

## CURRICULUM VITAE

The Johns Hopkins University School of Medicine

*Mary Beth Nebel*

Mary Beth Nebel

7 March 2017**DEMOGRAPHIC AND PERSONAL INFORMATION****Current Appointments**

- 2015-present Research Scientist, Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute
- 2016-present Affiliated Faculty, Wendy Klag Center for Autism & Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health
- 2017-present Assistant Professor, Department of Neurology, Johns Hopkins University School of Medicine

**Personal Data**

Kennedy Krieger Institute  
 716 N. Broadway, room 311  
 Baltimore, MD 21205

Tel (443) 923-9257  
 Fax (443) 923-9279  
 E-mail nebel@kennedykrieger.org

**Education and Training**

- 1998-2002 B.S.E., Biomedical Engineering, Duke University, Durham, NC  
 Research Advisor: Roger Nightingale
- 2005-2010 Ph.D., Joint Department of Biomedical Engineering, University of North Carolina & North Carolina State University, Chapel Hill, NC  
 Dissertation: Functional imaging of central mechanisms underlying human pain perception  
 Advisors: Gregory Essick & Mark Tommerdahl
- 2010-2015 Postdoctoral Research Fellowship, Neurology, Johns Hopkins School of Medicine, Baltimore, MD  
 Focus: Neuromaging and behavioral methods for investigating sensorimotor deficits in autism  
 Advisor: Stewart Mostofsky

**Professional Experience**

- 2002-2003 Data Technician, Department of Psychiatry, Washington University School of Medicine
- 2003-2005 Associate in Research, Duke-UNC Brain Imaging and Analysis Center, Duke University
- 2010-2013 Junior Contract Editor, American Journal Experts
- 2015-2016 Instructor, Department of Neurology, Johns Hopkins University School of Medicine

**PUBLICATIONS:****Original Research [OR]**

- [1] Rathnanther J, Wang L, **Nebel MB**, Hosakere M, Han X, Csernansky J & Miller M. Validation of semiautomated methods for quantifying cingulate cortical metrics in schizophrenia. *Psychiatry Research*. 2004; 132(1): 53-68.
- [2] Selemon L, Wang L, **Nebel MB**, Csernansky J, Goldman-Rakic P & Rakic P. Direct and indirect effects of fetal irradiation on cortical gray and white matter volume in the macaque. *Biological Psychiatry*. 2005; 57(1): 83-90.
- [3] **Nebel MB**, Sims E, Keefe F, Kraus V, Guilak F, Caldwell D, Pells J, Queen R & Schmitt D. Relationship of self-reported pain and functional impairment to gait mechanics in overweight and obese persons with knee osteoarthritis. *Arch Phys Med Rehabil*. 2009; 90:1874-79.
- [4] **Nebel MB**, Folger S, Tommerdahl M, Hollins M, McGlone F & Essick G. Temporomandibular disorder modifies cortical response to tactile stimulation. *J Pain*. 2010; 11:1083-94.
- [5] Cascio C, Moana-Filho E, Guest S, **Nebel MB**, Weisner J, Baranek G & Essick G. Perceptual and neural response to affective tactile texture stimulation in adults with Autism Spectrum Disorders. *Autism Research*. 2012; 5.4:231-244.

- [6] Eloyan A, Muschelli J, **Nebel MB**, Liu H, Han F, Zhao T, Barber A, Joel S, Pekar J, Mostofsky S & Caffo B. Automated diagnoses of attention deficit hyperactive disorder using magnetic resonance imaging. *Frontiers in Systems Neuroscience*. 2012; 6: 61.
- [7] Shou H, Eloyan A, Lee S, Zipunnikov V, Crainiceanu AN, **Nebel MB**, Caffo B, Lindquist M & Crainiceanu C. Quantifying the reliability of image replication studies: The image intraclass correlation coefficient (I2C2). *Cognitive, Affective & Behavioral Neuroscience*. 2013; 13(4): 714-724.
- [8] Di Martino A, Yan C, Li Q, Denio E, Castellanos F, Alaerts K, Anderson J, Assaf M, Bookheimer S, Dapretto M, Deen B, Delmonte S, Dinstein I, Ertl-Wagner B, Fair D, Gallagher L, Kennedy D, Keown C, Keyzers C, Lainhart J, Lord C, Luna B, Menon V, Minshew N, Monk C, Mueller S, Muller R, **Nebel MB**, Nigg J, O'Hearn K, Pelphrey K, Peltier S, Rudie S, Sunaert S, Thioux M, Tyszka J, Uddin L, Verhoeven J, Wenderoth N, Wiggins J, Mostofsky S & Milham M. The autism brain imaging data exchange: towards a large-scale evaluation of the intrinsic brain architecture in autism. *Molecular Psychiatry*. 2014; 19(6): 659-667. Role: prepared KKI's contribution to the exchange, provided technical advice on data cleaning  
Role: Prepared Kennedy Krieger's contribution to the data exchange and contributed to the critical revision of the manuscript
- [9] **Nebel MB**, Joel SE, Muschelli J, Barber A, Caffo B, Pekar JJ & Mostofsky S. Disruption of functional organization within the primary motor cortex in children with autism. *Human Brain Mapping*. 2014; 35:567-580.
- [10] \*Muschelli J, \***Nebel MB**, Caffo B, Barber A, Pekar JJ, & Mostofsky S. Reduction of motion-related artifacts in resting state fMRI using aCompCor. *NeuroImage*. 2014; 96:22-35, 2014.  
Role: \*contributed equally to all aspects of the manuscript; +corresponding author
- [11] Lindquist M, Xu Y, **Nebel MB** & Caffo B. Evaluating dynamic bivariate correlations in resting-state fMRI: A comparison study and a new approach. *NeuroImage*. 2014; 101:531-46.
- [12] Eloyan A, Shou H, Shinohara R, Sweeney E, **Nebel MB**, Cuzzocreo J, Calabresi P, Reich D, Lindquist M & Crainiceanu C. Health Effects of Lesion Localization in Multiple Sclerosis: Spatial Registration and Confounding Adjustment. *PloS One*. 2014; 9(9): e107263. Role: performed data analysis and wrote parts of the manuscript
- [13] **Nebel MB**, Eloyan A, Barber A & Mostofsky S. Precentral gyrus functional connectivity signatures of autism. *Frontiers in Systems Neuroscience*. 2014; 8:80. doi: 10.3389/fnsys.2014.00080.
- [14] Shou H, Eloyan A, **Nebel MB**, Mejia A, Pekar JJ, Mostofsky S, Caffo B, Lindquist M & Crainiceanu C. Shrinkage prediction of seed-voxel brain connectivity using resting state fMRI. *NeuroImage*. 2014; 102(2):938-44.
- [15] Barber A, Jacobson L, Wexler J, **Nebel MB**, Caffo B, Pekar JJ & Mostofsky S. Connectivity supporting attention in children with Attention Deficit Hyperactive Disorder. *NeuroImage Clinical*. 2015; 7: 68-81.
- [16] Mejia AF, **Nebel MB**, Shou H, Crainiceanu C, Pekar JJ, Mostofsky S, Caffo B & Lindquist M. Improving reliability of subject-level resting-state fMRI parcellation with shrinkage estimators. *NeuroImage*. 2015; 112: 14-29.
- [17] Sharer E, Crocetti D, Muschelli J, Barber AD, **Nebel MB**, Caffo BS, Pekar JJ & Mostofsky SH. Neural correlates of visuomotor learning in autism. *Journal of Child Neurology*. 2015; 30(14): 1877-1886.
- [18] **Nebel MB**, Eloyan A, Nettles CA, Sweeney KL, Ament K, Ward RE, Choe AS, Barber AD, Pekar JJ, Mostofsky SH. Intrinsic Visual-Motor Synchrony Correlates With Social Deficits in Autism. *Biological Psychiatry*. 2015; 79(8): 633-41.
- [19] Floris DL, Barber AD, **Nebel MB**, Martinelli MC, Lai M, Crocetti D, Baron-Cohen S, Suckling J, Pekar JJ, Mostofsky SH. Atypical lateralization of motor circuit functional connectivity in children with autism is associated with motor deficits. *Molecular Autism*. 2016; 7:35. doi: [10.1186/s13229-016-0096-6](https://doi.org/10.1186/s13229-016-0096-6).
- [20] Landa RJ, Haworth JL & **Nebel MB**. Ready, Set, Go! Low Anticipatory Response during a Dyadic Task in Infants at High Familial Risk for Autism. *Frontiers in Psychology*. 2016; 7:721. doi: [10.3389/fpsyg.2016.00721](https://doi.org/10.3389/fpsyg.2016.00721).
- [21] Dajani DR, Llabre MM, **Nebel MB**, Mostofsky SH & Uddin LQ. Heterogeneity of executive functions among comorbid neurodevelopmental disorders. *Scientific Reports*. 2016; doi: 10.1038/srep36566.
- [22] Mejia AF, **Nebel MB**, Eloyan A, Caffo B & Lindquist MA. PCA leverage: Outlier detection for high-dimensional functional magnetic resonance imaging data. *Biostatistics*. *In press*.
- [23] Di Martino A, O'Connor D, Chen B, Alaerts K, Anderson J, Assaf M, Balsters J, Baxter L, Beggiano A, Bernaerts S, Blanken L, Bookheimer S, Braden BB, Byrge L, Castellanos F, Dapretto M, Delorme R, Fair D, Fishman I,

Fitzgerald J, Gallagher L, Jao Keehn RJ, Kennedy D, Lainhart J, Luna B, Mostofsky S, Müller RA, **Nebel MB**, Nigg J, O'Hearn K, Solomon M, Toro R, Vaidya C, Wenderoth N, White T, Craddock C, Lord C, Leventhal B, Milham M. Enhancing studies of the connectome in autism using the Autism Brain Imaging Data Exchange II. Scientific Data. *In press*.

Role: Prepared Kennedy Krieger's contribution to the data exchange and contributed to the critical revision of the manuscript

[24] Chen S, Huang L, Qiu H, **Nebel MB**, Mostofsky SH, Pekar JJ, Lindquist MA, Eloyan A & Caffo BS. Parallel group independent component analysis for massive fMRI data sets. PloS One. *In press*.

[25] Dirlikov B, Younes L, **Nebel MB**, Martinelli MK, Tiedemann AN, Koch CA, Fiorilli D, Bastian A, Denckla MB, Miller MI & Mostofsky SH. Novel Automated Morphometric and Kinematic Handwriting Assessment: A validity study in children with ASD and ADHD. Journal of Occupational Therapy, Schools, & Early Intervention. *In press*.

## Review Articles [RA]

[1] **Nebel MB** & Gracely R. Neuroimaging of fibromyalgia. Rheum Dis Clin North America. 2009; 35(2): 313-27.

## FUNDING

### EXTRAMURAL Funding

#### Current:

05/13/16-04/30/2021 Visual Motor Development in Infants at High Risk for Autism  
K01 MH109766-01  
National Institute of Mental Health  
\$753,375  
Role: P.I.; 100% (12.00 calendar)  
This study will investigate developmental patterns of behavior and brain function hypothesized to contribute to impaired acquisition of skills necessary for normal motor and social-communicative development in autism. This work is expected to contribute to a more nuanced understanding of the neurodevelopmental pathways that lead to a diagnosis of autism.

#### Completed:

07/01/15-04/30/16 Statistical Methods for Mapping Human Brain Development  
R01 MH095836  
National Institute of Mental Health  
P.I.: Reiss  
Role: Co-Investigator; 25% (3.00 calendar)  
The goal of this project is to develop new statistical methods to compare trajectories of the functional organization of the brain in typically developing children and children with neurodevelopmental disorders, namely autism and attention deficit hyperactivity disorder. ***Dr. Nebel's effort / funding support for this project is subsumed under her K01.***

07/01/15-04/30/16 Adolescent Changes in Brain and Behavior in Boys and Girls with ADHD  
2 R01 MH085328-10A1  
National Institute of Mental Health  
P.I.: Mostofsky  
Role: Research Scientist; 32% (3.84 calendar)  
The goal of this project is to examine developmental changes in brain structure and behavior in girls and boys with ADHD and to examine the impact of these changes on adolescent mental health and other functional outcomes. The findings will help identify risk factors in children with ADHD and could thereby lead to prevention efforts and improved outcomes for children with ADHD.

07/01/15 – 06/30/16 Statistical Methods for Large N and P Problems  
R01 EB012547  
National Institute of Biomedical Imaging and Bioengineering  
P.I.: Caffo

Role: Co-Investigator; 25% (3.00 calendar)

The goal of this project is to tailor model-based blind source separation methods to the investigation of brain-behavior relationships in large, multi-site fMRI datasets from various patient populations, including autism. *Dr. Nebel's effort / funding support for this project is subsumed under her K01.*

11/01/12-10/31/14      Understanding the Brain Basis of Impaired Imitation Learning in Autism  
7961  
Autism Speaks  
\$112,100  
Role: P.I.; 100% (12 calendar)  
The goal of this project is to compare the influence of visual and proprioceptive input on imitation learning in school-age children with autism and to identify patterns of brain connectivity that are related to autism-associated impairments in imitation.

## EDUCATIONAL ACTIVITIES

### Teaching

#### Classroom instruction

2007 (Fall)      Co-Instructor, Ethics for Biomedical Graduate Students, UNC Chapel Hill  
2011 (Spring)    Writing Mentor, Undergraduate, The Science of Staying in Shape, Duke University  
2013 (Spring)    Writing Mentor, Undergraduate, Current Research in Neuroscience, Duke University  
2014 (Fall)      Writing Mentor, Undergraduate, Engineering Innovation, Duke University  
2015 (Spring)    Writing Mentor, Undergraduate, Visual Perception and the Brain, Duke University

#### CME instruction

JHMI/Regional  
2016 (Fall)      Guest Lecturer for Pediatric Radiology Housestaff, Multidisciplinary Updates in Pediatric Radiology, “Investigating the brain-basis of motor deficits in autism using functional magnetic resonance imaging”, Johns Hopkins University

#### Workshops /seminars

JHMI/Regional  
2014 (Fall)      Guest Lecturer, Clinical Neurosciences Conference Series, “Visuomotor functional connectivity in autism”, Johns Hopkins University  
2015 (Winter)    Guest Lecturer for Child and Adolescent Psychiatry Fellows, “Neurobiology of Autism”, Johns Hopkins University

## RESEARCH ACTIVITIES

### Research Focus

I am a biomedical engineer with specific training and expertise in imaging science and sensory-motor neuroscience. My research is focused on using large neuroimaging and video-based data sets to study how children learn to dynamically interpret sensory information to produce appropriate actions and how this process is disrupted in children with neurodevelopmental disorders, including Autism Spectrum Disorder (ASD). I have 14 years of experience collecting, processing and analyzing structural and functional Magnetic Resonance Imaging (MRI) data from healthy young adults, typically developing children and various adult and pediatric patient populations. I am also experienced in the development and implementation of task-based functional MRI measures of multisensory integration and visuomotor learning. In recent years, I have focused on developing innovative and reliable functional connectivity-based parcellation methods to study brain organization. Using these methods, we have demonstrated that abnormalities in the functional segregation of limb control within the motor system and in the intrinsic synchronization between motor and visual systems are related to the severity of social deficits in school-age children with ASD. As part of my NIMH funded Career Development Award (K01 MH109766-01), I am extending these findings to study the longitudinal development of visual-motor synchronization and hand-eye coordination in infants at high risk for ASD to determine whether the abnormalities observed in school-age children come online before or after symptom onset. I am also collaborating with others in the department to develop movement-based intervention methods for enhancing visual-motor connectivity necessary for imitating and learning from the actions of others.

## Research Program Building / Leadership

2000-2002 Research Assistant, Orthopaedic and Injury Biomechanics Lab, Duke University  
2002-2003 Data Technician, Department of Psychiatry, Washington University School of Medicine  
2003-2005 Associate in Research, Duke-UNC Brain Imaging and Analysis Center, Duke University  
2005-2008 Graduate Research Assistant, Michael W. Krzyzewski Human Performance Lab, Duke University

## Technology Transfer Activities

2009-2010 Graduate Student Intern, Office of Technology Development, University of North Carolina, Chapel Hill  
Performed prior art searches and assessed commercialization potential of medical device/diagnostic technology developed at UNC.

## SYSTEM INNOVATION AND QUALITY IMPROVEMENT ACTIVITIES Not Applicable

## ORGANIZATIONAL ACTIVITIES

### Institutional Administrative Appointments

2016 Reviewer, K-to-R Transition Program Specific Aims Speed Review Session

### Journal peer review activities

2010-present Biological Psychiatry, Ad-hoc Reviewer  
2010-present Cerebral Cortex, Ad-hoc Reviewer  
2010-present Journal of Neuroscience, Ad-hoc Reviewer  
2013-present NeuroImage, Ad-hoc Reviewer  
2013-present Frontiers in Computational Neuroscience, Review Editor

### Professional Societies

2013-present Society for Neuroscience, Member  
2013-present International Society for Autism Research, Member  
2014-present Organization for Human Brain Mapping, Member

## RECOGNITION *(in chronological order, earliest first by start date under each subcategory)*

### Awards, Honors

2002 Mary Beth Nebel Award, Duke University Division I Rowing Team  
Given annually to the varsity rower who best personifies persistence, leadership & resolve  
2008 UNC School of Dentistry Table Clinics Basic Science Research Award  
2012 ADHD-200 Global Prediction Competition Winning Team  
Contributed to the development of the Johns Hopkins Team's winning algorithm for classifying children as typically developing or having ADHD using demographic and neuroimaging information  
2013 International Society for Autism Research Travel Award to San Sebastian, Spain

### Invited Talks

#### JHMI/Regional

Nov 2014 Investigating the Brain Basis of Motor Deficits in Autism: SMART-KKI Collaborations  
Department of Biostatistics and The Wendy Klag Center for Autism and Developmental Disabilities  
Joint Grand Rounds, Bloomberg School of Public Health, Baltimore, MD

#### National

May 2015 Investigating the Brain Basis of Motor Deficits in Autism, Lectures on Analysis of Neuroimaging Data  
New York University Department of Child and Adolescent Psychiatry, New York, NY

## OTHER PROFESSIONAL ACCOMPLISHMENTS *(Optional)*

### Posters

Chancey VC, Nightingale RW, **Nebel MB**, Luck JF & Myers BS. *Extrapolation Function Selection for the Prediction of High-Load Responses from Low-Load Biomechanical Data*. International Workshop on Human Subjects for Biomechanical Research, San Antonio, TX, Aug 2001.



**Nebel MB**, Folger S & Essick G. *Modulation of tactile information processing by noxious heat: an fMRI study*. Society for Neuroscience (SfN), #825.7, San Diego, CA, Nov 2007.

McGlone F, **Nebel MB**, Essick G & Dancer C. *An fMRI compatible vibrotactile stimulator for the study of touch: basic science and clinical applications*. Building the NIH Toolbox: Research in Cognition, Sensation, Emotion, and Motor Function, Bethesda, MD, Oct 2008.

**Nebel MB**, Cascio C, Moana E, Baranek G, Folger S, McGlone F & Essick G. *Aberrant cortical processing of heat pain in autism: an fMRI study*. Organization for Human Brain Mapping (OHBM), San Francisco, CA, June 2009.

**Nebel MB**, Cascio C, Moana E, Baranek G, Folger S, McGlone F & Essick G. *Auditory cortex involvement in processing inaudible vibrotactile inputs: Differences between tactile hypo- and hyper-sensitive groups*. SfN, #78.15, Chicago, IL, Oct 2009.

**Nebel MB**, Joel SE, Muschelli J, Barber AD, Caffo BS, Pekar JJ & Mostofsky SH. *Functional parcellation of the motor cortex: Children with autism vs. typically developing children*. OHBM, Quebec, Canada, June 2011.

**Nebel MB**, Eloyan A, Barber A, Caffo B, Pekar JJ & Mostofsky S. *Motor Cortex Functional Connectivity Signatures of Autism*. International Meeting for Autism Research (IMFAR), #108.170, San Sebastian, Spain, May 2013.

Yau JM, **Nebel MB**, Hua J & Desmond JE. *Direct comparison of network connectivity revealed by resting-state fMRI and concurrent TMS-fMRI*. SfN, #550.21, San Diego, CA, Nov 2013.

Cohen JR, Barber AD, **Nebel MB**, D'Esposito M & Mostofsky SH. *Global brain organization is disrupted in children with ADHD*. SfN, #573.26, San Diego, CA, Nov 2013.

**Nebel MB**, Eloyan A, Nettles C, Sweeney K, Ament K, Ward R, Choe A, Barber A, Pekar JJ & Mostofsky SH. *Visual-motor functional connectivity relates to autism severity*. OHBM, Hamburg, Germany, June 2014.

Dirlikov B, **Nebel MB**, Bastian AJ, Younes L & Mostofsky SH. *Tablet-Based Method for Handwriting Assessment*. IMFAR, #137.037, Salt Lake City, UT, May 2015.

**Nebel MB**, Haworth JL, Hess C, Mostofsky SH & Landa RJ. *Visual-Motor Integration is Associated with Familial Liability for Autism*. IMFAR, #124.165, Salt Lake City, UT, May 2015.

Mejia A, Eloyan A, **Nebel MB**, Caffo BS & Lindquist MA. *Robust Leverage-Weighted Principal and Independent Components Analysis*. OHBM, Honolulu, HI, June 2015.

**Nebel MB**, Xu Y, Choe AS, Cohen JR, Barber AD, Mostofsky SH, Pekar JJ, Caffo BS & Lindquist MA. *Sliding windows are suboptimal for tracking functional connectivity dynamics*. OHBM, Geneva, Switzerland, June 2016.

Mejia A, **Nebel MB**, Barber AD, Choe A & Lindquist MA. *Scan Length, Shrinkage and Reliability of Resting-State Functional Connectivity in the HCP*. OHBM, Geneva, Switzerland, June 2016.

Dajani D, Odriozola P, **Nebel MB**, Mostofsky SH & Uddin L. *Functional brain network integrity reflects heterogeneous executive function ability in ASD and ADHD*. OHBM, Geneva, Switzerland, June 2016.

#### Oral/Podium Presentations

**Nebel MB**, Folger S, Tommerdahl M, Hollins M, McGlone F & Essick G. *Modulation of tactile responsiveness in somatosensory cortex by noxious heat: Implications for TMD*. 5<sup>th</sup> Scientific Meeting of the TMJ Association, Bethesda, MD, June 2008.

**Nebel MB**, Joel SE, Muschelli J, Barber A, Caffo B, Pekar JJ & Mostofsky S. *Disruption of functional organization within the primary motor cortex in children with autism*. 21<sup>st</sup> Scientific Meeting and Exhibition, International Society for Magnetic Resonance in Medicine (ISMRM), Melbourne, Australia, May 2012.

**Nebel MB**, Eloyan A, Nettles C, Sweeney K, Ament K, Ward R, Choe AS, Barber AD, Caffo BS, Pekar JJ & Mostofsky SH. *Visual-Motor Connectivity Relates to Autism Trait Severity*. 23<sup>rd</sup> Scientific Meeting and Exhibition, ISMRM, Milan, Italy, May 2014.

Barber A, Choe AS, Cohen J, **Nebel MB**, Xu Y & Lindquist MA. *Evaluating the Reproducibility of Dynamic Connectivity in fMRI*. IEEE International Symposium on Biomedical Imaging, Brooklyn, NY, April 2015.

Floris DL, Barber AD, **Nebel MB** & Mostofsky SH. *Atypical Lateralization of Motor Circuit Connectivity in Children with High-Functioning Autism Is Associated with Motor Deficits*. IMFAR, Salt Lake City, UT, May 2015.

#### Community Services

2011-2013 High School Student Mentor & Teacher Liaison Committee Member, Thread (formerly the Incentive Mentoring Program)

2016-present    [Back on My Feet Baltimore](#), an organization that combats homelessness through the power of running, community support and essential employment and housing resources

2017             Baltimore Point-In-Time Homeless Street Count Volunteer