

**Welcome to PSYC 41495-002/PSYC 81691-002: Development of Mathematical Cognition
Spring 2017
Tuesday and Thursday, 11:00 AM to 12:15 PM
Kent Hall, Room 380 (across from Applied Psychology Center)**

Instructor Information

Clarissa A. Thompson, Ph.D.

Office hours: Mondays 9:30 AM to noon, Fridays 9:30 AM to noon, or by appointment

Office location: Kent Hall Addition, Room 228

Email: cthomp77@kent.edu (preferred)

Office phone: (330) 672 – 3948

Course website: learn.kent.edu

Course Overview and Learning Outcomes

This course is meant to provide a very broad overview of research conducted in the domain of mathematical cognition. We will read high-impact, empirical and review papers from some of the leading experts in the field. Here are my main goals for students who take this course:

1. Students will learn about the methods used by cognitive developmental psychologists (and mathematics educators) to ascertain what children and adults know, and what they don't know, about mathematics. In support of this goal, students will write response papers and craft discussion questions that challenge the assertions of the assigned papers.
2. Students will explore the merits of basic and applied educational research. Students will identify how lab-based research might inform actual teaching practices. That is, how can we get these findings into the hands of teachers who can implement them with real classrooms of students? In support of this goal, students will create a game-based intervention/assessment that is appropriate for preschoolers. This mathematics game should be based on findings that are discussed in the course. Students will have an opportunity to work with several preschoolers from the Kent State University Child Development Center to "pilot test" their math game and gain intuitions about how young children reason about mathematics. Students should retain some practical information after leaving this course. To that end, students will be asked to think about what they're learning in the course and what advice they'd give to pre-service and in-service teachers who want to help their students learn mathematics at a deeper, conceptual level.
3. Students will learn how to write a proposal to fund their mathematics-focused research. One such external funding mechanism that supports education research is the Spencer Foundation. In support of this goal, students will write the proposal narrative for the Spencer Foundation's Small Research Grant. Learning how to apply for funding is an important part of an academic's job, and funding is often necessary to carry out high-caliber and impactful research plans.

Assigned Course Readings

The domain of mathematical cognition is quite vast. I have decided to take a minimalist approach to our reading list. We will read one or two articles in preparation for each class meeting so that we can discuss these articles in depth and think more about their limitations, possible future directions, and classroom applications. That being said, if a particular area piques your interest, please let me know! I'll be happy to point you in the direction of additional readings to support your course project. Copy and paste the links from the course calendar, and if you are on campus, you should be able to access the articles from the KSU library system, Google, or Research Gate. Let me know if you have any trouble with the links.

Course Expectations about Attendance and Participation

The fact that this is a small seminar, rather than a large lecture, offers both opportunities and challenges. The opportunities are for people to express themselves actively on a regular basis, rather than sitting back and just taking in what a lecturer tells them. The challenges are that with no one giving a lecture, the quality of the class depends at least as much on what you do as on what I do. For this reason, the ground rules of the class are somewhat different than most. Attendance is obligatory; I will expect everyone to be at each class meeting. I realize that on rare occasions, it is impossible to be at a particular class, but these exceptions should be kept to a minimum. Everyone is expected to actively participate in the discussion. This is essential if the class is to be a true seminar, rather than degenerating into a rotating lectureship or a conversation among a few interested students.

Components of Course

Grades in the course will be based on (1) daily response papers and conceptual discussion questions, (2) leading and participating in class discussions, (3) creation of a mathematics game for preschoolers, and (4) submission of a grant proposal. Each component will be worth 25% of your overall grade. Please keep in mind that the main goal of these assignments is to get you to think critically about the overarching topic of mathematical cognition. You should aim to attain a mastery of the assigned articles and propose ways to apply the findings in the real world (e.g., classroom).

Daily Response Papers and Conceptual Discussion Questions

After reading the assigned papers, create a one-page (seriously, just one page, no more!) document that contains a paragraph summary of the assigned readings (e.g., What was the main hypothesis? Method used? Results? Implications for the field of mathematical cognition?), your thoughts about how you might distill and convey these findings for pre-service and in-service teachers, and at least two conceptual-level discussion questions that will jump start our in-class discussion of the papers. These discussion questions should not be basic clarification questions (e.g., Why did the authors only test 5th graders in Wisconsin?). Rather, the questions should synthesize the research and speculate about the generalizability/practical application of the findings. It's OK if you don't have the answer to the question—that's why we conduct empirical research after all. We'll try to answer these discussion questions together as a class!

Daily response papers will be due by 9 AM on the day that we discuss the topic in class. Please submit your response papers to the dropbox in Blackboard and note that plagiarism detection is turned on in these dropboxes.

Leading and Participating in Class Discussions

Leading and participating in class discussions includes summarizing the main points of the assigned articles, having several discussion questions ready to pose to the rest of the class about the assigned readings, and active participation when someone else is leading the discussion of the assigned readings. It is especially important to participate actively when other people lead the discussion to insure that the experience is a good one for them and for the entire class. Remember: If you contribute interesting and informed perspectives when others lead the discussion, they are likely to do the same for you.

After discussion on "syllabus day," we decided that presenters will be decided in advance. Some students stated their preference on topics. Please see the updated course calendar for the weeks on which you will serve as presenter. All students will lead the same number of discussions throughout the semester. There's not a ton of pressure in leading a discussion because you will have already prepared your daily response paper and relevant discussion

questions for the assigned readings. Remember, we're all in this together. Let's make the most of each discussion!

Creation of a Mathematics Game for Preschoolers

Check out the Common Core State Standards for mathematics:

<http://www.corestandards.org/Math/>

Many empirical findings from mathematics cognition are apparent in these standards. The trouble is that teachers don't often receive professional development related to how to implement new empirical findings in their classrooms. So, there is quite a disconnect between lab-based research and the way that mathematics is taught in classrooms. Here's your chance to take a first step at engaging in translational research. I want you to think about how you can turn the research that we've discussed in class into a fun game about mathematics that is appropriate for a preschooler. I thought it'd be fun for you to get to work with some super cute and precocious three- to five-year-olds. So, we'll take a field trip to the College Classroom in the KSU Child Development Center where you'll get to play your mathematics game with some highly motivated children. We'll have a one-on-one meeting during class time to chat through your ideas about the game before you construct it and play it with real preschoolers! More details to come.

Grant Proposal Submission

If you'd like, you can take your mathematics game idea one step further by writing a research grant to fund this research. Or, if you have a different idea that is more relevant to the research that you're conducting at KSU, please feel free to propose this idea. We'll have a one-on-one meeting about your idea, and I can point you to some additional articles based on your interests if needed. You will write a short (1800 words or less) proposal to the Spencer Foundation. You will follow the instructions provided on their website (and reproduced below) for your final project. Please keep in mind that even though the proposal is short, it needs to be fully fleshed out. Sometimes it is more challenging to write a concise paper than a lengthy one. Don't leave this assignment until the last minute!

Small Research Grant Guidelines: <http://www.spencer.org/small-research-grants-application-guidelines>

The proposal narrative should be uploaded as a PDF file and should include the following elements:

- a description of the project and the central research question(s) and its significance;
- a brief summary of the relevant literature, the relationship of the proposed research to that literature, and the new knowledge expected to result from the proposed research;
- a summary of the conceptual framework, research methods, data collection instruments, and modes of analysis that the project will employ; and
- a clear identification of the Principal Investigator(s) and a clear definition of the role(s) he/she and any supporting researcher(s) will play.

Formatting requirements: The proposal narrative may not exceed 1800 words; at the conclusion of the narrative, please note the word count in parentheses. Your reference list should follow your narrative in the same PDF and will not count toward the 1800 word limit. The text should be double-spaced and in a standard, readable font and font size.

University Policies

Academic Misconduct

University policy 3-01.8 deals with the problem of academic dishonesty, cheating, and plagiarism. None of these will be tolerated in this class. The sanctions provided in this policy will be used to deal with any violations. If you have any questions, please read the policy at http://www.kent.edu/policyreg/policydetails.cfm?customel_datapageid_1976529=2037779 and/or ask.

Reasonable Accommodations for Students with Disabilities

University policy 3342-3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 330-672-3391 or visit www.kent.edu/sas for more information on registration procedures).

Academic Calendar and Registration Deadline

Important dates for the Spring 2017 semester can be found here:

<https://www.kent.edu/registrar/spring-important-dates>. It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

The official registration deadline for this course is **January 22, 2017**. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashLine) prior to the deadline indicated. Registration errors must be corrected prior to the deadline. The course withdraw deadline is **March 26, 2017**.

Course Calendar

Your instructor reserves the right to update/amend this syllabus as needed.

Weeks	Dates	Presenter	Topics	Readings	Links
Week 1	Jan 17		Syllabus & Course Overview	http://panamath.org/index.php	
	Jan 19	Kayla	Approximate Number System	Feigenson, Dehaene, & Spelke, 2004 Halberda et al., 2012	http://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(04)00131-7 http://www.halberdalab.net/files/HalberdaEtAl2012.pdf
Week 2	Jan 24	Erin	Numbers & the brain	Dehaene et al., 2003	http://www.unicon.org/publications/DehaeneEtAl3%20parietalCircuits_CogNeuropsych2003.pdf
	Jan 26	Jen		Jacob et al., 2012	http://www.sciencedirect.com/science/article/pii/S1364661312000344
Week 3	Jan 31	Colleen	Infants' Numerical Understanding	McCrink & Wynn, 2004	http://journals.sagepub.com/doi/full/10.1111/j.1095-7976.2004.00755.x
				McCrink & Wynn, 2007	http://www.jstor.org/stable/40064768?seq=1#page_scan_tab_contents
	Feb 2	Ben		Mix, Huttenlocher, & Levine, 2002	https://www.researchgate.net/publication/11433173_Multiple_Cues_for_Quantification_in_Infancy_Is_Number_One_of_Them
Week 4	Feb 7	Erin	Language/Learning Count List	Cheung et al., in press	https://static1.squarespace.com/static/55d8de91e4b0dd59bce96a7e5/15717cbe9b3db2bc355715b7e/1475857366759/CheungEtAl1%2810.5.16%29+Under+Review.pdf
	Feb 9	Jen		Gordon et al., 2004	http://staff.um.edu.mt/albert.gatt/teaching/dl/go_rdon04_numerical-cognition-without-words.pdf
Week 5	Feb 14	Colleen	Culture	Paik & Mix, 2003	http://languagelog.ldc.upenn.edu/myl/surprise/1106/PaikMix2003.pdf
				Pica et al., 2004	http://science.sciencemag.org/content/306/5695/499
	Feb 16	Ben		Carraher, Carraher, & Schliemann, 1985	http://online.library.wiley.com/doi/10.1111/j.2044-835X.1985.tb00951.x/abstract
				Stevenson, Chen, & Lee, 1993	http://science.sciencemag.org/content/259/5091/753
Week 6	Feb 21	Kayla	Space & Number	McCrink & Opfer, 2014	http://cdp.sagepub.com/content/23/6/439.abstract
				Pruden et al., 2011	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3372906/
	Feb 23	Colleen		Mix et al., 2016	https://www.researchgate.net/publication/303413374_Development_of_Quantitative_Thinking_Across_Correlated_Dimensions
Week 7	Feb 28	Jen	NL Estimation	Siegler & Opfer, 2003	http://www.psy.cmu.edu/~siegler/SieglerOpfer03.pdf
	Mar 2	Ben		Opfer, Thompson, & Kim, 2016	https://www.ncbi.nlm.nih.gov/pubmed/26774104
Week 8	Mar 7	Erin	Conceptual vs. Procedural Understanding	Fyfe, DeCaro, & Rittle-Johnson, 2014	http://online.library.wiley.com/doi/10.1111/bjep.12035/abstract
	Mar 9		Individual game proposal meeting	Schneider, Rittle-Johnson, & Star, 2011	https://www.ncbi.nlm.nih.gov/pubmed/21827291
Week 9	Mar 14	Jen	Analogy & Transfer	Richland, Zur, & Holyoak, 2007	http://learninglab.uchicago.edu/Publications_files/6%20Richland%20%282007%29%20Cog%20support%20for%20Analogies.pdf
				Sidney & Alibali, 2015	http://www.tandfonline.com/doi/abs/10.1080/15248372.2013.792091
	Mar 16	Kayla		Kaminski, Sloutsky, & Heckler, 2008	http://science.sciencemag.org/content/320/5875/454
Week 10	Mar 21	Ben	Arithmetic	Hamdan & Gunderson, 2016	https://www.ncbi.nlm.nih.gov/pubmed/27854466
	Mar 23		CDC Game Demonstration	McNeil, 2007	https://www3.nd.edu/~nmcneil/McNeil07.pdf
Week 11	Mar 28 & 30		No Class: Spring Break	Booth & Siegler, 2008	http://psy.cmu.edu/~siegler/boo-sieg08.pdf
Week 12	Apr 4	Erin	Interventions	Ramani & Siegler, 2008	http://www.psy.cmu.edu/~siegler/Ram-Sieg2008.pdf
	Apr 6		No Class: SRCD Conference	Berkowitz et al., 2015	https://cogdevlab.uchicago.edu/sites/cogdevlab.uchicago.edu/files/uploads/Science-2015-Berkowitz196-8.pdf
Week 13	Apr 11	Colleen	Fractions	Siegler, Thompson, & Schneider, 2011	http://www.psy.cmu.edu/~siegler/SIS2011.pdf
				Alibali & Sidney, 2015	http://www.sciencedirect.com/science/article/pii/S0959475215000043
	Apr 13	Jen		Lewis, Matthews, & Hubbard, 2015	http://website.education.wisc.edu/edneurolab/wp-content/uploads/2016/01/LewisMathewsHubbard_Final.pdf
Week 14	Apr 18	Kayla	Algebra & Patterns	Booth et al., 2014	http://www.sciencedirect.com/science/article/pii/S0022096513001793
				Fyfe, McNeil, & Rittle-Johnson, 2015	http://online.library.wiley.com/doi/10.1111/cdev.12331/abstract
	Apr 20		Discuss individual project proposals		
Week 15	Apr 25	Erin	Mathematical Difficulties	Geary et al., 2007	http://web.missouri.edu/~gearyd/files/Geary%20et%20al.%202007%20Child%20Development1.pdf
	Apr 27	Ben		Jordan & Levine, 2009	https://www.ncbi.nlm.nih.gov/pubmed/19213011
				Mazzocco et al., 2013	https://www.ncbi.nlm.nih.gov/pubmed/24027540
Week 16	May 2	Colleen	Math Anxiety	Maloney et al., 2015	https://cogdevlab.uchicago.edu/sites/cogdevlab.uchicago.edu/files/uploads/Maloney%20et%20al%20%282015%29%20Intergenerational%20effects.pdf
				Ramirez et al., 2015	https://cogdevlab.uchicago.edu/sites/cogdevlab.uchicago.edu/files/uploads/Ramirez%20et%20al%2013_Anxiety.pdf
	May 4	Kayla			https://www.researchgate.net/publication/283444631_Is_Math_Anxiety_Always_Bad_for_Math_Learning_The_Role_of_Math_Motivation
Finals	May 9		Project Due Date	Wang et al., 2015	