

CURRICULUM VITAE
The Johns Hopkins School of Medicine


Mary Beth Nebel

October 14, 2022

DEMOGRAPHIC AND PERSONAL INFORMATION

Current Appointments

University

2017–present Assistant Professor, Department of Neurology, Johns Hopkins University School of Medicine

2016–present Faculty Affiliate, Wendy Klag Center for Autism & Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health

Hospital N/A

Other

2015–present Research Scientist, Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute

Personal Data

Address: Kennedy Krieger Institute
716 N. Broadway, room 311
Baltimore, MD 21205
Center for Neurodevelopmental and Imaging Research

Tel: (443) 923-9257

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Education and Training

Undergraduate

1998–2002 B.S.E., Biomedical Engineering, Duke University, Durham, NC
Research Advisor: Roger Nightingale

Doctoral/Graduate

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

Postdoctoral

2010–2015 Postdoctoral Research Fellowship, Neurology, Johns Hopkins School of Medicine, Baltimore, MD
Focus: Neuroimaging and behavioral methods for investigating sensorimotor function 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

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.
Role: Assisted with data collection; performed manual segmentation of the right cingulate gyrus; contributed to the critical revision of the manuscript.
- 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.
Role: Performed manual segmentation of cortical grey and white matter; contributed to the critical revision of the manuscript.
- 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.
Role: Assisted with data collection; performed image quality control, preprocessing, and initial analyses of the task fMRI data; contributed to the critical revision of the manuscript.
- 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.
Role: Assisted with the development of a classification approach focused on motor functional connectivity; contributed to the interpretation of the results, the initial draft of the manuscript, and the subsequent revisions.
- 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.
Role: As the only study team member expert in neuroscience, I reprocessed the resting state fMRI data; generated functional connectivity estimates; contributed to the critical revision of the manuscript.
- 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, Keysers 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 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**, 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.
Role: As the only study team member expert in neuroscience, I preprocessed the resting state fMRI data; extracted time-series from regions of interest; contributed to the interpretation of the results and the critical revision of the manuscript.
- 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: Wrote scripts to spatially register the imaging data and contributed to the critical revision 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.
Role: Preprocessed the resting state fMRI data; guided region of interest selection for the functional connectivity analysis; contributed to the critical revision of the manuscript.
- 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.
Role: Assisted with image quality control and preprocessing; contributed to the critical revision of the manuscript.
- 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.
Role: Assisted with the design of the experiment; preprocessed the resting state fMRI data; guided region of interest selection for the parcellation analyses; contributed to the critical revision of the manuscript.
- 17 Sharer E, Crocetti D, Muschelli J, Barber AD, **Nebel MB**, Caffo BS, Pekar JJ, Mostofsky SH. Neural correlates of visuo-motor learning in autism. *Journal of Child Neurology*. 2015; 30(14): 1877-1886.
Role: Assisted with study design; guided quality control, preprocessing, and analysis of the task fMRI data; contributed to the critical revision of the manuscript.
- 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*. 2016; 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(1): 35.
Role: Contributed to the design of the study; assisted with image quality control and preprocessing; contributed to the critical revision of the manuscript.
- 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.
- 21 Dajani DR, Llabre MM, **Nebel MB**, Mostofsky SH, Uddin LQ. Heterogeneity of executive functions among comorbid neurodevelopmental disorders. *Scientific Reports*. 2016; 6: 36566. doi: 10.1038/srep36566.
Role: Compiled the data set for analysis; assisted with the interpretation of the results; contributed to the critical revision of the manuscript.
- 22 Mejia AF, **Nebel MB**, Eloyan A, Caffo B, Lindquist MA. PCA leverage: Outlier detection for high-dimensional functional magnetic resonance imaging data. *Biostatistics*. 2017; 18(3): 521-36.
Role: As the only study team member expert in neuroscience, I contributed to the design of the study; performed image quality control and preprocessing; assisted with the interpretation of the results and contributed to the critical revision of the manuscript.
- 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*. 2017; 4: 170010. doi: 10.1038/sdata.2017.10.
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*. 2017; 12(3): e0173496.
Role: Performed quality control and preprocessing on the fMRI data; contributed to the interpretation of the results and the critical revision of the manuscript.
- 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*. 2017; 10(2): 185-201.
Role: Designed the setup for digitizing the handwriting task; made the analysis more tractable by translating it to a high-performance computing cluster; generated figures; contributed to the interpretation of results and the critical revision of the manuscript.

- 26 Choe AS, **Nebel MB**, Barber AD, Cohen JR, Xu Y, Pekar JJ, Caffo BS, Lindquist MA. Comparing test-retest reliability of dynamic functional connectivity methods. *NeuroImage*. 2017; 158: 155-75.
Role: Contributed to the design of the study; classified independent components from the Human Connectome Project into functional brain networks; contributed to the interpretation of the results; assisted with the initial draft of the manuscript and the subsequent revisions.
- 27 Calhoun VD, Wager TD, Krishnan A, Rosch KS, Seymour KE, **Nebel MB**, Mostofsky SH, Nyalakanai P, Kiehl K. The impact of T1 vs EPI spatial normalization templates for fMRI data analyses. *Human Brain Mapping*. 2017; 38(11): 5331-42.
Role: Conducted comparison of spatial normalization approaches on pediatric fMRI data collected at Kennedy Krieger; contributed to the critical revision of the manuscript.
- 28 Stephens JA, Salorio CF, Gomes JP, **Nebel MB**, Mostofsky SH, Suskauer SJ. Response Inhibition Deficits and Altered Motor Network Connectivity in the Chronic Phase of Pediatric TBI. *Journal of Neurotrauma*. 2017; 34(22): 3117-23.
Role: Guided quality control, preprocessing, and analysis of the fMRI data; assisted with the interpretation of the results; contributed to the critical revision of the manuscript.
- 29 Stoodley CJ, D'Mello AM, Ellegood J, Jakkamsetti V, Liu P, **Nebel MB**, Gibson JM, Kelly E, Meng F, Cano C, Pascual JM, Mostofsky SH, Lerch JP, Tsai PT. Altered cerebellar connectivity in autism spectrum disorders and rescue of autism-related behaviors in mice. *Nature Neuroscience*. 2017; 20(12): 1744-51.
Role: Preprocessed and analyzed the pediatric neuroimaging data; generated figures; assisted with the initial draft of the manuscript and the subsequent revisions.
- 30 Mejia AF, **Nebel MB**, Barber AD, Choe AS, Pekar JJ, Caffo BS, Lindquist MA. Improved estimation of subject-level functional connectivity using full and partial correlation with empirical Bayes shrinkage. *NeuroImage*. 2018; 172: 478-91.
Role: Contributed to the design of the study; wrote code to calculate partial correlations used in the analyses; generated figures; contributed to the interpretation of the results; assisted with the initial draft of the manuscript and the subsequent revisions.
- 31 Rosch KS, Mostofsky SH, **Nebel MB**. ADHD-related sex differences in fronto-subcortical intrinsic functional connectivity and associations with delay discounting. *Journal of Neurodevelopmental Disorders*. 2018; 10(1): 34.
- 32 Dajani DR , Burrows CA, Odriozola P, Baez A, **Nebel MB**, Mostofsky SH, Uddin LQ. Investigating functional brain network integrity using a traditional and novel categorical scheme for neurodevelopmental disorders. *NeuroImage Clinical*. 2019; 21, 101678.
Role: Compiled the data set for analysis; assisted with the interpretation of the results; contributed to the critical revision of the manuscript.
- 33 Dajani DR , Burrows CA, **Nebel MB**, Mostofsky SH, Gates KM, Uddin LQ. Parsing heterogeneity in autism spectrum disorder and attention-deficit/hyperactivity disorder with individual connectome mapping. *Brain Connectivity*. 2019; 9(9): 673-691.
Role: Compiled the data set for analysis; assisted with the interpretation of the results; contributed to the critical revision of the manuscript .
- 34 Henry TR, Duffy KA, Rudolph MD, **Nebel MB**, Mostofsky SH, Cohen JR. Bridging global and local topology in whole-brain networks using the network statistic jackknife. *Network Neuroscience*. 2020; 4(1): 70-88.
Role: Compiled the data set for analysis; contributed to the critical revision of the manuscript.
- 35 D'Souza NS, **Nebel MB**, Wymbs N, Mostofsky SH, Venkataraman A. A joint network optimization framework to predict clinical severity from resting state functional MRI data. *NeuroImage*. 2020; 206: 116314
Role: Performed image quality control and preprocessing of the fMRI data; assisted with the interpretation of the results and the critical revision of the manuscript.
- 36 Mejia AF, **Nebel MB**, Wang Y, Caffo BS, Guo Y. Template independent component analysis: targeted and reliable estimation of subject-level brain networks using big data population priors. *Journal of the American Statistical Association*. 2020; 115(531): 1151-117.
Role: As the only study team member expert in neuroscience, I was responsible for classifying the functional brain networks used for template generation; contributed to the interpretation of the results; assisted with the initial draft of the manuscript and the subsequent revisions.
- 37 Wymbs, NF, **Nebel MB**, Ewen JB, Mostofsky SH. Altered inferior parietal functional connectivity is correlated with praxis and social skill performance in children with autism spectrum disorder. *Cerebral Cortex*. 2020; 31(5): 2639-52.

Role: Guided quality control, preprocessing, and analysis of the fMRI data; assisted with the interpretation of the results; contributed to the critical revision of the manuscript.

- 38 Lidstone DE, Rochowiak R, Mostofsky SH, **Nebel MB**. A data approach reveals that anomalous motor system connectivity is associated with the severity of core autism symptoms. *Autism Research*. 2021 Jan 22; doi: 10.1002/aur.2476.

- 39 Schirmer MD, Venkataraman A, Rekik I, Kim M, Mostofsky SH, **Nebel MB**, Rosch K, Seymour K, Crocetti D, Irzan H, Hutel M, Ourselin S, Marlow N, Melbourne A, Levchenko E, Zhou S, Kunda M, Lu H, Dvornek NC, Zhuang J, Pinto G, Samal S, Zhang J, Bernal-Rusiel J, Pienaar R, Chung AW. Neuropsychiatric disease classification using functional connectomics-results of the connectomics in neuroimaging transfer learning challenge. *Medical Image Analysis*. 2021; 70: 101972.

Role: Contributed to the design of the Connectomics in Neuroimaging Transfer Learning Challenge at the 22nd International Conference on Medical Image Computing and Computer Assisted Intervention; prepared the Challenge dataset; contributed to the critical revision of the manuscript.

- 40 Risk BB, Murden RJ, Wu J, **Nebel MB**, Venkataraman A, Zhang Z, Qui D. Which multiband factor should you choose for your resting-state fMRI study? *NeuroImage* 2021; 234: 117965.

Role: Conducted seed-based functional connectivity analyses; generated figures; contributed to the initial draft of the paper and the subsequent revisions.

- 41 Duffy KA, Rosch KS, **Nebel MB**, Seymour KE, Lindquist MA, Pekar JJ, Mostofsky SH, Cohen JR. Increased integration between default mode and task-relevant networks in children with ADHD is associated with impaired response control. *Developmental Cognitive Neuroscience*. 2021; 50: 100980.

Role: Compiled the data set for analysis; contributed to the critical revision of the manuscript.

- 42 Augustine F, **Nebel MB**, Mostofsky SH, Mahone EM, Singer HS. Aberrant prefrontal cortical-striatal functional connectivity in children with primary complex motor stereotypies. *Cortex*. 2021; 142: 272-82.

Role: Contributed to the study design; performed quality control, preprocessing, and analyses on the fMRI data; contributed to the initial draft of the paper and the subsequent revisions.

- 43 Chen C , Lidstone D, Crocetti D, Mostofsky SH, **Nebel MB**. Increased interhemispheric somatomotor functional connectivity and mirror overflow in ADHD. *NeuroImage: Clinical* 2021; 31: 102759.

- 44 D'Souza NS, **Nebel MB**, Crocetti D, Robinson J, Wymbs N, Mostofsky SH, Venkataraman A. Deep sr-DDL: Deep structurally regularized dynamic dictionary learning to integrate multimodal and dynamic functional connectomics data for multidimensional clinical characterizations. *NeuroImage* 2021; 241: 118388.

Role: Performed quality control and preprocessing on the fMRI data; assisted with the interpretation of the results and the critical revision of the manuscript.

- 45 Hawks ZW, Todorov A, Marrus N, Nishino T, Talovic M, **Nebel MB**, Girault JB, Davis S, Marek S, Seitzman BS, Eggebrecht AT, Elison J, Dager S, Mosconi MW, Tychsen L, Snyder AZ, Botteron K, Estes A, Evans A, Gerig G, Hazlett HC, McKinstry RC, Pandey J, Schultz R, Styner M, Wolff JJ, Zwaigenbaum Z, Markson L, Petersen SE, Constantino JN, White DA, Piven J, Pruett JR. A prospective evaluation of infant cerebellar-cerebral functional connectivity in relation to behavioral development in autism. *Biological Psychiatry Global Open Science* 2021. doi: 10.1016/j.bpsgos.2021.12.004

Role: Assisted with cerebellar region-of-interest selection, network classification, and interpretation of the results; contributed to the critical revision of the manuscript.

- 46 Zhao Y, **Nebel MB**, Caffo BS, Mostofsky SH, Rosch KS. Beyond massive univariate tests: Covariance regression reveals complex patterns of functional connectivity related to attention-deficit/hyperactivity disorder, age, sex, and response control. *Biological Psychiatry Global Open Science*. 2022; 2(1): 8-16.

Role: Contributed to the study design; performed quality control, image preprocessing, and functional connectivity estimation; contributed to the initial draft of the paper and the subsequent revisions.

- 47 Zhao Y, Matteson DS, Mostofsky SH, **Nebel MB**, Risk BB. Group linear non-gaussian component analysis with applications to neuroimaging. *Computational Statistics and Data Analysis*. 2022; 171: 107454. Role: Preprocessed the resting state fMRI data and ran group ICA to compare with the new approach; contributed to the initial draft of the paper and the subsequent revisions.

- 48 **Nebel MB**, Lidstone D, Wang L , Benkeser D, Mostofsky SH, Risk, BB. Accounting for motion in resting-state fMRI: What part of the spectrum are we characterizing in autism spectrum disorder? *NeuroImage*. 2022; 257: 119296.

- 49 *Gaddis A, *Lidstone D, **Nebel MB**, Griffiths RR, Mostofsky S, Mejia A, Barrett FS. Psilocybin Induces Spatially Constrained Alterations in Thalamic Functional Organization and Connectivity. *NeuroImage*. 2022; 260: 119434. Role: Guided

preprocessing and analysis of the resting state fMRI data; contributed to the initial draft of the paper and the subsequent revisions.

- 50 Mejia AF, Bolin D, Yue YR, Wang J, Caffo BS, **Nebel MB**. Template independent component analysis with spatial priors for accurate subject-level brain network estimation and inference. *Journal of Computational and Graphical Statistics* (in press).

Review Articles [RA]

- 1 **Nebel MB**, Gracely R. Neuroimaging of fibromyalgia. *Rheum Dis Clin North America*. 2009; 35(2): 313-27.
- 2 Doss MK, Madden MB, Gaddis A, **Nebel MB**, Griffiths RR, Mathur BN, Barrett FS. Models of psychedelic drug action: modulation of cortical-subcortical circuits. *Brain* 2021. doi: 10.1093/brain/awab406.
- 3 Song Y, Lally PJ, Yanez Lopez M, Oeltzschner G, **Nebel MB**, Gagoski B, Kecskemeti S, Hui SCN, Zöllner HJ, Shukla D, Arichi T, De Vita E, Yedavalli V, Thayyil S, Fallin D, Dean DC 3rd, Grant PE, Wisnowski JL, Edden RAE. Edited magnetic resonance spectroscopy in the neonatal brain. *Neuroradiology*. 2022; 64(2): 217-232.

Proceedings Reports [PR]

- 1 Venkataraman A, Wymbs N, **Nebel MB**, Mostofsky S. A Unified Bayesian Approach to Extract Network-Based Functional Differences from a Heterogeneous Patient Cohort. In *Proc: CNI: International Workshop on Connectomics in NeuroImaging*. 2017; 1-8.
- 2 D'Souza NS, **Nebel MB**, Wymbs N, Mostofsky S, Venkataraman A. A Generative-Discriminative Basis Learning Framework to Predict Clinical Severity from Resting State Functional MRI Data. In: Frangi A., Schnabel J., Davatzikos C., Alberola-López C, Fichtinger G (eds) *Medical Image Computing and Computer Assisted Intervention – MICCAI 2018*. Lecture Notes in Computer Science, vol 11072. Springer, Cham. https://doi.org/10.1007/978-3-030-00931-1_19.
- 3 D'Souza NS, **Nebel MB**, Wymbs N, Mostofsky S, Venkataraman A. Integrating Neural Networks and Dictionary Learning for Multidimensional Clinical Characterizations from Functional Connectomics Data. In: Shen D, et al. (eds) *Medical Image Computing and Computer Assisted Intervention – MICCAI 2019*. Lecture Notes in Computer Science, vol 11766. Springer, Cham. https://doi.org/10.1007/978-3-030-32248-9_79.
- 4 D'Souza NS, **Nebel MB**, Crocetti D, Wymbs N, Robinson J, Mostofsky S, Venkataraman A. A Deep-Generative Hybrid Model to Integrate Multimodal and Dynamic Connectivity for Predicting Spectrum-Level Deficits in Autism. In: Martel AL, et al. (eds) *Medical Image Computing and Computer Assisted Intervention – MICCAI 2020*. Lecture Notes in Computer Science, vol 12267. Springer, Cham. https://doi.org/10.1007/978-3-030-59728-3_43.
- 5 D'Souza NS, **Nebel MB**, Crocetti D, Wymbs N, Robinson J, Mostofsky S, Venkataraman A. A Matrix Autoencoder Framework to Align the Functional and Structural Connectivity Manifolds as Guided by Behavioral Phenotypes. In: de Bruijne M, et al. (eds) *Medical Image Computing and Computer Assisted Intervention – MICCAI 2021*. Lecture Notes in Computer Science, vol 12907. Springer, Cham. https://doi.org/10.1007/978-3-030-87234-2_59.

Software [SW]

- 1 Mejia AF [aut, cre], Pham D [aut], **Nebel MB [ctb]**. templateICAR: Estimate Brain Networks Using Empirical Population Priors. 2022. R package version 0.3.1, <https://doi.org/10.1080/01621459.2019.1679638>.

Other Media [OM]

- 1 Caffo BS, Eloyan A, Han F, Liu H, Muschelli J, **Nebel MB**, Zhao T, Crainiceanu C. SMART Thoughts on the ADHD 200 Data Analysis Competition [blog post]. *Simply Statistics*, 2 Nov. 2011, <https://simplystatistics.org/>. Accessed 5 Feb. 2022.

Media Releases or Interviews [MR]

- 6/21/2022 Interviewed for Spectrum: "Causal inference method mitigates motion bias in autism imaging studies" by Emily Harris. <https://doi.org/10.53053/ZLQB7192>. Accessed 15 July 2022.

Case Reports [CR] None.

Book Chapters, Monographs [BC] None.

Books, Textbooks [BK] None.

FUNDING

EXTRAMURAL FUNDING

Research Extramural Funding

Current

| | |
|-----------------|---|
| 2/1/18–1/31/23 | Subtle Motor functioning and Functional Connectivity in Youth Medically Cleared After Mild TBI R01 HD090266, National Institute of Child Health and Human Development \$600,009 P.I. Stacy Suskauer Role: Co-Investigator 25% (3.00 calendar) The goal of this project is to evaluate whether subtle motor function and functional brain connectivity are abnormal even when youth clinically appear to have recovered from concussion, with the goal of identifying ways to minimize problems after youth concussion. |
| 2/1/19–11/30/22 | Bayesian Methods for Cortical Surface Neuroimaging Data R01 EB027119, National Institute of Biomedical Imaging and Bioengineering \$83,119 P.I. Amanda Mejia (Indiana University) Role: KKI subcontract PI/Co-Investigator; 15% (1.8 calendar) We will develop computationally efficient Bayesian methods for analyzing cortical surface functional magnetic resonance imaging (fMRI) data. We will apply the proposed methods to study brain-behavior relationships in autism and amyotrophic lateral sclerosis. *Please note, for the first 3 years, Dr. Nebel's effort and funding support for this project will be subsumed under her K01. |
| 8/1/20–5/31/25 | Sleep and Circadian Dysfunction, Brain and Neurobehavioral Development in Autism P50HD103538, Eunice Kennedy Shriver National Institute of Child Health and Human Development \$177,959 P.I. Bradley Schlagger Role: Co-Investigator; 5% (0.60 calendar) The goal of this project is to refine how sleep/wake problems are assessed in children with autism by applying novel statistical modeling to objective, actigraphy-based measures and parent-report measures and examining how disturbed sleep and altered RARs might affect brain structure and function. *For the first year and the first 8 months of year 2, Dr. Nebel's effort and funding support for this project will be subsumed under her K01. |
| 10/1/21–6/30/26 | Healthy Brain & Child Development National Consortium (HBCD-NC) U01 DA055350-01, National Institute of Health \$2,150,019 P.I. M. Daniele Fallin, Irina Burd, Joan Kaufman Role: Co-Investigator; 40% (4.8 calendar) year 1; 60% (7.2 calendar) years 2-5 The HBCD-NC will follow 7,500 mothers and their children across the U.S. from before birth to 10 years of age to better understand which harmful and protective environments exert the greatest impact on child development. |

Pending

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| 9/1/22–8/31/27 | Edited Magnetic Spectroscopy in the Pediatric Brain R01 EB032788, National Institute of Mental Health |
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| | <p>\$219,480</p> <p>P.I. Richard Edden</p> <p>Role: KKI Subcontract P.I.; 10% (1.2 calendar)</p> <p>We will develop multi-spectrum edited MRS in the pediatric brain, building acquisition and data processing tools, acquiring key reference data and disseminating the resulting experiments to collaborative partner sites.</p> |
| 9/1/22–8/31/27 | <p>Affective and neurocognitive mechanisms underlying antidepressant effects of psilocybin therapy</p> <p>R01 MH130699, National Institute of Mental Health</p> <p>\$3,863,171</p> <p>P.I. Frederick Barrett</p> <p>Role: Co-I; 10% (1.2 calendar)</p> <p>The goal of this double-blind, placebo-controlled, mechanistic study will extend our prior work to determine whether negative affect and cognitive control play a role in enduring psilocybin effects on depression severity in patients with major depressive disorder.</p> |
| 4/1/23–3/31/25 | <p>Application of novel high-dimensional moderation and mediation computational models to examine neurobehavioral mechanisms of sex differences in adolescent outcomes for children with ADHD</p> <p>R21 (resubmission), National Institute of Mental Health</p> <p>\$240,855</p> <p>P.I. Keri Rosch</p> <p>Role: Co-I; 10% (1.2 calendar)</p> <p>The goal of this proposal is to use modern, multimodal (brain structure/function, behavior), multivariate (multiple measures within a modality) statistical analyses that allow unified modeling of the interactions at brain and behavioral levels impacting sexual dimorphic adolescent outcomes in children with ADHD.</p> |
| Previous | |
| 11/1/12–10/31/14 | <p>Understanding the Brain Basis of Impaired Imitation Learning in Autism</p> <p>#7961, Autism Speaks</p> <p>Role: P.I.; 100% (12 calendar)</p> <p>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.</p> |
| 7/1/15–4/30/16 | <p>Adolescent Changes in Brain and Behavior in Boys and Girls with ADHD</p> <p>2 R01 MH085328-10A1, National Institute of Mental Health</p> <p>P.I. Stewart Mostofsky</p> <p>Role: Research Scientist; 32% (3.84 calendar)</p> <p>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.</p> |
| 7/1/15–4/30/16 | <p>Statistical Methods for Mapping Human Brain Development</p> <p>R01 MH095836, National Institute of Mental Health</p> <p>P.I.: Philip Reiss</p> <p>Role: Co-I; 25% (3.00 calendar)</p> <p>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.</p> |
| 7/1/15–6/30/16 | <p>Statistical Methods for Large N and P Problems</p> <p>R01 EB012547, National Institute of Biomedical Imaging and Bioengineering</p> <p>P.I.: Brian Caffo</p> |

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

The goal of this project is to tailor model-based independent component blind source separation methods to investigate brain-behavior relationships in large, multi-site fMRI data sets from various patient populations, including autism.

5/13/16–4/30/22 n.c.e.

Visual Motor Development in Infants at High Risk for Autism

K01 MH109766–01, National Institute of Mental Health

\$148,947

Role: P.I. 75% (9.00 calendar)

We will use advanced statistical methods to 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.

7/1/18–6/30/21

CRCNS Research Proposal: Collaborative Research: Discovering Network Structure in the Space of Group-Level Functional Differences

#1822581, National Science Foundation

\$138,916

P.I. Archana Venkataraman

Role: Co-Investigator; 4.16% (0.50 calendar)

This project will develop methods to discover and characterize brain network architectures in the space of group-level functional differences. We will strategically leverage patient heterogeneity to guide network estimation in three clinical test beds: autism, ADHD, and schizophrenia. *Dr. Nebel's effort and funding support for this project were subsumed under her K01.

9/30/19–3/31/22 n.c.e

HEALthy ORCHARD: Developing Plans for a Baltimore Site of the HEALthy Brain and Child Development (HBCD) Study

R34 DA050292, National Institute of Drug Abuse

\$191,453

P.I. M. Daniele Fallin

Role: Co-Investigator; 2.0% (0.24 calendar)

We propose to create a Baltimore site for the NIH HBCD initiative, to join in recruiting and following pregnant women with and without substance use disorders and their children including longitudinal assessments of brain function, social, emotional, and cognitive development through age 10. *Dr. Nebel's effort and funding support for this project will be subsumed under her K01.

Educational Extramural Funding

Current

None.

Pending

7/1/23–6/30/28

Psychiatric Epidemiology Training Program

T32MH014592, National Institute of Mental Health

P.I. Heather Volk; Peter Zandi

Role: Affiliated Faculty

Recent scientific advances in -omics and imaging present new opportunities for accelerating the discovery and translation of findings into public health gains. This training program will capitalize on the unusually rich resources for biomedical research at the Johns Hopkins University to provide trainees with the skills and experiences needed to lead multi-disciplinary research that takes advantage of these emerging opportunities and promotes mental health.

Previous

None.

INTRAMURAL FUNDING

Current

7/1/22–6/30/24

Identifying Challenges with Learning to Drive in ASD Pilot Study: Advancing Understanding of the Role of Visual Motor Integration.

Wendy Klag Center for Autism & Developmental Disabilities Faculty Grant
\$100,000

P.I. Johnathon Ehsani

Role: Co-Investigator

The objectives of this application are to determine the feasibility of enrolling participants with ASD who previously underwent comprehensive research-based assessments as children, that included deep diagnostic, behavioral and neuroimaging phenotyping into a longitudinal driving research study; and to examine how previously identified childhood visual-motor integration deficits impact learning to drive and real-world driving behavior.

Pending

None.

Previous

None.

CLINICAL ACTIVITIES None.

EDUCATIONAL ACTIVITIES

Educational Focus

My educational focus is on teaching students, post-docs, faculty, and staff current best practices in fMRI research while developing the ability to evaluate the utility of methodological advances in data acquisition, processing, and analysis within the context of their research. I believe experiential learning activities targeted to the learner's particular interest in brain function are the best way to encourage curiosity, engage learners in scientific inquiry, and to promote the problem solving and communication skills necessary to conduct cutting-edge, collaborative brain research.

TEACHING

Classroom Instruction

JHMI/Regional None.

National

| | |
|----------------------|---|
| 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, 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 |
| 2017 (Fall) | Guest Lecturer, Undergraduate, Applied Linear Regression, Indiana University |
| 2018 (Fall) | Guest Lecturer, Undergraduate, Applied Linear Regression, Indiana University |
| 2019 (Fall) | Guest Lecturer, Undergraduate, Applied Linear Regression, Indiana University |
| 2020 (Fall, virtual) | Guest Lecturer, Undergraduate, Applied Linear Regression, Indiana University |
| 2020 (Fall, virtual) | Guest Lecturer, Undergraduate, Applied Linear Regression, Indiana University |
| 2022 (Fall, virtual) | Guest Lecturer, Undergraduate and Graduate, Applied Linear Regression, Indiana University |

International None.

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 |
|-------------|--|

National None

International None.

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

National None.

International None.

MENTORING

Pre-doctoral Advisees/Mentees

- 5/12–9/12 Dina Dajani, Ph.D., User Experience Researcher at Facebook
Leadership Alliance Summer Research-Early Identification Program Internship
Shared scholarship: OA21, OA32, OA33
- 5/19–5/20 Liwei Wang, MS, Statistical Programmer at Novartis GDD
field supervisor for Liwei’s Applied Practice Experience as part of her Biostatistics MSPH from Emory University
Shared scholarship: OA48
- 5/19–7/20 Christine Chen, B.S., Child Studies M.Ed student at Vanderbilt University
Shared scholarship: OA43
- 10/21–present Emma Jagasia, MSN, MPH, DNP/Ph.D. student
Predoctoral fellow supported by the NICHD T32 HD094687 grant focused on interdisciplinary training in the science of risk factors, neurophysiological, developmental, physical, and mental health sequelae for exposure to trauma and violence.

Post-doctoral Advisees/Mentees None.

Thesis Committees None.

Educational Program Building/Leadership None.

Educational Demonstration Activities None.

Clinical Instruction None.

RESEARCH ACTIVITIES

Research Focus

I study how children learn to interpret sensory information to produce appropriate actions using functional magnetic resonance imaging (fMRI) and video-based assessments of behavior. Using these tools, I have demonstrated how atypical communication between visual and motor brain regions may contribute to impaired motor and social skill performance in autistic children. To extend these methods to study the emergence of visually guided reaching in children at higher likelihood for autism, I have helped establish the infrastructure to scan infants and toddlers during natural sleep at KKI/JHU. Given the inherent challenges of scanning young populations, my secondary focus is on innovative analysis methods that make the most of the available data by minimizing artifacts and maximizing the accuracy, reproducibility, and generalizability of fMRI-derived connectivity metrics.

Research Program Building/Leadership

- 9/19–present Steering committee, Scanning children 0–4 years of age during natural, unsedated sleep. This team, which includes Dr. Daniele Fallin, Chair of the Department of Mental Health in the Johns Hopkins Bloomberg School of Public Health, Dr. Peter Van Zijl, Director of the F. M. Kirby Center for Functional Magnetic Resonance Imaging at KKI, and Dr. James Pekar, manager of the Kirby Center, is responsible for developing the institutional infrastructure to conduct this area of MRI research previously lacking at KKI and the JHUSOM. During the planning phase of the HEALthy Brain and Child Development Study (HBCD), I led the operational

aspects of pilot scanning at KKI, which included the design of infant and toddler protocols, and I served as the liaison between the local imaging team at the F. M. Kirby Center for Functional Magnetic Resonance Imaging at KKI who designed the MR sequences we used and PI Dr. Fallin's participant recruitment team. I continue to organize the day-to-day operations of the MRI team for the KKI/JHU site of the HBCD.

Research Demonstration Activities None.

Inventions, Patents, Copyrights None.

Technology Transfer Activities None.

SYSTEM INNOVATION AND QUALITY IMPROVEMENT ACTIVITIES None.

ORGANIZATIONAL ACTIVITIES

Institutional Administrative Appointments

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

2015–present Frontiers in Computational Neuroscience, Review Editor

Other Peer Review Activities [non medico-legal]

2017 Abstract reviewer for the annual meeting of the Organization for Human Brain Mapping

Advisory Committees, Review Groups/Study Sections

2020–present Member, Healthy Brain and Child Development National Consortium MRI Working Group

2021–present Member, Healthy Brain and Child Development National Consortium Scanning Young Populations Working Group

Professional Societies

2013–2018 Society for Neuroscience, Member

2013–present International Society for Autism Research, Member

2013–present Organization for Human Brain Mapping, Member

2015–present Flux Society, Member

Session Chair

International

5/21 Session chair, "Bodies, Faces, and Limbs: Measuring Movement in the Context of Autism," International Society for Autism Research, Annual Meeting, Virtual conference

9/22 Session Co-organizer and Co-chair, "The potentially big role of the 'little brain' in cognitive development," Flux Congress, Paris, France

JHMI/regional None.

National None.

Conference Organizer None.

Consultantships None.

RECOGNITION

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
- 2017 Emerging Women's Leadership Program, Johns Hopkins School of Medicine

Invited Talks

JHMI/regional

- 2014 Speaker, Johns Hopkins Bloomberg School of Public Health Department of Biostatistics and The Wendy Klag Center for Autism and Developmental Disabilities Joint Grand Rounds, "Investigating the Brain Basis of Motor Deficits in Autism: SMART-KKI Collaborations," Baltimore, MD
- 2019 Speaker, 20th Anniversary Symposium of the F.M. Kirby Research Center for Functional Brain Imaging at Kennedy Krieger Institute, "Investigating the Brain Basis of Motor Deficits in Autism," Baltimore, MD
- 2020 Speaker, 1st anniversary of the Pediatric Neuroscience Collaborative at Kennedy Krieger Institute, "Changes in brain functional connectivity associated with the emergence of reaching and grasping in infants at higher likelihood for autism," Baltimore, MD
- 2022 Speaker, Department of Psychiatry and Behavioral Sciences Research Conference, "Accounting for motion in fMRI: what part of the spectrum are we characterizing in autism spectrum disorder?," Baltimore, MD

National

- 5/15 Speaker, NYU Department of Child and Adolescent Psychiatry Lectures on Analysis of Neuroimaging Data, "Investigating the Brain Basis of Motor Deficits in Autism," New York, NY
- 6/17 Speaker, Statistical Methods in Imaging Conference, "Making Motor Connectivity Great Again," Pittsburg, PA
- 6/17 Speaker, Infant Brain Imaging Study Annual Meeting, "Examining the emergence of visually guided reaching/grasping in infants at high risk for autism," New York, NY
- 7/18 Speaker, Emory University Center for Biomedical Imaging Statistics, "Communication is hard or why I study motor coordination in autism," Atlanta, GA
- 11/18 Speaker, University of Virginia Department of Psychology, "Communication is hard or why I study motor coordination in autism," Charlottesville, VA
- 11/18 Speaker, Infant Brain Imaging Study Annual Meeting, "Changes in brain functional connectivity associated with the emergence of reaching and grasping in infants at high risk for autism," Chicago, IL
- 9/19 Speaker, Indiana University Club Neuro Lunchbox Seminar Series, "Communication is hard or why I study motor coordination in autism," Bloomington, IN
- 8/20 Speaker, Joint Statistical Meetings, "Better Together: Improved Estimation of Subject-Level Functional Connectivity with Empirical Bayes Shrinkage," Virtual conference

International

- 9/22 Speaker, Flux Congress, "Using template ICA to investigate participant-specific features of cerebellar functional organization" Sorbonne University, Paris, France
- 9/22 Speaker, Joint seminar for the Precision Medicine by Data Integration and Causal Learning, Soda, and MIND teams, "Accounting for motion in fMRI: What part of the spectrum are we characterizing in autism spectrum disorder?" Inria Saclay, Palaiseau, France

OTHER PROFESSIONAL ACCOMPLISHMENTS

Oral/Podium Presentations

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|-------|--|
| 6/08 | Modulation of tactile responsiveness in somatosensory cortex by noxious heat: Implications for TMD. 5 th Scientific Meeting of the TMJ Association, Bethesda, MD. |
| 5/12 | Disruption of functional organization within the primary motor cortex in children with autism. 21 st Scientific Meeting and Exhibition, International Society for Magnetic Resonance in Medicine (ISMRM), Melbourne, Australia. |
| 5/14 | Visual-Motor Connectivity Relates to Autism Trait Severity. 23 rd Scientific Meeting and Exhibition, ISMRM, Milan, Italy. |
| 4/15 | Evaluating the Reproducibility of Dynamic Connectivity in fMRI. IEEE International Symposium on Biomedical Imaging, Brooklyn, NY [Dr. Martin Lindquist gave the talk]. |
| 5/15 | Atypical Lateralization of Motor Circuit Connectivity in Children with High- Functioning Autism Is Associated with Motor Deficits. Annual meeting of the International Society for Autism Research, Salt Lake City, UT [Dr. Dorothea Floris gave the talk]. |
| 12/21 | Efficient Bayesian estimation of brain activation with cortical surface and subcortical data using EM. 14 th International Conference of the ERCIM Working Group on Computational and Methodological Statistics, King's College, London, UK [Dr. Daniel Spencer gave the talk]. |

Community Service

- | | |
|-----------|---|
| 2011–2013 | High School Student Mentor & Teacher Liaison Committee Member, Thread (formerly the Incentive Mentoring Program) |
| 2016–2021 | Back on My Feet Baltimore, an organization that combats homelessness through the power of running, community support, and essential employment and housing resources, Volunteer |
| 2017 | Baltimore Point-In-Time Street Count Volunteer |