OMB No. 0925-0001 and 0925-0002 (Rev. 10/15 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. DO NOT EXCEED FIVE PAGES. NAME: Clarissa A. Thompson eRA COMMONS USER NAME (credential, e.g., agency login): clarissathompson POSITION TITLE: Assistant Professor of Psychological Sciences EDUCATION/TRAINING *(Begin with baccalaureate and include postdoctoral training if applicable. Add/delete rows as necessary)*

INSTITUTION AND LOCATION
DEGREE (if applicable)
Completion Date MM/YYYY

FIELD OF STUDY
California University of PA, California, PA
AB 12/2002 Psychology and Music
The Ohio State University, Columbus, OH
MA 06/2005 Developmental and Cognitive
Psychology The Ohio State University, Columbus, OH
PHD 06/2008 Developmental and Cognitive
Psychology Carnegie Mellon University, Pittsburgh, PA
Postdoctoral Fellow
08/2010 Cognitive Development;
Supervised by Robert Siegler

A. Personal Statement

I am a psychologist who studies children's cognitive development, and I established the Kent State University (KSU) Cognitive Development Lab (www.clarissathompson.com) in the Fall 2014 semester after working in a tenure track position at the University of Oklahoma for four years. My overarching program of research in cognitive development investigates the ways that children and adults (1) learn and transfer knowledge to novel contexts, (2) develop strategies to solve problems, (3) remember information, and (4) differ in accuracy and response times as they make simple two-choice decisions. I study these questions in the domain of mathematics learning and problem solving.

1. Fazio LK, Bailey DH, Thompson CA, Siegler RS. Relations of different types of numerical magnitude representations to each other and to mathematics achievement. J Exp Child Psychol. 2014 Jul;123:53-72. PubMed PMID: 24699178. 2. Siegler RS, Thompson CA. Numerical landmarks are useful--except when they're not. J Exp Child Psychol. 2014 Apr;120:39-58. PubMed PMID: 24382407. 3. Siegler RS, Thompson CA, Schneider M. An integrated theory of whole number and fractions development. Cogn Psychol. 2011 Jun;62(4):273-96. PubMed PMID: 21569877. 4. Thompson CA, Opfer JE. Costs and benefits of representational change: effects of context on age and sex differences in symbolic magnitude estimation. J Exp Child Psychol. 2008 Sep;101(1):20-51. PubMed PMID: 18381214.

B. Positions and Honors

Positions and Employment 2010 - 2014 Assistant Professor of Psychology, University of Oklahoma, Norman, OK 2014 - Assistant Professor of Psychological Sciences, Kent State University,

Kent, OH

Other Experience and Professional Memberships - Member, Cognitive Development Society, Society for Research in Child Development, Psychonomics Society, Society for the Teaching of Psychology - Conference submission reviewer, AERA, Cognitive Development Society, Cognitive Science Society, and Society for Research in Child Development - Textbook and supplement reviewer, McGraw Hill and Cengage

Honors 2015 - 2017 Editorial Board Member for two high-impact journals, Journal of *Experimental Child Psychology* and *Developmental Psychology*
2017 Assistant Editor of online research methods textbook, Top Hat

C. Contribution to Education Research

1. Learning and Transfer to Novel Contexts

Younger children possess less precise, logarithmic representations, whereas older children possess more accurate and adult-like representations. My work (Thompson & Opfer, 2010) was the first to show evidence for the logarithmic-to-linear shift in larger numeric ranges (0-10,000 and 0-100,000) at later time points in development.

Second graders abruptly adopt a linear representation if they receive corrective feedback about the placement of 150, the maximally discrepant point between a logarithmic and linear function constrained to pass through 0 and 1,000 (Opfer & Siegler, 2007). In my work, I investigated whether robust transfer of the linear representation might be induced without any direct feedback at all (Thompson & Opfer, 2010). I progressively aligned (Gentner, 1983; Kotovsky & Gentner, 1996) small and large numeric scales by presenting them simultaneously to children. Children randomly assigned to the no progressive alignment group were unable to compare their answers across smaller and larger numeric ranges, and these participants did not accurately scale up their linear representation to increasingly larger scales.

There is an ongoing debate in the literature about whether children's numerical representations actually undergo a qualitative shift from logarithmic to linear (Barth, Slusser, Cohen, & Palladino, 2011; Opfer, Siegler, & Young, 2011; Slusser, Santiago, & Barth, 2013). Our results (Opfer, Thompson, & Kim, 2016) showed that

model fit was not impacted by whether children were asked to estimate an equal sampling of numbers spanning the 0-1,000 number line or whether numerosities were over-sampled at the low end of the numerical scale, but model fit was greatly impacted when children were given feedback about the midpoint of the line.

How good are children at monitoring the fact that they can more easily estimate the location of whole numbers in small numeric ranges, than the location of whole numbers in large numeric ranges? Our research group (Wall, Thompson, Dunlosky, & Merriman, 2016) chose a small numeric range in which our participants should make accurate estimates, and a large numeric range in which they should make inaccurate estimates. Our findings indicated that children are generally more confident in their small-scale estimates than their large-scale estimates. We replicated these findings in two additional studies, and furthermore, found evidence that children used their confidence judgments to control their behavior.

a. Wall JL, Thompson CA, Dunlosky J, Merriman WE. Children can accurately monitor and control their number-line estimation performance. Dev Psychol. 2016 Oct;52(10):1493-1502. PubMed PMID: 27548391. b. Opfer JE, Thompson CA, Kim D. Free versus anchored numerical estimation: A unified approach. Cognition. 2016 Apr;149:11-7. PubMed PMID: 26774104. c. Thompson CA, Opfer JE. How 15 hundred is like 15 cherries: effect of progressive alignment on representational changes in numerical cognition. Child Dev. 2010 Nov-Dec;81(6):1768-86. PubMed PMID: 21077863. d. Opfer JE, Thompson CA. The trouble with transfer: insights from microgenetic changes in the representation of numerical magnitude. Child Dev. 2008 May-Jun;79(3):788-804. PubMed PMID: 18489428.

2. Fractions and Strategy Choice

Recently, I have focused on children's and adults' misconceptions about fractions (Fazio, Bailey, Thompson, & Siegler, 2014; Siegler & Thompson, 2014; Siegler, Thompson, & Schneider, 2011; Thompson & Opfer, 2008). We proposed an integrated theory of whole numbers and fractions (Siegler et al., 2011). Unlike earlier theories about fractions that suggested understanding of whole numbers was privileged and fraction understanding was hard-won, we argued that children sometimes overextend what they know to be true about whole numbers to all numbers, including fractions. Overextension of knowledge about whole numbers to fractions can lead to misconceptions. In my program of research (Siegler, Thompson, & Schneider, 2011; Siegler & Thompson, 2014; Sidney, Thalluri, Buerke, & Thompson, under review), I evaluate students' fraction misconceptions by asking children and adults to explain their answers and characterizing their strategy choices. Children who reported translating fractions into easier to handle numbers (3/5 = 60%), segmenting the number line into parts (e.g., referencing that 1⁄2 is the midpoint of a 0-1 number line and 2 1⁄2 is the midpoint of a 0-5 number line), and discussing the holistic magnitude of the fraction (e.g., 1/11 is very small and close to

0) made more accurate estimates and were likely to have higher overall mathematics achievement scores.

a. Fazio LK, Bailey DH, Thompson CA, Siegler RS. Relations of different types of numerical magnitude representations to each other and to mathematics achievement. J Exp Child Psychol. 2014 Jul;123:53-72. PubMed PMID: 24699178.
b. Siegler RS, Thompson CA. Numerical landmarks are useful--except when they're not. J Exp Child Psychol. 2014 Apr;120:39-58. PubMed PMID: 24382407. c. Siegler RS, Thompson CA, Schneider M. An integrated theory of whole number and fractions development. Cogn Psychol. 2011 Jun;62(4):273-96. PubMed PMID: 21569877. d. Thompson CA, Opfer JE. Costs and benefits of representational change: effects of context on age and sex differences in symbolic magnitude estimation. J Exp Child Psychol. 2008 Sep;101(1):20-51. PubMed PMID: 18381214.

3. Memory and Numerical Representations

Learning and memory are intricately linked. Children's performance on tasks in which they estimated numbers on number lines, created lines of particular lengths, and produced sets of dots was correlated with their ability to recall numeric information presented in meaningful vignettes (Thompson & Siegler, 2010). In a follow-up study with second graders (Thompson & Opfer, 2016), I found that improvements to children's numerical estimation accuracy and recall accuracy are causally linked. Those children who adopted a linear representation in the 0-1,000 range after receiving feedback on numbers around 150 more accurately recalled numbers than did children who did not learn a linear representation of numbers.

a. Thompson CA, Opfer JE. Learning Linear Spatial-Numeric Associations

Improves Accuracy of Memory for Numbers. Front Psychol. 2016;7:24. PubMed PMID: 26834688; PubMed Central PMCID: PMC4720732. b. Thompson CA, Siegler RS. Linear numerical-magnitude representations aid children's memory for numbers. Psychol Sci. 2010 Sep;21(9):1274-81. PubMed PMID: 20644108.

4. Individual Differences in Accuracy and Response Times

To better understand the nature of numerical development, I have also investigated the components of information processing that differ between children and adults as they make simple, two-choice mathematics decisions. My previous research (Ratcliff, Love, Thompson, & Opfer, 2012) asked children and adults to compare non-symbolic whole numbers. For instance, participants saw an array of dots flashed on the screen, and they had to decide whether there were more or less than 50 dots visible. We applied the Diffusion Model (Ratcliff, 1978), a sequential sampling model, to better understand the components of information processing that differed across the lifespan. We found that college-aged adults made faster and

more accurate decisions than did children because adults accumulated higher-quality evidence prior to making their decisions, set more narrow decision criteria, and encoded the stimuli and executed their responses quicker than did children. In subsequent studies, we tracked individual differences in these components of information processing across symbolic and non-symbolic whole number comparisons and recognition memory tasks (Ratcliff, Thompson, & McKoon, 2015; Thompson, Ratcliff, & McKoon, 2016). We found strong correlations across tasks on accuracy, response times, and the components of information processing.

a. Thompson CA, Ratcliff R, McKoon G. Individual differences in the components of children's and adults' information processing for simple symbolic and non-symbolic numeric decisions. J Exp Child Psychol. 2016 Oct;150:48-71. PubMed PMID: 27239983. b. Ratcliff R, Thompson CA, McKoon G. Modeling individual differences in response time and accuracy in numeracy. Cognition. 2015 Apr;137:115-36. PubMed PMID: 25637690; PubMed Central PMCID: PMC4353499. c. Ratcliff R, Love J, Thompson CA, Opfer JE. Children are not like older adults: a diffusion model analysis of developmental changes in speeded responses. Child Dev. 2012 Jan-Feb;83(1):367-81. PubMed PMID: 22188547; PubMed Central PMCID: PMC3267006.

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

R305A160295, IES

Opfer (PI) 07/01/16-06/30/20 Cognitive Support for Learning Fractional Magnitudes We investigate whether East Asian cognitive supports (e.g., analogies, fraction language) impact fraction learning and transfer students in the U.S. Role: CPI; 26.05% CY effort

Pending Award, IES Thompson (PI) 07/01/18-06/30/22 Assessing the Impact of Area and Number Line Models for Learning and Transfer of Fraction Multiplication and Division in Fifth Grade Can visual models, such as number lines, help children learn about fraction division and transfer their learning to other relevant problems? In this project, we will develop a fraction multiplication and division app as well as classroom modules to help students and teachers learn about this difficult course content. Role: PI; 18% CY effort

Pending Award, NSF Thompson (PI) 07/01/18-06/30/21 Collaborative research: Comparing area models and number lines for processing fifth grade fraction arithmetic tasks of differing depths of knowledge Can visual models, such as number lines, help children learn about fraction division and transfer their learning to other relevant problems? In this project, we will develop a fraction multiplication and division app as well as classroom modules to help students and teachers learn about this difficult course content. Role: PI; 2.25 AY months, 1 summer month

Pending Award, NSF Thompson (Co-PI) 06/01/18-06/30/22 Collaborative research: Exploring a structure-based intervention approach on patterns for fourth and fifth grade students with mathematical difficulties (Project SIP for SMDs) In this interdisciplinary project that spans psychology, mathematics education, and special education, we will: (1) identify and understand factors and critical “pressure points” (i.e., intrinsic components; Perfetti & Adlof, 2012) that are associated with the development of strong structure sense and efficient generalization skills among 4th and 5th grade Students with Math Difficulties (SMDs) in the context of their experiences with non-repeating patterns (e.g., linear patterns) and (2) develop, test, and refine a structure-based intervention approach on patterns (SIP) that can facilitate that development. Role: Co-PI; 2.25 AY months, 1 summer month