The Neurobiology and Psychology of Play
GU4282
4 points

Class Time: Thursday 12:10-2

Class Location: Zoom

Instructor: Melanie Pincus, PhD
Email:
Office Hours: TBD

Course Bulletin Description: Play is a highly rewarding activity that is considered critical to cognitive, social, and emotional development. How do we define play and how do we study it? How does play help humans and other animals learn about their world and prepare them for adulthood? This course will examine the latest developments in the field of play from various methodological approaches to understand the relationship between play, learning, and normative development.

Prerequisites: PSYC UN1001 The Science of Psychology or equivalent introductory psychology course and instructor permission

Full Description: Play is a highly rewarding activity that is regarded as a central ingredient in learning and necessary for the normative development of executive functions, cognition, social competence, and emotion regulation in humans and other animals. Play may be fundamental to allowing children to develop an understanding of symbolic representation and role play, imitate adult behaviors, process emotional events, and learn about their world. However, this proposition is not without its controversies, and some question the evidence supporting broad claims that play is integral to development. This seminar course will survey the current state of research, examining the literature with a critical eye to better understand the relationship between play and cognitive, social, and emotional development. Gaps in the literature will be discussed and questions for future research will be identified and elaborated.

With its heterogenous presentation across the animal kingdom, how does one define and measure play? If play is frivolous and serves no benefit, why did it evolve in some animals? Through a close examination of the literature on play, we will develop an understanding of how play is defined and why it may have evolved, particularly in mammals. We will explore the neural mechanisms of play, including the neurobiology and circuitry of its rewarding properties. After developing a basic understanding of play, we will investigate the evidence that play is linked to the development of executive functions, cognition, theory of mind and social competence, emotion and stress regulation, language, and mathematics. Considering these critical relationships, we will then turn our attention to arguments for incorporating play into pedagogy, and evaluate the efficacy of interventions that have blended play with instruction and academic learning.

We will come to understand the current state of research on play from various perspectives, assess strengths and weaknesses in the arguments that play is fundamental for development, and identify empirical questions where further research is warranted.

Learning Goals:

By the end of this course, we will:

- Demonstrate knowledge of the neurobiological basis of play and its relationship to development
- Evaluate key research findings in psychology and neuroscience and describe whether these findings support theories that play is meaningfully linked to development
- Apply critical thinking to evaluate the methodology of empirical research and whether the conclusions drawn by the authors are reasonable
- Summarize empirical articles and communicate knowledge in written and oral form
- Design a research study to investigate an open question in the field of play research with a sound methodological approach

Role of this Course in the Psychology Curriculum: This course is an advanced seminar course for undergraduate students.

- For students pursuing the Psychology major or the Post-bac Certificate Program in Psychology, this course could be used to fulfill the seminar requirement.
- For students pursuing the Psychology major or concentration or the Post-bac Certificate Program in Psychology, this course could be used to meet Group 2 distribution requirements.
- For students pursuing the Neuroscience & Behavior major, this course could be used to fulfill the P5 Advanced Seminar requirement.

Topics and Readings: Readings include empirical articles, reviews, and book chapters. These will be available as pdfs on Courseworks. The potential reading assignments listed below are subject to revision.

Week 1: Introduction to Play

- How is Play defined? What are the different types of play and how does play change across development?
- Why did play evolve in certain species and what general functions does it serve?
- Readings
    - Graham, K. L., & Burghardt, G. M. (2010). Current perspectives on the biological study of play: signs of progress. *The Quarterly Review of Biology*, *85*(4), 393-418.
    - Zosh, J. M., Hirsh-Pasek, K., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., ... & Whitebread, D. (2018). Accessing the inaccessible: Redefining play as a spectrum. *Frontiers in psychology*, 9, 1124.
    - Gray, P. (2019). Evolutionary functions of play: Practice, resilience, innovation, and cooperation. In P. K. Smith & J. Roopnarine (Eds.), *The Cambridge Handbook of Play: Developmental and Disciplinary Perspectives*, pp 84-102. Cambridge, UK: Cambridge University Press.

Week 2: Neural Correlates of Play

- What do rodent models tell us about the circuits and neurotransmitter systems involved in play? To what extent is the reward system involved?
- How does depriving animals of play in critical periods alter the brain and what implications does this have for development?
- Readings

    - Vanderschuren, L. J., Achterberg, E. M., & Trezza, V. (2016). The neurobiology of social play and its rewarding value in rats. *Neuroscience & Biobehavioral Reviews*, *70*, 86-105.
    - Bell, H. C., Pellis, S. M., & Kolb, B. (2010). Juvenile peer play experience and the development of the orbitofrontal and medial prefrontal cortices. *Behavioural brain research*, *207*(1), 7-13.
    - van Kerkhof, L. W., Trezza, V., Mulder, T., Gao, P., Voorn, P., & Vanderschuren, L. J. (2014). Cellular activation in limbic brain systems during social play behaviour in rats. *Brain Structure and Function*, *219*(4), 1181-1211.
    - Supplemental:
        - Himmler, B. T., Pellis, S. M., & Kolb, B. (2013). Juvenile play experience primes neurons in the medial prefrontal cortex to be more responsive to later experiences. *Neuroscience Letters*, *556*, 42-45.

Week 3: Neural Correlates of Play (continued)

- What brain regions are implicated in play in non-human primates?
- What is the evidence for a relationship between play and the development of behavioral flexibility in primates?
- How can the emerging neuroscience of intrinsic motivation inform our understanding of play in humans?
- Readings
    - Graham, K. L. (2011). Coevolutionary relationship between striatum size and social play in nonhuman primates. American Journal of Primatology, 73(4), 314-322.
    - Montgomery, S. H. (2014). The relationship between play, brain growth and behavioural flexibility in primates. *Animal Behaviour*, *90*, 281-286.
    - Di Domenico, S. I., & Ryan, R. M. (2017). The emerging neuroscience of intrinsic motivation: A new frontier in self-determination research. *Frontiers in Human Neuroscience*, 11, 145.

Week 4: What is the relationship between Play and the development of Executive Functions and Cognition?

- What evidence is there among non-human animal models that play is linked with the executive functions?
- What role does play have in the development of EFs and reasoning in humans?
- Readings
    - Pellis, S. M., & Pellis, V. C. (2017). What is play fighting and what is it good for? *Learning & behavior*, *45*(4), 355-366.
    - Carlson, S. M., & White, R. E. (2013). Executive function, pretend play, and imagination. *The Oxford handbook of the development of imagination*, 161-174.
    - Buchsbaum, D., Bridgers, S., Skolnick Weisberg, D., & Gopnik, A. (2012). The power of possibility: Causal learning, counterfactual reasoning, and pretend play. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1599), 2202-2212.
    - Supplemental
        - Lillard, A. S., Pinkham, A. M., & Smith, E. (2011). Pretend play and cognitive development. *Handbook of cognitive development*, *2*, 285-311.
        - Pellegrini, A. D., & Bohn, C. M. (2005). The role of recess in children's cognitive performance and school adjustment. *Educational researcher*, *34*(1), 13-19.

        - Panksepp, J., Burgdorf, J., Turner, C., & Gordon, N. (2003). Modeling ADHD-type arousal with unilateral frontal cortex damage in rats and beneficial effects of play therapy. *Brain and Cognition*, *52*(1), 97-105.
        - Berk, L. E., Mann, T. D., & Ogan, A. T. (2006). Make-Believe Play: Wellspring for Development of Self-Regulation. In D. G. Singer, R. M. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: How play motivates and enhances children's cognitive and social-emotional growth* (p. 74–100).

Week 5: Play and Development of Theory of Mind

- What are the theories that explain the relationship between pretend play and the development of theory of mind?
- What is the evidence that pretend play is causally linked to the development of theory of mind?
- Readings
    - Leslie, A. M. (1987). Pretense and representation: The origins of "theory of mind." *Psychological review*, *94*(4), 412-426.
    - Youngblade, L. M., & Dunn, J. (1995). Individual differences in young children's pretend play with mother and sibling: Links to relationships and understanding of other people's feelings and beliefs. *Child Development*, *66*(5), 1472-1492.
    - Hughes, C., & Dunn, J. (1998). Understanding mind and emotion: longitudinal associations with mental-state talk between young friends. *Developmental psychology*, *34*(5), 1026.
    - Supplemental:
        - Lillard, A. (2001). Pretend play as twin earth: A social-cognitive analysis. *Developmental Review*, *21*(4), 495-531.

Week 6: Play and Social Competence

- What is the relationship between frequency and complexity of social play and the development of social competence with peers in children?
- Does research with animal models indicate a causal link between social play and social competence?
- Assignment: Topic Proposal Due
- Readings
    - Connolly, J. A., & Doyle, A. B. (1984). Relation of social fantasy play to social competence in preschoolers**.** *Developmental Psychology*, *20*(5), 797.
    - Van den Berg, C. L., Hol, T., Van Ree, J. M., Spruijt, B. M., Everts, H., & Koolhaas, J. M. (1999). Play is indispensable for an adequate development of coping with social challenges in the rat. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, *34*(2), 129-138.
    - Lindsey, E. W., & Colwell, M. J. (2013). Pretend and physical play: Links to preschoolers' affective social competence. *Merrill-Palmer Quarterly*, *59*(3), 330-360.
    - Supplemental:
        - Kempes, M. M., Gulickx, M. M. C., van Daalen, H. J. C., Louwerse, A. L., & Sterck, E. H. M. (2008). Social competence is reduced in socially deprived rhesus monkeys (Macaca mulatta). *Journal of Comparative Psychology*, *122*(1), 62.

        - Howes, C., & Matheson, C. C. (1992). Sequences in the development of competent play with peers: Social and social pretend play. *Developmental Psychology*, *28*(5), 961.

Week 7: Play and its Relationship to Emotion & Stress Regulation

- How does play deprivation in animal models inform our understanding of the relationship between play and stress regulation?
- How does play deprivation alter the brain in animal models, and do these alterations relate to stress regulation?
- What theories exist to suggest play may be adaptive for emotional and stress regulation in humans? Is there evidence to support this?
- Readings
    - Von Frijtag, J. C., Schot, M., van den Bos, R., & Spruijt, B. M. (2002). Individual housing during the play period results in changed responses to and consequences of a psychosocial stress situation in rats. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, *41*(1), 58-69.
    - Burleson, C. A., Pedersen, R. W., Seddighi, S., DeBusk, L. E., Burghardt, G. M., & Cooper, M. A. (2016). Social play in juvenile hamsters alters dendritic morphology in the medial prefrontal cortex and attenuates effects of social stress in adulthood. *Behavioral neuroscience*, *130*(4), 437.
    - Potasz, C., Varela, M. J. V. D., Carvalho, L. C. D., Prado, L. F. D., & Prado, G. F. D. (2013). Effect of play activities on hospitalized children's stress: a randomized clinical trial. *Scandinavian journal of occupational therapy*, *20*(1), 71-79.

Week 8: Proposing Our Own Experiments on Play

- What are open questions in the field?
- How might we investigate the neural correlates of play in humans?
- How will we design experiments to address open questions?
- Assignment:
    - Draft of Experimental Proposal Due
    - In-class Presentation of Proposed Experiment

Week 9: Play and Language Development

- What is the evidence that play is important for learning language and literary skills?
- Are there certain types of play that are particularly helpful for developing language skills in children?
- Readings:
    - Pellegrini, A. D. (1980). The relationship between kindergartners' play and achievement in prereading, language, and writing. *Psychology in the Schools*, *17*(4), 530-535.
    - Roskos, K. A., & Christie, J. F. (2013). Gaining Ground in Understanding the Play-Literacy Relationship. *American Journal of Play*, 6(1), 82-97.
    - Weisberg, D. S., Zosh, J. M., Hirsh-Pasek, K., & Golinkoff, R. M. (2013). Talking it up: play, language development, and the role of adult support. *American Journal of Play*, *6*(1), 39-54.
    - Supplemental:
        - Bergen, D., & Mauer, D. (2000). *Symbolic play, phonological awareness, and literacy skills at three age levels.* In K. A. Roskos & J. F. Christie (Eds.), *Play*

and literacy in early childhood: Research from multiple perspectives (p. 45–62). Lawrence Erlbaum Associates Publishers.

- Nicolopoulou, A., & Ilgaz, H. (2013). What do we know about pretend play and narrative development? a response to Lillard, Lerner, Hopkins, Dore, Smith, and Palmquist on" the impact of pretend play on children's development: a review of the evidence". *American Journal of Play*, *6*(1), 55-81.

Week 10: Play and Math Learning

- Does play facilitate learning numerical knowledge and spatial skills?
- Is math learning enhanced by particular kinds of play?
- Readings
  - Ramani, G. B., & Siegler, R. S. (2008). Promoting broad and stable improvements in low-income children's numerical knowledge through playing number board games. *Child development*, *79*(2), 375-394.
  - Levine, S.C., K.R. Ratliff, J. Huttenlocher & J. Cannon. 2012. Early puzzle play: a predictor of preschoolers' spatial transformation skill. *Developmental Psychology* 48: 530–542.
  - Fisher, K. R., Hirsh-Pasek, K., Newcombe, N., & Golinkoff, R. M. (2013). Taking shape: Supporting preschoolers' acquisition of geometric knowledge through guided play. *Child development*, *84*(6), 1872-1878.
  - Supplemental:
    - Ferrara, K., Hirsh-Pasek, K., Newcombe, N. S., Golinkoff, R. M., & Lam, W. S. (2011). Block talk: Spatial language during block play. *Mind, Brain, and Education*, *5*(3), 143-151.

Week 11: Towards a Playful Pedagogy

- Does academic performance benefit by allowing recess? What are the mechanisms?
- How can play be incorporated into learning experiences in schools and public spaces?
- Are there evidence-based interventions demonstrating the efficacy of a playful pedagogical approach?
- Readings
  - Weisberg, D. S., Hirsh-Pasek, K., & Golinkoff, R. M. (2013). Guided play: Where curricular goals meet a playful pedagogy. *Mind, Brain, and Education*, *7*(2), 104-112.
  - Hassinger-Das, B., Bustamante, A. S., Hirsh-Pasek, K., & Golinkoff, R. M. (2018). Learning landscapes: Playing the way to learning and engagement in public spaces. *Education Sciences*, *8*(2), 74.
  - Pellegrini, A. D., & Bohn, C. M. (2005). The role of recess in children's cognitive performance and school adjustment. *Educational researcher*, *34*(1), 13-19.
  - Supplemental:
    - Samuelsson, I. P., & Carlsson, M. A. (2008). The playing learning child: Towards a pedagogy of early childhood. *Scandinavian journal of educational research*, *52*(6), 623-641.

Week 12: Game-Based Learning

- How do insights into the neural mechanisms of reward learning inform game-based learning in the classroom?
- How do theories about play and education inform the development of game-based learning?

- Does game-based learning transfer to cognitive skills and facilitate academic performance?
- Readings
    - Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist*, *50*(4), 258-283.
    - Green, C.S., A. Pouget & D. Bavelier. 2010. Improved probabilistic inference as a general learning mechanism with action video games. *Current Biology* 20**:** 1573–1579.
    - Young, M. F., Slota, S., Cutter, A. B., Jalette, G., Mullin, G., Lai, B., ... & Yukhymenko, M. (2012). Our princess is in another castle: A review of trends in serious gaming for education. *Review of educational research*, *82*(1), 61-89.
    - Supplemental:
        - Howard-Jones, P. A., & Jay, T. (2016). Reward, learning and games. *Current opinion in behavioral sciences*, *10*, 65-72.

Week 13: Synthesizing What We Have Learned and Future Directions

- What are other open questions in the field that would be fruitful avenues for investigation?

Course requirements:

Class preparation and participation:

The assigned readings are designed to give you a broad overview of the field and engage your critical thinking skills. Strong preparation and participation in class will elevate the level of discussion and lead to thought-provoking discussion. You will be asked to submit a short (one-paragraph) reading response to the week's readings on CourseWorks by 5:00pm the day before each class period. In these responses, you can discuss something you found interesting in the readings, questions you have about the material, or areas of the reading you think warrant critique or further investigation. The assignments will be graded on a pass/fail basis, but these assignments must be submitted before the deadline if you are to pass that week's assignment.

To ensure that everyone is keeping up with the readings and meaningfully contributing to class discussions, your active participation in class discussions will contribute to your final grade. Effective participation in class includes asking insightful or clarifying questions, offering critiques of the research methodology and conclusions drawn by the authors, connecting the readings to other material, and actively listening to your peers. If regularly contributing to class discussions is difficult for you, please raise this issue with me as soon as possible and we may be able to work out other ways for you to contribute in a thoughtful way.

Leading discussions: You will be responsible for presenting an article and leading the class discussion for at least two class meetings. A primary objective in this course is to help you develop your oral and written communication skills, and it is important to demonstrate that you can present an article in a clear way. In the first week of class, I'll provide more information and give a demonstration of the sort of presentation I'm looking for. Briefly, you'll walk us through your assigned article, describing the methods and results, critiquing the strengths and weaknesses of the study design, and explaining the importance of the findings. Please meet with me at least two days prior to your presentation, so I can provide feedback and help answer any questions you have. Because the goal is for you to become more skilled in presenting research findings and lead discussion, the second presentation will be weighted more heavily than the first.

Experiment Proposal Paper: Early in the semester, you will be asked to start thinking about an open question in the field of play research and how you would address the question with an empirical study. We will discuss this project in greater detail in class; in short, you'll be asked to submit a topic proposal, an experimental design, and a final draft of 10-15 pages that includes a review of relevant literature, a description of your experimental design, and a discussion section outlining your anticipated results and how you would interpret them. The topic proposal—the first assignment due Week 6—will include a short paragraph about your intended topic and a list of at least five (and no more than 10) references to support your rationale. I will review this and provide feedback on the topic and potential sources. Once your topic is approved, you can begin designing the experiment, which you will present in class during Week 8. Your feedback in class should inform how you move forward with your final research proposal paper, which will be due the last day of classes.

Grading: Grades will be calculated based on the percentages outlined below.

A. Class preparation and participation.....25%
- Reading responses 10%
- Contribution to class discussion 15%

B. Discussion leading.....35%
- First presentation 15%
- Second presentation 20%

C. Experiment proposal paper.....40%
- Topic proposal: 5%
- Proposed experimental design: 10%
- Final draft: 25%

Class policies:

Diversity & Inclusion: My aim is to foster a learning environment that supports a diversity of perspectives and experiences and honors your identities. Please reach out to me with any concerns or suggestions you may have to better address your learning needs and to improve the effectiveness of this course. I look forward to working together to create a classroom community built on mutual respect and inclusivity.

Students with Disabilities: Students with special needs who may require classroom/assignment accommodations should make an appointment with me before or during the first week of class. You should also contact the Office of Disability Services (ODS) in Lerner Hall before the start of the course to register for these accommodations. The procedures for registering with ODS can be found at http://health.columbia.edu/services/odsor by calling (212) 854-2388.

Academic integrity: As members of this academic community, we are responsible for maintaining the highest level of personal and academic integrity: "Each one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity.... The exchange of ideas relies upon a mutual trust 12 that sources, opinions, facts, and insights will be properly noted and carefully credited. In practical terms, this means that, as students, you must be responsible for the full citations of others' ideas in all of your research papers and projects... [and] you must always submit your own work and not that of another student, scholar, or internet agent" (from the Columbia University Faculty Statement on https://www.college.columbia.edu/faculty/resourcesforinstructors/academicintegrity/statement).

Plagiarism—whether intentional or inadvertent—is a serious violation of academic integrity. If you have any questions about what constitutes plagiarism and/or how to properly cite sources, please come to me. I am more than happy to help. Similarly, if you put yourself in a situation, e.g., starting an assignment very late, in which you think your best option might be to cut some corners, see me. It is far better to have a few points deducted from a paper than to compromise your academic integrity and potentially put your academic standing in jeopardy.

Attendance: Class participation is the foundation of this course. Of course, there are times when life gets in the way of things, but more than one absence will be detrimental to your learning – and to your grade. One absence will not negatively impact your grade, but please inform me of the absence as soon as possible. You will still be responsible for the work due in that class, e.g., reading responses and interim deadlines for the final paper.

Late assignments: If there's an appropriate reason for turning an assignment in late, please discuss it with me well in advance so that we can work out an arrangement. I will have to penalize late assignments, unless there is an appropriate reason and the revised due date has been agreed upon ahead of time.

Class Etiquette: Research shows that many of us think we're good multi-taskers. Research also shows that most of us are not. If you typically take notes or read papers on a laptop, you can use the laptop in class. But, out of respect for your classmates and in the interest of your own learning and ability to actively participate in class discussions, please refrain from using your laptop inappropriately.