**Elizabeth M. Brannon, Ph.D.**

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# Personal Data

# Date of Birth January, 16, 1971

Place of Birth Ann Arbor, MI

# Education

Ph.D., Columbia University, Psychology, 2000

Advisor, Dr. Herbert S. Terrace

Thesis Title “Ordinal numerical representations in rhesus monkeys”

Ph.D. awarded with distinction

M.A., Columbia University, Biological Anthropology, 1994

Advisor, Dr. Marina Cords

B.A., University of Pennsylvania, Biological Anthropology, 1992

## Thesis advisor, Dr. Dorothy Cheney

*summa cum laude* with distinction in the major

## Positions Held

Full Professor, Department of Psychology, The University of Pennsylvania 2015-

Full Professor, Center for Cognitive Neuroscience & Department of Psychology and Neuroscience, Duke University, 2012- **(**On leave**)**

Associate Professor, Center for Cognitive Neuroscience & Department of Psychology and Neuroscience, Duke University, 2008-2011

Associate Professor, Evolutionary Anthropology, Duke University, 2008-present (Secondary Appointment)

Adjunct Assistant Professor, Department of Psychology, University of North Carolina, Chapel Hill. 2002-present (Secondary Appointment)

Assistant Professor, Center for Cognitive Neuroscience & Department of Psychology and Neuroscience, Duke University, 2001-2008

Assistant Research Professor, Center for Cognitive Neuroscience & Department of Psychology: Experimental, Duke University, 2000-2001

## Honors and Awards

Nominated for Psychonomic Society Governing Board, 2014

James McDonnell Scholar Award, 2008-2015

Early Investigator Award, Society for Experimental Psychology (SEP), 2008

Thomas Langford Lectureship Award, Duke University, 2008

NSF CAREER Award (2005-2010)

John Merck Scholar (2003-2007)

Ph.D. awarded with distinction, 2000

Presidential Teaching Award, Columbia University, 1997

*summa cum laude* with distinction in the major, 1992

Phi Beta Kappa, elected 5/12/93

University Scholar of the University of Pennsylvania, 1989-1992

National Research Service Award, NIMH, 1998-2000

National Science Foundation Graduate Fellowship, 1993-1996

University Scholar Research Grant, University of Pennsylvania, 1992

Research Grants and Fellowships

## *Current funding*

## 2014-2019 RO1 HD079106-01

## “Improving Math Ability via Primitive Number Sense Training”

Elizabeth M. Brannon (PI)

The main goals of this research proposal are to explore the cognitive and neural relationship between approximate arithmetic and symbolic arithmetic in adults and children using training paradigms and fMRI.

2010-2016 National Science Foundation Research Grant, 0951690

“*Relationship between early and later developing numerical abilities*”

Elizabeth M. Brannon (PI). $699,966 (no cost extension)

2008-2016 James S. McDonnell Foundation Scholar Award. Elizabeth M. Brannon (PI). $600,000 (no cost extension)

#### *Completed funding*

*2013-2015* National Center for Responsible Gaming,

Scott Huettel (PI), Brannon Co-PI

2013-2014 BASS teaching team, Duke, Brannon and Hahn $16,800

Math before Symbols: Games to Increase School Readiness in Pre-Schoolers: This team will work with pre-school and early elementary school children to test the effectiveness of an iPad-based game in readying children¹s math skills, and a subset of the team might aim to produce a pre-K children¹s book based on these insights about how children learn math before symbols.

2013-2014 Initiative on Education and Human Development, Duke, $25,000

2010-2012 RO1 HD059108-06A2 (1 year RO1 renewal & no cost extension)

*“Representation of number in infancy”*

Elizabeth M. Brannon (PI). $289,500

2008-2013 NICHD RO1HD057173-01

*“Functional and neuroimaging of the development of neural mechanisms for number processing”*

Kevin Pelphrey (PI), EMB (Co-PI)

2009-2013 NEI 1R01EY01

“*Contributions of Areas LIP and VIP to Numerical Behavior*. ”

Michael L Platt (PI), EMB (Co-I)

2010-2011 NICHD RO1 HD-049912-05S1 (ARRA supplement)

*“Representation of number in primates”*

Elizabeth M. Brannon (PI). $59,661

2005-2011 NICHD RO1HD049912-01A2

*“Representation of number in primates”*

Elizabeth M. Brannon (PI) $969,871

2005-2011 NSF CAREER award

*“CAREER: Evolution and development of numeracy”*

Elizabeth M. Brannon (PI). $400,000

2009-2011 NIH[1RC1 MH088680-01](https://commons.era.nih.gov/commons/genericStatus.do?actionRole=nonPI&applID=7820806&uhf-token=%2B5ZilYwVJc1kCoEKvVt4pff03Ww%3D)

“*From Phenotype to Mechanism: Mapping the Pathways Underlying Risky Choice*”

Scott Huettel (PI), EMB (Co-I)

2010-2011 NSF workshop conference award

*“Space, Time and Number: The Cerebral Basis of Mathematical Intuitions”*

Elizabeth M. Brannon (PI). Direct $32,717

2010-2011 NICHD R13 workshop conference award

*“Space, Time and Number: The Cerebral Basis of Mathematical Intuitions”*

Elizabeth M. Brannon (PI). Direct $9,000

2003-2008 NIMH RO1MH066154-01

“Representation of number in infancy”

Elizabeth M. Brannon (PI). Direct $600,000

2003-2007 John MERCK Scholars Fellowship,

“The evolution and ontogeny of mathematical abilities human infants represent number.”

Elizabeth M. Brannon (PI). Direct $150,000

2002-2006 NSF ROLE and Developmental and Learning Sciences

*“The Representation of Number in Infancy”*

Elizabeth M. Brannon (PI).

2001-2003 RO3 MH64955-01

*“Electrophysiological correlates of numerical discrimination in human infants”*

Elizabeth M. Brannon (PI), G.R. Mangun (Co-PI)

2001-2002 B/START MH63075-01 NIMH

“Knowledge of numerical relationships in infants”

Elizabeth M. Brannon (PI)

2000 Arts and Science Research Council, Duke University

#### External Service & Professional Experience

2015-2019 Governing Board of The Mathematical Cognition and Learning Society (MCLS)

2015- Associate Editor, *Open Mind*

*2004-* Editorial Board *Cognition*

2010- Associate Editor *Frontiers in Comparative Psychology*

2010- Editorial Board *Frontiers in Developmental Psychology*

2011-2015 Associate Editor, *Developmental Science*

2010-2014 Regular Panel member NIH Cognition and Perception Study Section

2010-2015 Executive committee member for The International Society for the Study of Attention & Performance

2010-2015 Treasurer of The International Society for the Study of Attention & Performance

2009-2012 Advisory board *Current Directions in Psychological Science*

2009-2013 Editorial Board *Journal of Experimental Psychology: Animal Behavior Processes*

*2008-2010* Editorial Board *Infancy*

2003-2010 Editorial Board *Psychological Science*

Conferences and Symposia Organized

2014 Beyond Academia: workshop for graduate students considering career paths outside of academia, October, 30th, 2014

2010 International Attention and Performance meeting in Paris, France, on Space Time and Number: Co-organizer with Dr. Stanislas Dehaene

2007 National Science Foundation Workshop on Neuroscience and Mathematics

Co-Chair with Dr. John Anderson

2009 Comparative Cognition Society Symposium in honor of Dr. Herb Terrace 2009

Invited Symposia talks and Colloquia

**2016**

* Distinguished Lecturer in the Social, Behavioral, and Economic Sciences (SBE) Directorate, 3-9-2016
* Psychology Colloquium, Villanova, 2-5-2016
* Lecture at Annual meeting of Concepts, Actions, and Objects: Functional and Neural Perspectives, Center for Mind/Brain Sciences, Rovereto, Italy, May 6-9, 2016.

**2015**

* 5th Latin American School for Educational Neuroscience March, 2015 in Chile
* Society for Research in Child Development, Philadelphia, Symposium
* Rutgers, New Brunswick, Fetzschrift for C.R. Gallistel & Rochel Gelman, April, 2015

**2014**

* Invited Speaker Emory University, NSF funded workshop on learning, March 2014
* Colloquium, University of Pennsylvania, May, 2014
* Origins of Intelligence workshop, Sapporo Japan, July 2014
* Special invited lecture Japanese Animal behavior meeting, Inuyama, Japan, July 2014
* Colloquium, Keio University, Tokyo, Japan, July 2014
* MIT invited colloquium, October, 2014, Department of Brain and Cognitive Sciences
* Rethinking the innateness hypothesis, Rutgers, October 2014
* Invited Speaker, Society for Language Development, Boston, November 2014

**2013**

* University Scholar Seminar, Duke, November 22nd
* Morris Symposium: Quantification and Number, Stony Brook September 2013
* Colloquium, INSERM, Paris June 2013
* Colloquium, Lisbon Champalimaud Neuroscience Programme, July 10th
* Cognitive Science Colloquium, University of Maryland, May 2nd
* NIH conference on Math Cognition Conference, May 20th-21st
* Keynote speaker for Femmes, Middle school girls science day, Durham NC

**2012**

* 2nd Latin American School for Education, Cognitive and Neural Sciences to be held during March 5-16, 2012 in Patagonia, Argentina
* Psychology colloquium, Washington University, March 26th
* Psychology colloquium, Princeton University, September 21st

**2011**

* Developmental Brownbag, UNC, Chapel Hill
* Workshop on Evolution of Human Cognition, Georgetown University
* Psychology Department Colloquium, Harvard University
* Ben Gurion University, Israel April 2011, declined
* National Institute for Child Development Math Consortium Meeting, May 16-17, 2011
* Second Annual Aspen Brain Forum titled, “Cognitive Neuroscience of Learning with Implications for Education**,**” New York Academy of Sciences and the Aspen Brain Forum Foundation, Aspen, Colorado September 22-24, 2011
* Cognitive Neuroscience Colloquium, University of Pennsylvania, November, 2011

**2010**

* Invited presidential colloquium, International Conference on Infant Studies (ICIS)

March 2010

* Duke Institute for Brain Sciences, Workshop on Development, Spring 2010
* Conference on Space, Time, and Number, Paris, 2010
* American Scientist Pizza Lunch, September 21st, 2010
* Developmental BrownBag UNCG, Dec 3rd 2010

**2009**

* American Academy of Advancement of Science, Invited Symposium on *Comparative Cognition:  The Science of Mental Evolution*
* Comparative Cognition Society, Organizer of symposium to honor H.S. Terrace
* Invited colloquia at University of British Columbia, interdisciplinary speaker series, Arts and Science, Neuroscience, & Med School

**2008**

* Society for Experimental Psychology: Young Investigator Award Speaker
* Invited symposium speaker, International Primatological Society, Edinburgh

**2007**

* Symposium on Brain Mechanisms of Sequential Behavior, Society for Neuroscience, The neural and behavioral underpinnings of numerical ordering San Diego CA, October 2007
* Cognitive Neuroscience Society symposium: Numerical Understanding in the Brain: Comparative, Developmental, and Neural Perspectives, New York May 2007
* National Science Foundation conference on Neuroscience and Learning, invited speaker, May 2007
* Invited Colloquium, Institute for Research in Cognitive Science, University of Pennsylvania, March 2007

**2006**

* National Institutes of Health Behavioral and Social Science Research Lecture Series, Nov 20, 2006
* American Psychological Association, invited symposium, August 10-13, 2006, in New Orleans
* Invited meeting Konrad Lorenz Institute for Evolution and Cognition Research (KLI), The New Cognitive Sciences, June 2006 Vienna; Organizers Lynn Nadel & Mary Peterson
* Invited colloquium, Department of Psychology, Stanford, April 2006
* Invited colloquium, Department of Psychology, Northwestern, March 2006
* Invited Developmental Brown Bag, Department of Psychology, University of Chicago, March 2006

**2005**

* Invited colloquium, Department of Psychology, Columbia, December 2005
* Invited Presidential Symposium Cognitive Development Society October 2005
* Invited symposia Yale conference on objects and infancy, May 2005
* Invited colloquium, Department of Psychology, Yale, March 2005
* Invited address, Southern Society for Philosophy and Psychology, March 2005

**2003-2004**

* Cognitive Neuroscience Summer Institute, Dartmouth NH June 2004
* Invited colloquium, Department of Psychology, Georgia State University, Fall 2003.
* Invited meeting Fyssen Foundation, “From monkey to human brain” Paris, France June 2003
* Presidential symposium Eastern Psychological Association, 2003, “Numerical thinking: A comparative study”
* Invited meeting, OECD. Brockton, MA. January 2003

**2001-2002**

* Invited Developmental Brown Bag, Department of Psychology, University of Virginia, November 2002.
* Invited Developmental Brown Bag, Social and Health Sciences Dept., Duke University, September, 2002.
* Invited Colloquium Max Planck, Leipzig, May 2002.
* Invited Colloquium Max Planck, Tuebingen, May 2002.
* Invited Colloquium, Center for Cognitive Science, Rutgers University, December 2001.
* Job talk, Department of Psychology, University of North Carolina, Chapel Hill April, 2001
* Invited BEAST, Department of Anthropology, Duke University, April 2001.

**2000**

* Department of Neurobiology, Faculty guest speaker at weekend retreat, Duke University Medical Center, October 2000.
* Cortex Club, Department of Neurobiology, Duke University Medical Center, Fall 2000
* Commentator for Exploring the Mind Symposium, Duke University, February 2000.
* Invited colloquium, Nathan Kline Institute, NYC, February, 2000.

**1997-1999**

* Dissertation seminar, “Ordinal numerical abilities in rhesus monkeys,” Department of Psychology, Columbia University, 1999.
* St. Ann’s High School, Brooklyn, NY, “Science and education,” Fall 1999
* Lunch-box seminar (job talk); Department of Psychology, Duke University, January, 1999.
* Department of Psychology, Columbia University, “Chunking in humans and animals” 1998.
* Department of Psychology, University of Pennsylvania, “Ordinal numerical knowledge in rhesus monkeys,” April, 1997.

# Publications

# udesignates undergraduate collaborators

\*designates peer reviewed publications

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**Submitted or under revision**

1. Bugden, S., DeWind, N.K., **Brannon, E. M.**, Harnessing the approximate number system to improve symbolic math processing, Under Review, Invited review for *Current Opinion in Neuroscience*
2. \*DeWind, N.K., **Brannon, E. M.**, Platt, M.L. A population code for visual quantity in macaque ventral intraparietal area (VIP), Under Revision
3. \*DeWind, N.K., Peng, J., Luou A. E. **Brannon, E. M.**, Platt, M.L. Evidence from pharmacological inactivation does not support a unique role for the intraparietal sulcus in approximate enumeration in macaque monkeys, submitted
4. \*uPark, J. Bermudezu, V., **Brannon, E.M.,** Early childhood math intervention via intuitive number sense training, under revision at JECP
5. \*Park, J. Woldorff, M., **Brannon, E.M.,** Experience-Dependent Hemispheric Specialization of Letters and Numbers changes over development
6. \*Starr, A., & **Brannon, E. M.** A role for visuospatial working memory in mediating the interaction between space and time, under revision at *Psychonomic Bulletin and Review*

**Google Scholar H index – 50**

**Books & Special issues**

1. **Brannon, E.M.** (Ed.) 2010. Thought without language: A tribute to the contributions of H.S. Terrace. *Behavioral Processes*, *82*(2), 137-138.
2. Dehaene, S., & **Brannon, E.M.** (Ed.s)Space, Time, and Number in the Brain: searching for the foundations of mathematical thought. Elsevier, 2011.
3. Dehaene, S., & **Brannon, E.M.** 2010. Space, time, and number: A Kantian research program. *Trends in Cognitive Sciences*, *14*(12), 517-519.
4. Purves, D., **Brannon, E.,** Cabeza, R., Huettel, S., LaBar, K., Platt, M., Woldorff, M. (2007). Principles of Cognitive Neuroscience. Sunderland, Massachusetts: Sinauer Associates.

**Reviews and Commentaries**

1. \*Park, J., **Brannon, E.M.,** How to interpret cognitive training studies:   
   A reply to Lindskog & Winman, *Cognition,* Accepted
2. **Brannon, E.M.,** & Park, J. (2015). Navigator Chapter for: Phylogeny and Ontogeny of Mathematical and Numerical understanding, In Handbook on Mathematical Cognition, Ed.s R.Cohen-Kadosh
3. \*Starr, A., & **Brannon, E. M.** (2015).Evolutionary and Developmental Continuities in Numerical Cognition, Chapter In Ed.s Geary, D, Berch, K. Mann-Koepke, Academic Press: London.
4. Merritt, D., DeWind, N., & **Brannon, E.M.** (2012). Comparative cognition of number representation, In Handbook of Comparative Cognition. Editors, T. Zentall and E. Wasserman. Oxford: Oxford University Press.
5. \*Roitman, J.D., **Brannon, E.M., &** Platt, M.L. (2012). Representation of numerosity in posterior parietal cortex. *Frontiers in Integrative Neuroscience*, *6*(25). PMCID: PMC3364489.
6. **Brannon, E.M., &** Merritt, D. (2011). Evolutionary foundations of the Approximate Number System. In Space, Time, and Number in the Brain: Searching for the Foundations of Mathematical Thought. Dehaene, S., & Brannon, E.M. (Eds.). New York, NY: Elsevier.
7. Cantlon, J. F., & **Brannon, E. M.** (2011). Animal Arithmetic.Encyclopedia of Animal Behavior*.* Editors, Breed, M.D., & Moore, J. Oxford: Elsevier.
8. **Brannon, E**.M., Jordan, K.E., & Jones, S. (2010). Behavioral Signatures of Numerical Discrimination. Primate Neuroethology. Platt, M.L., & Ghazanfar, A. (Eds.). Oxford: Oxford University Press.
9. Dehaene, S., & **Brannon, E.M.** (2010). Space, Time, and Number: A Kantian Research Program. Special Issue on Space, Time, and Number, *Trends in Cognitive Sciences*, *14*(12), 517-519. DOI: 10.1016/j.tics.2010.09.009.
10. **Brannon, E.M.** (2010). Introduction to Thought without language: A tribute to the contributions of H.S. Terrace. *Behavioral Processes*, *82*(2), 137-138.
11. \*Cantlon, J.F., Platt, M.L., & **Brannon, E.M.** (2009). Beyond the number domain. Invited review. *Trends in Cognitive Sciences*, *13*(2), 83-91. PMCID: PMC2709421.
12. Jordan, K.E., & **Brannon, E.M.** (2009). A comparative approach to understanding human numerical cognition. The Origins of Object Knowledge. Hood, B., & Santos, L. (Eds.). Oxford: Oxford University Press.
13. \*Libertus, M.E., & Brannon, E.M. (2009) Behavioral and neural basis of number sense in infancy, *Current Directions in Psychological Science*, *18*(6), 346-351. PMCID: [PMC2857350](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2857350/?tool=nihms).
14. Brannon, E.M, & Cantlon, J. F. (2009). A comparative perspective on the origin of numerical thinking. In Cognitive Biology: Evolutionary and Developmental Perspectives on Mind, Brain, and Behavior. Luca Tomasi, Mary A. Peterson, and Lynn Nadel (Eds.). Cambridge: MIT Press.
15. Cantlon, J. F., Cordes, S., Libertus, M. E., & **Brannon, E. M.** (2009). Numerical abstraction: It ain’t broke. (commentary). *Behavioral and Brain Sciences*, *32*(3-4), 331-332.
16. \*Cantlon, J.F., Cordes, S., Libertus, M.E., **Brannon, E.M.** (2009) Comment on “Log or Linear? Distinct Intuitions of the Number Scale in Western and Amazonian Indigene Cultures, *Science*, *323*(5910), 38. PMCID: PMC3393850.
17. \*Cordes, S., & **Brannon, E. M.** (2008). Quantitative competencies in infancy. Invited Annual Review, *Developmental Science, 11*(6), 803-808. DOI: 10.1111/j.1467-7687.2008.00770.x.
18. **\*Brannon, E.M.** (2006). The representation of numerical magnitude. Invited review for *Current Opinion in Neurobiology,* *16*(2), 222-229. PMCID: PMC1626588.
19. **Brannon, E.M.,** & Terrace, H.S. (2002). The Evolution and Ontogeny of Ordinal Numerical Ability. InBekoff, M., Allen, C., and Burghardt, G.M. The Cognitive Animal. Cambridge, MA: The MIT Press. Pp. 197-204.

**Papers**

1. \*DeWind, N.K., **Brannon, E. M.**, Significant Inter-Test Reliability Across Approximate Number System Assessments, Accepted, *Frontiers in Psychology, Cognition*
2. \*Drucker, C., Rossau, M., **Brannon, E. M.** Implicit sequence learning in ring-tailed lemurs (*Lemur catta*), *Journal of the Experimental Analysis of Behavior,* Accepted
3. \*Cantlon, J., & Merritt, D. **Brannon, E. M.** (2016) Subtraction in monkeys, *Animal Cognition,* 19:405–415, DOI 10.1007/s10071-015-0942-5
4. \*Drucker, C.B., Rossau, M.A., & **Brannon, E. M.** (2016). Comparison of discrete ratios by rhesus macaques (*Macaca mulatta*), *Animal Cognition.* 19:75–89, DOI: 10.1007/s10071-015-0914-9
5. \*DeWind, N.K., G.K. Adams, Platt, M.L. **Brannon, E. M.**, (2015). Modeling the approximate number system; Quantifying the contribution of visual stimulus features, *Cognition, 142, 247-265.*
6. \*Drucker, C.B., & **Brannon, E. M.** (2015).Commentary on: "Number-space mapping in the newborn chick resembles humans’ mental number line", *Frontiers in Psychology,* 6:352. DOI: 10.3389/fpsyg.2015.00352
7. \*Li, R., **Brannon, E. M.**, Huettel, S., (2015). Children do not exhibit ambiguity aversion despite intact familiarity bias. *Frontiers in Psychology,* 5 1519
8. \*Park J. Dewind, N., Woldorff, M., & **Brannon, E. M.**, (2015) Rapid and direct encoding of numerosity in the visual stream, 1-16. *Cerebral Cortex,* DOI: 10.1093/cercor/bhv017
9. \*Starr, A., & **Brannon, E.M.** (2015) Developmental continuity in the link between sensitivity to numerosity and physical size, *Journal of Numerical Cognition, 7-20,* doi: 10.1093/cercor/bhv017
10. \*Starr, A., & **Brannon, E. M.** (2015). Evidence against continuous variables driving numerical discrimination in infancy, *Frontiers in Developmental Psychology, 6*(923).
11. \*Drucker, C., & **Brannon, E. M.** (2014). Rhesus monkeys (*Macaca mulatta*) map number onto space, *Cognition, 132*(1), 57-67. PMCID: PMC4031030.
12. \*Libertus, M., Starr, A., Williamsonu, T., & **Brannon, E.M.** (2014).Number trumps area for 7-month-old infants**,** *Developmental Psychology, 50*(1), 108-112. PMCID: PMC3796133.
13. \*Park, J., & **Brannon, E. M.** (2014). Improving arithmetic performance with number sense training: An investigation of underlying mechanism,*Cognition, 133*(1), 188-200. NIHMSID: NIHMS614955.
14. \*Park, J., Chiangu, C., **Brannon, E.M**., & Woldorff, M. (2014). Experience-Dependent Hemispheric Specialization of Letters and Numbers is Revealed in Early Visual Processing, *Journal of Cognitive Neuroscience*
15. \*Pinhas, M., Woldorff, M., & **Brannon, E.M.** (2014). Electrophysiological evidence for the involvement of the approximate number system in preschoolers’ processing of spoken number words, *Journal of Cognitive Neuroscience, 26*(9), 1891-1904. NIHMSID: 621122.
16. \*[Jones, S. M., Pearson, J., DeWind, N., Paulsen, D., Tenekedjievau, A., & **Brannon, E.M**. (2013). Lemurs and macaques show similar numerical sensitivity. *Animal Cognition, 17*(3), 503-15.PMCID: PMC3966981.](http://brannonlab.org.s84504.gridserver.com/wp-content/uploads/Jones_et_al_2013.pdf)
17. \*Merritt, D.J., & **Brannon, E.M.** (2013).Nothing to it: Precursors to a zero concept in preschool children. *Behavioural Processes*, *93*, 91-97. PMCID: PMC 3582820.
18. \*Park, J.**,** Li, R., & **Brannon, E.M.,** (2013).Neural connectivity patterns underlying symbolic number processing indicate mathematical achievement in children. *Developmental Science, 17*(2), 187-202.DOI: 10.1111/desc.12114.
19. \*Park, J., & **Brannon, E.M.** (2013). Training the approximate number system improves math proficiency, *Psychological Science, 24*(10), 2013-1019. PMCID: PMC3797151.
20. \*Starr, A. Libertus, M.E., & **Brannon, E.M.** (2013). Number sense in infancy predicts mathematical abilities in childhood. *Proceedings of the National Academy of Sciences, 110*(45), 18116-18120.PMCID: PMC3831472.
21. \*Starr, A., Libertus, M.E., & **Brannon, E.M.** (2013). Infants show ratio dependent discrimination regardless of set size, *Infancy,* 18(6), 1-15. PMCID: PMC3864890.
22. \*DeWind, N.K., & **Brannon, E.M.** (2012). Malleability of the approximate number system: effects of feedback and training. *Frontiers in Human Neuroscience*, *6*(68). PMCID: PMC3329901.
23. \*Jones,S.M., & **Brannon, E.M.** (2012). Prosimian primates show ratio dependence in spontaneous quantity discriminations. *Frontiers in Comparative Psychology*, *3*(550). PMCID: PMC3572878.
24. \*MacLean, E.L., Mandalaywalau, T.M., & **Brannon, E.M.** (2012). [Variance-sensitive choice in lemurs: constancy trumps quantity](http://www.springerlink.com/content/q156875p43483866/), *Animal Cognition, 15*(1), 15-25. PMCID: PMC3645319.
25. \*Paulsen, D.J., Carter, R.M., Platt, M.L., Huettel, S.A., & **Brannon, E.M.** (2012). Neurocognitive development of risk aversion from early childhood to adulthood*. Frontiers in Human Neuroscience, 5*(178). PMCID: PMC3250075.
26. \*MacLean, E.L., Matthews, L.J., Hare, B. Nunn, C.L., Anderson, R.C., Aureli, F. **Brannon, E.M.**, Call, J., Drea, C.M., Emery, N.J., Haun, D.B.M., Herrmann, E., Jacobs, L.F., Platt, M.L., Rosati, A.G., Sandel, A., Schroepfer, K.K., Seed, A.M., Tan, J., van Schaik, C.P., Wobber, V., (2011). How Does Cognition Evolve?: Phylogenetic Comparative Psychology, *Animal Cognition, 15*(2), 223-238. PMCID: PMC3980718.
27. \*Cantlon, J.F. Davis, S.W., Libertus, M.E. Kahane, J. **Brannon, E.M.** Pelphrey, K.A. (2011). Inter-Parietal White Matter Development Predicts Numerical Performance in Young Children, *Learning and Individual Differences, 21*(6), 672-680. PMCID: PMC3240671.
28. \*Cordes, S., & **Brannon, E.M.** (2011). Attending to one of many: When infants are surprisingly poor at discriminating an item’s size, *Frontiers in Psychology*, *2*(65). PMCID: PMC3110486.
29. \*Merritt, D. MacLean, E. Crawfordu, J.C. **Brannon, E. M.** (2011). Numerical rule-learning in ring-tailed Lemurs (*Lemur catta*). *Frontiers in Comparative Psychology, 2*(23), 1-9. PMCID: PMC3113194.
30. \*Libertus, M.E., **Brannon, E.M.,** Woldorff, M. (2011). Parallels in stimulus-driven oscillatory brain responses to numerosity changes in 7-month-old infants and adults, *Developmental Neuropsychology*, *36*(6), 651-667. PMCID: PMC3638794.
31. \*Paulsen, D.J., Platt, M.L., Huettel, S.A., &. **Brannon, E.M**., (2011). Decision-making under risk in children, adolescents, and young adults. *Frontiers in Developmental Psychology*, *2*(72). PMCID: PMC3110498.
32. \*Cantlon, J. F., Safford\*, K.E., & **Brannon, E.M.** (2010). Spontaneous Analog Number Representations in 3-year-old Children. *Developmental Science*, *13*(2), 289–297. PMCID: PMC2819667.
33. \*Jones, M.S., Merritt, D., Cantlon, J., & **Brannon, E.M.** (2010). Context affects the numerical semantic congruity effect in rhesus monkeys. *Behavioral Processes*, *83*(2), 191-196. PMCID: PMC3677752.
34. \*Libertus, M., & **Brannon, E.** (2010). Stable individual differences in number discrimination in infancy. *Developmental Science*, *13*(6), 900-906. PMCID: PMC2966022.
35. \*Merritt, D., Casasanto, D., **Brannon, E.M.** (2010). Do monkeys think in metaphors? Representations of space and time in monkeys and humans, *Cognition, 117*(2), 191-202. PMCID: PMC2952654.
36. \*Paulsen, D., Woldorff, M., & **Brannon, E.M**. (2010). Individual differences in nonverbal number discrimination correlate with event-related potentials and measures of probabilistic reasoning. *Neuropsychologia, 48*(13), 3687–3695. PMCID: PMC2975800.
37. \*Pearson, J., Roitman, J.D. **Brannon, E.M.** Platt, M.L., & Raghavachari, S. (2010). A physiologically-inspired model of numerical classification based on graded stimulus coding. *Frontiers in Behavioral Neuroscience*, *4*(1). PMCID: PMC2814553.
38. \*Cantlon, J. F., Libertus, M.E., Pinel, P., Dehaene, S., **Brannon, E.M., &** Pelphrey, K.A. (2009). The neural development of an abstract concept of number. *Journal of Cognitive Neuroscience*, *21*(11), 2217-2229. PMCID: PMC2745480.
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    Competence/Performance Debate in the Acquisition of Counting as a Representation of the Positive Integers. *Cognitive Psychology, 52*(2), 130-169.
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83. **\*Brannon, E.M.,** Wusthoffu, C.J., Gallistel, C.R., & Gibbon, J. (2001). Numerical subtraction in the pigeon: evidence for a linear subjective number scale. *Psychological Science*, *12*(3), 238-243.
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88. \*Platt, M.L., **Brannon**, **E.M.,** Brieseu, T.L. & French, J.A. (1996). Differences in feeding ecology predict differences in performance between golden lion tamarins (Leontopithecus rosalia) and Wied’s marmosets (Callithrix kuhli) on spatial and visual memory tasks. *Animal Learning and Behavior*, *24*(4), 384-393.

**Selected scientific Commentaries on Brannon Publications\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Selected press coverage can be viewed at www.brannonlab.org

* Carey, S. (1998) Knowledge of number: it's evolution and ontology, *Science, 282*, 641-2.
* Azar, B. (2000) Monkeying around with number, *APA Monitor* (31)1.
* Dehaene**,** S. (2001).Subtracting pigeons: Logarithmic or linear? Psychological Science.Vol 12(3), 244-246.
* Bower, B. (2002). Numbers in Mind, *Science News* 161, 392-393.
* Bower, B. (2005). Math Minus Grammer, *Science News* 167, 117-118.
* Santos, L R. (2005). Primate Cognition: Putting Two and Two Together, *Current Biology,* 15 (1), R545-R547
* Gross, L. (2006). A Neural Seat for Math? *PLOS, Biology*, 4(5)e149
* Miller, J. (2006) Babies show budding number ability, *Science News*, 169.
* Feigenson, L. (2007) *Trends in Cognitive Science*.
* **Dingfelder, S.F. (2007) Monkey Math, *APA monitor* (38) 3.**
* Gross, L. (2007). Neurons for numerosity: As quantities increase, so does the neural response. *PLOS, Biology*, 5(8)e226.
* Van Opstal, F. (2007). Labeled-line coding and summation coding of numerosities in prefrontal and parietal cortex. J. of Neuroscience. 27(36)9535-9536.
* Beran MJ., (2008) The Evolutionary and Developmental Foundations of Mathematics. PLoS Biol 6(2): e19 [doi:10.1371/journal.pbio.0060019](http://dx.doi.org/10.1371/journal.pbio.0060019)
* Top 100 scientific findings Discover Magazine 2013

Scientific Society Memberships

American Psychological Association, American Psychological Society, Comparative Cognition Society, Cognitive Development Society, Cognitive Neuroscience Society, Eastern Psychological Association, International Society for Infant Studies, Psychonomics Society, Society for Research in Child Development, Society for Neuroscience, Vision Science Society

Department and University Service

* Representative for Graduate Admissions Committee, Penn
* Presenter for DIBS external advisory board, 12/2014
* Presenter for Leaky Foundation DIBS Presentation 9/26/2014
* Chair of developmental faculty search Spring 2015
* CCN retreat committee 2014
* Faculty co-chair for DIBS Career path workshop, Fall, 2014
* Presenter for DIBS outreach event, Dallas, Texas, January 2014
* Presenter for Duke Parents, March 2014
* Chair of tenure committee, Dr. Michael Tomasello
* Academic Programs Committee (Provost advisory committee) 2013-2015
* Presenter for Duke Forward event, Washington DC, 2013
* Executive committee for Initiative on Human Education and Development, 2013
* Developmental Area head, 2011-2015
* Chair of search committee for developmental psychology, 2011-2013
* Director of Graduate Studies, Cognitive Neuroscience Admitting Program, 2008-2009, 2010-2016
* Tenure review committee for Dr. Stephen Mitroff, 2011
* Review committee for Dean of Engineering School, 2011-2012
* Tenure review committee for Brian Hare, Evolutionary Anthropology, 2011
* Third year review committee for Makeba Wilbourn, 2010-2011
* Third year review committee for Amy Joh, 2010-2011
* Member of P&N chair advisory committee 2008-2009, 2010-2012
* Tenure review committee for Dr. Elizabeth Marsh, 2011
* Director of Graduate Studies, P&N, 2008-2009
* Third year review committee for Stephen Mitroff, 2008-2009
* Member of search committee for chair of Evolutionary Anthropology 2008-2009
* Member of steering committee for Primate Genomics Initiative 2008-2010
* Member of Director’s Board Duke Lemur Center, 2006-2009
* Faculty organizer of Developmental Brown Bag 2007-2009
* Faculty organizer of Cognitive Development Brown Bag 2006-2007
* Research board for the Duke Primate Center (protocol review) 2004-2010
* Member of search committee for cognitive development area, 2007-2008
* Member of Bylaws committee for P&N Spring 2007-2008
* Organizer for Topics in Cognitive Neuroscience Talk Series Spring 2007
* Faculty Advisor for Student magazine “The Duke Mind,” 2007-2008
* Member of search committee for cognitive primatology position, 2005-2006
* Associate Director of Graduate Studies 2002-2005
* Department ethics representative *2001-2005, 2007-2009, 2011-2013*
* Member of search committee for behavioral genetics position, 2004-2005
* Internal Advisory Board for the Duke Primate Center 2002-2005
* Member of search committee forDirector of Center for Cognitive Neuroscience 2002

# Teaching

***Courses taught:***

Educational Neuroscience Seminar Spring 2014

Bass seminar 2013-2014

Professional Development Course for graduate students (2010-2015)

Thought without Language seminar (Spring 2001, 2002, 2003, 2004, 2005)

Developmental Psychology lecture course (Fall 2002, 2004, 2006, 2007, 2012)

Graduate seminar Nonverbal Cognition (Spring 2004)

Graduate seminar in Cognitive Neuroscience (Spring 2008)

Graduate seminar in Advanced Topics in Cognitive Development (Spring 2011, Fall 2012, Fall, 2014)

***Team Teaching and Guest Lectures:***

Evolution and Development Proseminar 2001-2006

Graduate course on Cognitive Neuroscience 2000-2015 (1-2 lectures each semester)

Undergraduate course on Cognitive Neuroscience guest lectures for Kevin LaBar

Guest lecture in Introduction to Visual Culture by Kristine Stiles, 2008 & 2011

Guest Lecture in Graduate Cognitive Development, UNC, Chapel Hill Spring 2009, 2012, 2014

***Current graduate students:***

Carline Drucker (NSF) 2011-

Rosa Li (NSF) 2011-

Emily Szkudlarek 2014-

**Past graduate students**

Kerry Jordan, PhD, May 2007; associate professor Utah State University 2007-

Jessica Cantlon, PhD October 2007; assistant professor University of Rochester 2009-

Melissa Libertus, PhD, May 2010; assistant professor University of Pittsburg 2013-

David Paulsen, May 2012, Data Scientist

Sarah Jones, May 2012, currently visiting assistant Professor at St. Norbert College

Nick Dewind, November 2014 (Post-doc with Brannon)

Ariel Starr, May 2015, NSF recipient (postdoc with Dr. Sylvia Bunge)

***Current postdoctoral students:***

*Stephanie Bugden 2015-*

*Nick DeWind 2015-*

***Past Postdoctoral Students*:**

Kerrie Lewis 2002-2004; Associate Professor Texas State University 2006-

Donna Lutz 2003-2005; nonacademic job

Dustin Merritt 2006-2011; nonacademic job

Jamie Roitman 2002-2006; Assistant Professor University of Illinois, Chicago

Sara Cordes 2005-2009; Associate Professor, Boston College

Michal Pinhas 2011-2013, Assistant professor, Ariel University

Joonkoo Park 2011-2014, Assistant professor University of Massachusetts, Amherst

***Competitive Funding awarded to my students***

NSF Graduate Fellowship, Kerry Jordan 2004-2007

APA American Psychological Association Dissertation award, Kerry Jordan 2006-2007

NSF Graduate Fellowship, Jessica Cantlon 2004-2007

NRSA Graduate Fellowship, David Paulsen 2010-2012

APA Elizabeth Koppitz Fellowship, Jessica Cantlon 2007-2008

NRSA Postdoctoral Fellowship, Sara Cordes 2006-2009

NRSA Postdoctoral Fellowship, Dustin Merritt 2009-2011

NRSA Predoctoral Fellowship, David Paulsen 2010-2013

Hitchings New Investigator Award, Melissa Libertus, 2006

STERN dissertation award, Melissa Libertus, 2009-2010

Broad Graduate Fellowship, Nick DeWind, 2011-2012

NSF Graduate Fellowship, Ariel Starr, 2012-2015

DIBS postdoctoral fellowship, Joonkoo Park 2012-2013

NSF Graduate Fellowship, Caroline Drucker, 2013-2016

NSF Graduate Fellowship, Rosa Li, 2013-2016

SRCD dissertation improvement award, Ariel Starr, 2014-2015

Trice family award, Caroline Drucker 2015-2016

***Graduate student dissertation committees (not including my own students):***

Susan Ormsbee, PBS, defended PhD Spring 2003

Tracy Barrett, PBS, defended PhD April 2004

Michelle Merrill, Biological Anthropology, defended PhD April 2004

Aaron Sandler, Neurobiology Department, defended PhD 2006

Jose Larrauri, Psychology and Neuroscience, defended PhD, July 2008

Jen Gibbons, Psychology and Neuroscience, MAP committee 2009

Evan MacLean, Evolutionary Anthropology defended PhD 2012

Amrita Nair, Neurobiology defended 2013

Kait Clark, Psychology and Neuroscience, defended PhD, 2014

Amy Winecoff, Psychology and Neuroscience

Courtnea Rainey, Psychology and Neuroscience

Daniel Pages, Psychology and Neuroscience

Emma Wu Dowd, Psychology and Neuroscience

Christopher Krupenye, Evolutionary Anthropology

Joe Barter, Psychology and Neuroscience

Kristin Johnson, Psychology and Neuroscience

Kelsey Lucca, Psychology and Neuroscience

***Undergraduate independent studies and practicums:***

**Evolutionary Anthropology** (3) (Talia Baghdoyan with distinction in the major, 2014)

**Biology** (3)

**Psychology** (over 40 students since 2000, many with distinction in the major)

(Rachel Roberts, with distinction in the major 2014; Cayley Larimer, 2015)

**Neuroscience** (Crystal Chiang, Anchal Sabharwal, Marley Rossa with distinction in the major 2014; Sonia Godbole, 2015; Pawan Mathew, 2015)

*Undergraduate students who coauthored publications as a result of independent study or work-study collaborations Sara Abbott, Whitney Tompson, Laura Pruitt, Lauren Wolfe, Rebecca Fink, Kelley E. Safford, Tara Mandalwaya, Jeremy Crawford, Priya Patel, Crystal Chiang, Rachel Roberts, Vanessa Bermudez,* Talia Baghdoyan

Mentor for Mechanisms of Behavior NSF summer students (2000-2010)

Mentor for Howard Hughes Summer Undergraduate Students (2000-2004, 2006)

Mentor for Howard Hughes High School interns (3 students 2003-2004, 2006, 2007)

Mentor for Vertical Integration Program (2 students, 2006; 4 students, 2007; 1 student, 2008)

Mentor for high school students from North Carolina School of Science and Math 2008-2009, 2013-2014, 2014-2015

# Conference Talks and Posters

**2015**

* Early childhood math intervention via number sense training, SRCD, Park, J. Bermudez, V., and Brannon, E.M. Poster to be presented at the biennial meeting of the Society for Research in Child Development. Philadelphia, PA.
* Starr, A., DeWind, N.K., & Brannon, E.M. (2015, March). The role of non-numerical stimulus features in the development of the number sense. Oral paper presented at the biennial meeting of the Society for Research in Child Development. Philadelphia, PA.

**2014**

* DeWind, N., Brannon, E.M., Platt. M.L. Poster presented The Society for Neuroscience, 2014
* Park J, DeWind N, Woldorff MG, **Brannon E.M.** Abstraction of number concepts from visual percepts in the human brain. Mathematical Cognition Conference. 2014. Arlington, VA.
* Park J, DeWind N, Woldorff MG, **Brannon E.M.** Abstraction of number concepts from visual percepts in the human brain. Cognitive Neuroscience Society. 2014. Boston, MA.
* Starr, A., DeWind, N.K., & **Brannon, E.M.** (2014, September). The role of non-numerical stimulus features in the development of the number sense. Poster to be presented at the annual meeting of Flux, The International Congress for Integrative Developmental Cognitive Neuroscience. Los Angeles, CA.
* Starr, A. & **Brannon, E.M.** (2014, July). Infants simultaneously encode numerical and temporal information. Poster presented at the biennial meeting of the International Conference for Infant Studies. Berlin, Germany.

**2013**

* Drucker, C.B., **Brannon, E.M**., & Platt, M. L.  Transcranial magnetic stimulation of macaque intraparietal sulcus impairs numerical processing.  Society for Neuroscience Annual Meeting, San Diego.
* Starr, A., & **Brannon E.M.** (2013, October). Shared and separable representations of magnitude in 4-year-old children. Poster presented at the biennial meeting of the Cognitive Development Society. Memphis, TN.
* Starr, A., Libertus, M.E., & **Brannon, E.M.** (2013, May). ANS acuity in infancy predicts ANS acuity in early childhood. Poster presented at the Math Cognition Conference. Bethesda, MD.
* Starr, A., Libertus, M.E., & **Brannon, E.M.** (2013, April). Infants show ratio-dependent discrimination regardless of set size. Paper presented at the biennial meeting of the Society for Research in Child Development. Seattle, WA.
* Starr, A., Libertus, M.E., & **Brannon, E.M.** (2013, April). ANS acuity in infancy predicts ANS acuity in early childhood. Poster presented at the biennial meeting of the Society for Research in Child Development. Seattle, WA.

**2012**

* Pinhas, M., Paulsen, D. J., & **Brannon, E. M.** (October, 2012). Individual differences in preschoolers’ numerical acuity modulate event-related potential ratio effects. Paper presented at the 42nd annual meeting of the Society for Neuroscience, New Orleans, USA.
* Pinhas, M., Donohue, S. H., Woldorff, M. G., & **Brannon, E. M.** (April, 2012) Electrophysiological recordings of brain activity in preschoolers reveals the conceptual processing of spoken number words. Poster presented at the 19th annual meeting of the Cognitive Neuroscience Society, Chicago, USA.
* Starr, A., Libertus, M.E., & **Brannon, E.M.** (2012, June). Small number discrimination in infancy: a case for approximate number representations. Poster presented at the biennial meeting of the International Society for Infant Studies. Minneapolis, MN.
* Starr, A., & **Brannon, E.M.** (2012, June). Sound-shape congruency in preverbal infants. Poster presented at the biennial meeting of the International Society for Infant Studies. Minneapolis, MN.

**2011**

* **Brannon, E. M.**, Pinhas, M., Starr, A., & Libertus, M. (October, 2011). Relationship between early and later developing numerical abilities. Annual principal investigators meeting of the Research and Evaluation on Education in Science and Engineering (REESE) program, National Science Foundation, Washington, USA
* Jones, S., & **Brannon, E.M.** Conference on Comparative Cognition
* Cordes, S., & **Brannon, E.M.** 8-Month Olds Know Words Refer to Number: Verbal Labels Enhance Large Number Discrimination in Preverbal Infants, SRCD, Montreal
* Paulsen, D.J., Carter, M., Platt, M.L., Huettel, S.A., &. **Brannon, E.M.** Risky Decision Making and Development: Behavioral Trajectories and Neural Recruitment From Early Childhood to Adulthood, SRCD, Montreal
* Paulsen, D.J., Carter, M., Platt, M.L., Huettel, S.A., & **Brannon, E.M.** Risky Decision Making and Development: Behavioral Trajectories and Neural Recruitment From Early Childhood to Adulthood, Cognitive Neuroscience Society

**2010**

* Libertus, M., **Brannon, E.M.,** & Woldorff, M. (2010). Time course of stimulus-driven oscillatory synchronization and adaptation to numerical changes. Annual Meeting of the Cognitive Neuroscience Society (CNS), Montreal, Canada.
* Libertus, M., & **Brannon, E.M.** (2010). Developmental trajectory of the relationship between numerical discrimination and other cognitive abilities in infancy. 17th Biennial International Conference on Infant Studies (ICIS), Baltimore.
* Paulsen, D., Carter, M., Huettel, S., Platt, M., & **Brannon, E.** (2010). Risky decision making in young children activates prefrontal and posterior parietal regions, Cognitive Neuroscience Society, Montreal, QB
* Paulsen, D., Carter, M., Huettel, S., Platt, M., **Brannon, E.** (2010). Risky decision making and development: neural recruitment from childhood to adulthood, Society for Neuroeconomics, Evanston, IL.
* Paulsen, D., Carter, M., Platt, M., Huettel, S., **Brannon, E.** (2010). Risky decision making and development: neural recruitment from childhood to adulthood. Society for Neuroscience, San Diego, CA.

**2009**

* Cantlon, J. F., & **Brannon, E. M.** (2009). The evolution of numerical cognition: Evidence from non- human primates. AAAS Annual Meeting, Chicago, IL.
* Cordes, S., Platt, M., & **Brannon, E. M.** (2009). Hot handed kids and gambling adults: Strategy reversal in risky decision making from childhood to adulthood. Society for Research in Child Development, Denver, Co.
* DeWind N.D., **Brannon E.M.,** & Platt M.L. (2009). November. Neural encoding of numerosity in the ventral intraparietal area in numerically naïve rhesus monkeys. Society for Neuroscience, Chicago, IL.
* Jones, S. M., Cantlon, J. F., & **Brannon, E. M.** (2009). Numerical sensitivity of lemurs. International Conference on Comparative Cognition, Melbourne, FL.
* Libertus, M., & **Brannon, E. M.** (2009). Evidence for Weber’s Law in infants’ numerical
* discriminations from a new change detection paradigm. Society for Research in Child
* Development, Denver, CO.
* Libertus, M., **Brannon, E. M.**, & Woldorff, M. (2009). Stimulus-driven oscillatory responses to numerical changes: a novel frequency-tagging EEG paradigm. Cognitive Neuroscience
* Society, San Francisco, CA.
* Merritt, D. J., Casasanto, D., & **Brannon, E. M.** (2009). Do monkeys use space to think about time? Society for Research in Child Development, Denver, CO.
* Merritt, D. J., Casasanto, D., & **Brannon, E. M.** (2009). The effects of space on time judgments in rhesus monkeys and humans. Comparative Cognition, Melbourne, FL.
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* Paulsen, D., Carter, M., Huettel, S., Platt, M., **Brannon, E.** (2009). Neurometrics of risky decision making in 6- to -7-year-old children, Society for Neuroeconomics, Evanston, IL.

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