed to cover this material:

a) Assigned Readings and Lectures:

Taken as a set these articles are intended to provide a comprehensive overview of perspectives, research designs, and statistical approaches currently used in developmental research. These texts should be read by the "read by dates" specified in this syllabus. To orient your reading and animate class discussions, I will post 3 to 5 questions pertaining to a subset of texts on **Sakai** a few days in advance of the "read by date" (in a folder called **"Reading Guidelines"**). Also you wil be required to post personnal comments on those article to be shared with the class (see **evaluation**). My lectures will expand on those questions and the texts they pertain to. Lectures will be posted on Sakai after we covered them in class.

b) Class Discussion:

The different topics to be introduced will begin with an half-an-hour class discussion of the shared impressions, comments, and questions you will have posted on Sakai, ahead of their coverage in class. Your contribution to this aspect of this course will be noted and graded.

Evaluation

To do well in this class you should prepare yourself to read, reflect upon the different topics, discuss your views, and write about them. You will be evaluated on the following bases:

(1) Short essays on two of the topics listed below in the Calendar. I suggest 5 pages, double-spaced (Times 12) as a guideline. You can exceed this limit by half a page if the extensiveness of your coverage justifies it. Guidelines for writing these essays will be posted in the "Essay Guides" folder. **I will not accept your essays by email; only in class on the due dates specified in the Calendar.**

(2) Midterm and final exam exams will each cover the first and second half of the semester respectively, and the **final is not cumulative**. Both will include multiple-choice questions, matching questions, fill in the blanks, and short essay questions (3 to 6 lines on average).

(3) You are expected to participate both to the open forums on Sakai and their discussion in class. A full 20% of your final grade will be based on your contributions to those activities. On Sakai you will be reminded at the introduction of new topics to post your reflections on the reading material. These may take many forms: quoting a segment that got your attention and explaining why it did so, integrating ideas from multiple readings, highlighting statements that you do not understand, or still, explaining why you may disagree with authors on specifics. I will grade these entries based on their frequency and the quality of their contribution to a class discussion (entries should not exceed 4-6 lines).

Your final grade will be computed on the following basis:

2 essays @ 20% each	40%
Midterm and Final@ 20% each	40%
Class participation:	20%

Honor Code:

"Plagiarism—using information from a written source without appropriate acknowledgement—is an honor code violation. Ideas or information in your written work and class presentations must be appropriately referenced, whether the original source is written or verbal. Five or more words taken verbatim from any source must be placed in quotation marks with the source appropriately referenced. If you have questions about any of these matters, ASK." Each student is required to sign his/her name to the honor code pledge (i.e. "I herby certify that during this examination I have neither given nor received aid.") in order to receive a final grade.

Grading Scale: A (92.0 +), A- (90 - 91.9), B+ (87 - 89.9), B (84 - 86.9), B- (81 - 83.9), C+(78 - 80.9), C (75 - 77.9), C- (72 - 74.9), D+(69 - 71.9), D (60.0-68.9) F (less than 60.0)

Calendar, Topics, and Reading Assignments

WEEK/ TOPIC	ASSIGNMENT
Aug 23	
. Introduction to this course	Syllabus
. Discussion: What do you know already about evolution and development?	
Aug 25-30	
1. COSMOLOGICAL CONDITIONS FOR LIFE AND INTELLIGENCE TO EVOLVE	Smith (2011)
Sept 1-8	
2. EXPLAINING BIOLOGICAL DIVERSITY THROUGH EVOLUTION	
. Darwin: Evolution by natural selection (1859)	Lecture notes
. Assumptions and logic of his theory	
. The conceptual structure of the evolutionary synthesis and the gene-centered view of evolution	Mayr (1982) See Wikipedia
. Problem: rates of genetic evolution and speciation are not correlated	
. Alternative modes of evolution: latent potentials, co-optation, neoteny	Gould (1996)
Sept 13-20	
3. DEVELOPMENT: HIERARCHICAL ORGANIZATION AND RELATIONAL CAUSATION	
. From prokaryotes to eukaryotes and the possibility of development	Lecture notes
. The probabilistic nature of development: Gottlieb's co-actional model	
. Contingent activity at the cellular and organismic levels	
. Living systems as negative entropy and the concepts of niche and niche construction	
Sept 22-29	

4. ROLE OF DEVELOPMENT AND BEHAVIOR IN EVOLUTION: A NEW SYNTHESIS

. Neophenogenesis: evolution of the phenotype ahead of genetic change	Johnston (1990)
Example 1: Incipient speciation in fruit flies	Gottlieb (2002)
Example 2: The evolution of bird flight from therapsid ancestry	
Example 3: Phenotypic evolution on Koshima island's Rhesus macaques	
. Niche construction and the generation of new sources of natural selection	Laland (2008)

Essay #1 : Sections 1 through 4
Due on Oct 11

Oct 4-11

5. THE EPIGENETIC REGULATION OF THE GENOME

. Chromatin structure, histones, acetylation, and methylation	
. Experiential regulation of gene transcription	
Example 1: Maternal effects on the methylation of the glucocorticoid receptor gene in male rats	Meaney (2010)
. Example 2: Maternal effects on the methylation of the estrogen receptor gene in female rats	Lecture notes
. Implications for sex-specific life-course histories	

Oct 13: Catch-up
Oct 18: Miderm Exam

Oct 25-27

6. AN INTRODUCTION TO THE CONCEPT OF BIOLOGICAL SENSITIVITY TO CONTEXT

. Evolution of our understanding of G x E interactions in psychology: 4 models	Lecture notes
Read Meaney's (2010) intro on Gene x Environment interactions.	
. Nature favors selecting for thresholds of response as opposed to fixed traits	
. The stress response system: source of plasticity in development and evolution	Ellis (2012)
. One genome, multiple life histories	

Nov 1-Nov 10

7. THE STRESS RESPONSE SYSTEM: EVOLUTION AND DEVELOPMENT

. Organization, development, and function of the Stress Response System	Gunnar (2007)
. Porge's polyvagal theory and the social engagement system	Porges (2010)
. Evidence for biological sensitivity to context:	
1. In HPA activity	Boyce (2005)
2. In vagal regulation	Propper (2007)

Essay #2 : Sections 5 through 7
Due on Nov 17.

Nov 15-Dec 1

8. THE ADAPTIVE CALIBRATION MODEL (ACM) AND LIFE HISTORIES

. Patterns of joint activity among the SNS, PNS, HPA and life histories	Del Giudici (2011)
. Empirical verification of the ACM Model	Kolacz (2016)
. Middle childhood as a switch point in life histories	Del Giudici (2014)
. Experiential canalization of brain and behavior	Blair (2012)

Dec 6

9. HOW DOES POVERTY GET UNDER THE SKIN?

. Poverty, differential susceptibility, and executive function Raver (2013)

Tues Dec 13th Final Exam same classroom at 8:00 AM

Required Reading and Read-by Dates

Aug 25

1. Smith, H. A. (2011). Alone in the universe. *American Scientist*, 99(4), 320-327.

Sep 1

2. Mayr, E. (1982). *The growth of biological thought: Diversity, evolution, and inheritance* (Chapter 11, The causation of evolution: natural selection, pp. 426-510). Cambridge, MA: Harvard University Press.
3. Gene-centered view of evolution: https://en.wikipedia.org/wiki/Gene-centered_view_of_evolution
4. Gould, S. J. (1996). Creating the creators. *Discover*, 17, 43-54.

Sept 22

5. Johnston, T. D., & Gottlieb, G. (1990). Neophenogenesis: A developmental theory of phenotypic evolution. *Journal of Theoretical Biology*, 147, 471-495.
6. Gottlieb, G. (2002). Developmental-behavioral initiation of evolutionary change. *Psychological Review*, 109(2), 211-218.
7. Laland, K. N., Odling-Smee, J. Gilbert, S. F. (2008). EvoDevo and niche construction: Building bridges. *Journal of Experimental Zoology*, 310B, 549-566.

Oct 4

8. Meaney, M.J. (2010). Epigenetics and the biological definition of Gene X Environment interactions. *Child Development*, 81 (1) 41-79.

Oct 25

9. Ellis, B. J., & Bjorklund, B. J. (2012). Beyond mental health: An evolutionary analysis of development under risky and supportive conditions. An introduction to the special section. *Developmental Psychology*, 48(3), 591-597.

Nov 1

10. Gunnar, M., & Quevedo, K. (2007). The neurobiology of stress and development. *Annual Review of Psychology*, 58, 145-152. 13. 13.

Del Giudici, M. Ellis, B. J., & Shirtcliff, E. A (2011). The adaptive calibration model of stress responsivity. *Neuroscience and Behavioral Reviews*, 35, 1562-1592

11. Porges, S.W., and Furman, S.A. (2010). The early development of the autonomic nervous system provides a neural platform for social behaviour: A polyvagal perspective. *Infant and Child Development*, Online in Wiley Interscience (www.interscience.wiley.com). DOI: 10.1002/icd.688

12. Propper, C., More, G. A., Mills-Koonce, R. M., Halpern, C. T., Hill-Soderlund, A. L., Calkins, S. D., Carbone, M. A., & Cox, M. J. (2008). Gene-environment contributions to the development of infant vagal reactivity: The interaction of dopamine and maternal sensitivity. *Child Development*, 79(5), 1377-1394.

Nov. 15

13. Del Giudici, M. Ellis, B. J., & Shirtcliff, E. A (2011). The adaptive calibration model of stress responsivity. *Neuroscience and Behavioral Reviews*, 35, 1562-1592
14. Kolacz, J., Holochwost, S. J., Gariépy, J.-L. & Mills-Koonce, R. M. (2016). Patterns of joint parasympathetic, sympathetic, and adrenocortical activity and their association with temperament in early childhood. *Developmental Psychobiology*. DOI 10.1002/dev.21429
15. Del Giudici, M. (2014). Middle childhood: An evolutionary-developmental synthesis. *Child Development Perspectives*, 8(4), 193-200.
16. Blair, C, & Raver, C. (2012). Child development in the context of adversity: Experiential canalization of brain and behavior. *American Psychologist*, 67, 309-318.

Dec 6

17. Raver, C., Blair, C. & Willoughby, M. (2013). Poverty as a predictor of 4-year-olds executive function: New perspectives on models of diffrential susceptibility. *Developmental Psychology*, 49(2), 292-304.