

# David McCoy

BIostatistician · Data Scientist

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“Dredge with Dignity.”

## Summary

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My research focuses on data-adaptive target parameters paired with building statistical estimators that are asymptotically unbiased and have the lowest variance. In most real-world situations, the analyst does not know what combinations of treatment or exposure lead to disease or what mediating paths these effects have. My work is in causal machine learning where these exposures and paths are both discovered in the data and valid inference estimated for causal target parameters. Before working in semi-parametric statistics I was an applied medical statistician and data scientist.

## Education

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### University of California, Berkeley

Berkeley, USA

PHD IN ENVIRONMENTAL HEALTH SCIENCES

Oct. 2019 - June. 2023

- Thesis: Targeted Learning for Estimating Mediation and Moderation in Toxic Mixtures
- Research Synopsis: Development of assumption-lean statistical inference methods for determining the joint impact, interaction, effect modification and mediation of mixed treatment or exposure.
- Advisors: Alan Hubbard, Mark van der Laan, Martyn Smith

### London School of Hygiene and Tropical Medicine

London, UK

MASTER OF SCIENCE IN EPIDEMIOLOGY

Oct 2014 - Dec 2017

- Thesis: Predicting neurological impairment in acute spinal cord injury using models incorporating clinical data with lesion-based volumetric and texture features: a retrospective cohort study
- Research Synopsis: Development artificial intelligence algorithms to segment spinal cord tissue from magnetic resonance imaging and predict clinical outcomes from imaging data and patient history

### University of Delaware

Delaware, USA

BACHELOR OF SCIENCES IN PHILOSOPHY, PSYCHOLOGY AND COGNITIVE SCIENCE

Sept 2005 - May 2009

- Research Synopsis: Electroencephalography of spatial attention

## In-Preparation

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- **David McCoy**, Alejandro Schuler, Mark Van der Laan, and Alan Hubbard. “Cross-Validated Decision Trees with Targeted Maximum Likelihood Estimation for Nonparametric causal mixtures analysis”. In: *Arxiv* (2023)
- **David McCoy**, Alejandro Schuler, Mark Van Der Laan, and Alan Hubbard. “Semi-Parametric Identification and Estimation of Interaction and Effect Modification in Mixed Exposures using Stochastic Interventions”. In: (2023)
- **David McCoy**, Alejandro Schuler, and Alan Hubbard. “Interacting Risk Factors Related to Environmental Racism on COVID-19 Transmission and Mortality across U.S. Counties”. In: (2023)
- **David McCoy**, Alejandro Schuler, Alan Hubbard, and Mark Van der Laan. “Mixed Exposure-Mediation Discovery and Estimation using Stochastic Interventions”. In: (2023)
- **David McCoy**, Alejandro Schuler, Alan Hubbard, and Mark Van der Laan. “High-dimensional Mediation Analysis of a Mixed Exposure using Cross-Validated Decision Trees and Targeted Learning”. In: (2023)

## Publications

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- Ethan Winkler, David Wu, Eugene Gil, **David McCoy**, Kazim Narsinh, Zhengda Sun, Kerstin Mueller, Jayden Ross, Helen Kim, Shantel Weinsheimer, et al. “Endoluminal biopsy for molecular profiling of human brain vascular malformations”. In: *Neurology* 98.16 (2022), e1637–e1647

- Azhagiya Singam Ettayapuram Ramaprasad, Martyn T Smith, **David McCoy**, Alan E Hubbard, Michele A La Merrill, and Kathleen A Durkin. “Predicting the Binding of Small Molecules to Nuclear Receptors Using Machine Learning and Molecular Modeling Techniques”. In: *ENVIRONMENTAL AND MOLECULAR MUTAGENESIS*. vol. 63. WILEY 111 RIVER ST, HOBOKEN 07030-5774, NJ USA. 2022, pp. 66–66
- Azhagiya Singam Ettayapuram Ramaprasad, Martyn T Smith, **David McCoy**, Alan E Hubbard, Michele A La Merrill, and Kathleen A Durkin. “Predicting the binding of small molecules to nuclear receptors using machine learning”. In: *Briefings in Bioinformatics* 23.3 (2022)
- **David McCoy**, Whitney Mgbara, Nir Horvitz, Wayne M Getz, and Alan Hubbard. “Ensemble machine learning of factors influencing COVID-19 across US counties”. In: *Scientific reports* 11.1 (2021), p. 11777
- Joseph Knox, Ryan Sincic, **David McCoy**, Colby Sostarich, and Daniel L Cooke. “Comparing occlusive balloon performance using 3-dimensional printed models of intracranial aneurysmal defects”. In: *World Neurosurgery* 146 (2021), e888–e895
- Kazim H Narsinh, Kamileh Narsinh, **David McCoy**, Zhengda Sun, Cathra Halabi, Karl Meisel, Tarik Tihan, Krishna Chaganti, Matthew R Amans, Van V Halbach, et al. “Endovascular biopsy of vertebrobasilar aneurysm in patient with polyarteritis Nodosa”. In: *Frontiers in Neurology* (2021), p. 1989
- K Narsinh, **David McCoy**, Z Sun, E Winkler, A Abla, and D Cooke. *E-012 Endovascular biopsy of vertebrobasilar aneurysm demonstrates differential expression of immunologic genes in polyarteritis nodosa patient*. 2020
- Michele M Tana, **David McCoy**, Briton Lee, Roshan Patel, Joseph Lin, and Michael A Ohliger. “Texture features from computed tomography correlate with markers of severity in acute alcohol-associated hepatitis”. In: *Scientific Reports* 10.1 (2020), p. 17980
- E Winkler, D Wu, **David McCoy**, A Abla, and D Cooke. *O-020 Endoluminal biopsy for molecular classification of human brain arteriovenous malformations*. 2020
- Ethan Winkler, **David McCoy**, Zhengda Sun, and Daniel Cooke. “RNA-seq Based Non-Invasive Endovascular Biopsy of Brain Arteriovenous Malformations”. In: *Stroke* 51.Suppl\_1 (2020), A128–A128
- JA Knox, MD Alexander, **David McCoy**, DC Murph, PJ Hinckley, JC Ch’Ang, CF Dowd, VV Halbach, RT Higashida, MR Amans, et al. “Impact of aortic arch anatomy on technical performance and clinical outcomes in patients with acute ischemic stroke”. In: *American Journal of Neuroradiology* 41.2 (2020), pp. 268–273
- Andrew L Callen, Sara M Dupont, Adi Price, Ben Laguna, **David McCoy**, Bao Do, Jason Talbott, Marc Kohli, and Jared Narvid. “Between always and never: evaluating uncertainty in radiology reports using natural language processing”. In: *Journal of Digital Imaging* 33 (2020), pp. 1194–1201
- **David McCoy**, Sara M Dupont, Charley Gros, Jared Narvid, Julien Cohen-Adad, and Jason F Talbott. “Convolutional neural network based segmentation of the the spinal cord and intramedullary injury in acute blunt spinal cord trauma”. In: (2019)
- Joseph A Knox, Judy Ch’ang, Daniel Murph, **David McCoy**, and Daniel Cooke. “Impact of aortic arch anatomy on technical performance and clinical outcomes in acute ischemic stroke patients”. In: *Journal of Clinical and Translational Science* 3.s1 (2019), pp. 146–147
- Jonathan S Lee, Sarah Lisker, Eric Vittinghoff, Roy Cherian, **David McCoy**, Alex Rybkin, George Su, and Urmimala Sarkar. “Follow-up of incidental pulmonary nodules and association with mortality in a safety-net cohort”. In: *Diagnosis* 6.4 (2019), pp. 351–359
- E Smith, M Amans, K Meisel, and **David McCoy**. *E-088 Psychological impact of pulsatile tinnitus in the US population*. 2019
- **David McCoy**, SM Dupont, C Gros, J Cohen-Adad, RJ Huie, A Ferguson, X Duong-Fernandez, LH Thomas, V Singh, J Narvid, et al. “Convolutional neural network–based automated segmentation of the spinal cord and contusion injury: Deep learning biomarker correlates of motor impairment in acute spinal cord injury”. In: *American Journal of Neuroradiology* 40.4 (2019), pp. 737–744
- Grace F Donzelli, Jeffrey Nelson, **David McCoy**, Charles E McCulloch, Steven W Hetts, Matthew R Amans, Christopher F Dowd, Van V Halbach, Randall T Higashida, Michael T Lawton, et al. “The effect of preoperative

- embolization and flow dynamics on resection of brain arteriovenous malformations”. In: *Journal of neurosurgery* 132.6 (2019), pp. 1836–1844
- Colin Yee, **David McCoy**, Jay Yu, Aaron Losey, Caroline Jordan, Terilyn Moore, Carol Stillson, Hee Jeung Oh, Bridget Kilbride, Shuvo Roy, et al. “Endovascular ion exchange chemofiltration device reduces off-target doxorubicin exposure in a hepatic intra-arterial chemotherapy model”. In: *Radiology: Imaging Cancer* 1.1 (2019), e190009
  - James W Salazar, Karl Meisel, Eric R Smith, Aaron Quiggle, **David McCoy**, and Matthew R Amans. “Depression in patients with tinnitus: a systematic review”. In: *Otolaryngology–Head and Neck Surgery* 161.1 (2019), pp. 28–35
  - Jared Narvid, **David McCoy**, Sara M Dupont, Andrew Callen, Duygu Tosun, Joanna Hellmuth, and Victor Valcour. “Abnormal cerebral perfusion profile in older adults with HIV-associated neurocognitive disorder: discriminative power of arterial spin-labeling”. In: *American Journal of Neuroradiology* 39.12 (2018), pp. 2211–2217
  - Z Sun, H McGregor, M Dickey, **Mccooy, D**, M Conrad, and D Cooke. “Endovascular sampling and targeted gene expression profiling of single endothelial cells from pulmonary arteriovenous malformations in hereditary hemorrhagic telangiectasia”. In: *ANGIOGENESIS*. vol. 21. 1. SPRINGER VAN GODEWIJCKSTRAAT 30, 3311 GZ DORDRECHT, NETHERLANDS. 2018, pp. 155–156
  - MB Conrad, AM Fernandez, ML Eltgroth, **McCoy, D**, B Ishaque, MA Dickey, and SW Hetts. “Accuracy of a CTA vessel analysis tool for measurement of pulmonary arteriovenous malformation feeding arteries compared to conventional CT and angiography”. In: *ANGIOGENESIS*. vol. 21. 1. SPRINGER VAN GODEWIJCKSTRAAT 30, 3311 GZ DORDRECHT, NETHERLANDS. 2018, pp. 162–162
  - Hugh McGregor, Zhengda Sun, **David McCoy**, Vishal Kumar, Miles Conrad, Mark Wilson, and Daniel Cooke. “Endovascular biopsy and endothelial cell gene expression analysis of dialysis arteriovenous fistulas: a feasibility study”. In: *Journal of Vascular and Interventional Radiology* 29.10 (2018), pp. 1403–1409
  - Daniel L Cooke, **David McCoy**, Van V Halbach, Steven W Hetts, Matthew R Amans, Christopher F Dowd, Randall T Higashida, Devon Lawson, Jeffrey Nelson, Chih-Yang Wang, et al. “Endovascular biopsy: in vivo cerebral aneurysm endothelial cell sampling and gene expression analysis”. In: *Translational stroke research* 9 (2018), pp. 20–33
  - **David McCoy**, Russell Huie, S Dupont, William Whetstone, Sanjay Dhall, Rachel Tsolinas, Xuan Duong-Fernandez, Leigh Thomas, Vineeta Singh, Lisa Pascual, et al. “Atlas-based volumetric assessment of T2 abnormality in acute spinal cord injury predicts motor outcomes: a transforming research and clinical knowledge in SCI (TRACK-SCI) pilot study”. In: *Proceedings of the International Society of Magnetic Resonance in Medicine, Paris, France* (2018)
  - Jeffrey K Yang, Andre M Cote, Caroline D Jordan, Sravani Kondapavulur, Aaron D Losey, **David McCoy**, Andrew Chu, Jay F Yu, Teri Moore, Carol Stillson, et al. “Interventional magnetic resonance imaging guided carotid embolectomy using a novel resonant marker catheter: demonstration of preclinical feasibility”. In: *Biomedical microdevices* 19 (2017), pp. 1–11
  - Zachary D Threlkeld, Benjamin Kozak, **David McCoy**, Sara Cole, Christine Martin, and Vineeta Singh. “Collaborative interventions reduce time-to-thrombolysis for acute ischemic stroke in a public safety net hospital”. In: *Journal of Stroke and Cerebrovascular Diseases* 26.7 (2017), pp. 1500–1505
  - **David McCoy**, JF Talbott, Michael Wilson, MD Mamlouk, J Cohen-Adad, Mark Wilson, and J Narvid. “MRI atlas-based measurement of spinal cord injury predicts outcome in acute flaccid myelitis”. In: *American Journal of Neuroradiology* 38.2 (2017), pp. 410–417
  - Jeffrey K Yang, Andre Cote, Caroline D Jordan, Aaron Losey, **David McCoy**, Andrew Chu, Jay F Yu, Teri Moore, Carol Stillson, Fabio Settecase, et al. “Interventional Magnetic Resonance Imaging Guided Carotid Embolectomy using a Novel MRI-Conditional Resonant Catheter: Demonstration of Preclinical Feasibility”. In: (2017)
  - Jonathan S Lee, Sarah Lisker, Roy P Cherian, George Su, Alex Rybkin, **David McCoy**, Raman Khanna, and Urmimala Sarkar. “PURSUING INCIDENTAL PULMONARY NODULES IN A SAFETY-NET COHORT: LOST TO FOLLOW-UP”. in: *JOURNAL OF GENERAL INTERNAL MEDICINE*. vol. 32. SPRINGER 233 SPRING ST, NEW YORK, NY 10013 USA. 2017, S294–S294

- H McGregor, Z Sun, M Conrad, M Wilson, **David McCoy**, and D Cooke. “Endothelial cell sampling in dialysis arteriovenous fistulas: a pilot study comparing gene expression in stenoses and controls”. In: *Journal of Vascular and Interventional Radiology* 2.28 (2017), S148
- Daniel L Cooke, Van Halbach, Steven Hetts, Matthew Amans, Christopher Dowd, Randall Higashida, Devon Lawson, Jeffrey Nelson, **David McCoy**, Helen Kim, et al. “Endovascular Biopsy: in vivo Brain Aneurysm Endothelial Cell Sampling and Gene Expression Analysis”. In: *Stroke* 48.suppl\_1 (2017), A198–A198
- Mark A Lum, Alastair J Martin, Matthew D Alexander, **David McCoy**, Daniel L Cooke, Prasheel Lillaney, Parham Moftakhar, Matthew R Amans, Fabio Settecase, Andrew Nicholson, et al. “Intra-arterial MR perfusion imaging of meningiomas: comparison to digital subtraction angiography and intravenous MR perfusion imaging”. In: *Plos one* 11.11 (2016), e0163554
- Matthew Amans, MA Lum, AJ Martin, MD Alexander, **David McCoy**, DL Cooke, P Lillaney, P Moftakhar, MR Amans, F Settecase, et al. “Intra-Arterial MR Perfusion Imaging of Meningiomas: Comparison to Digital Subtraction Angiography and Intravenous MR Perfusion Imaging”. In: (2016)
- Sravani Kondapavulur, Andre M Cote, Kiel D Neumann, Caroline D Jordan, **David McCoy**, Marc C Mabray, Derek Liu, Chia-Hung Sze, Ayushi Gautam, Henry F VanBrocklin, et al. “Optimization of an endovascular magnetic filter for maximized capture of magnetic nanoparticles”. In: *Biomedical microdevices* 18 (2016), pp. 1–13
- AM Wetherby, J Woods, C Nottke, ST Stronach, D Dow, and **David McCoy**. “Systematic Observation of Red Flags of autism spectrum disorder [Unpublished manual]”. In: *Florida State University* (2016)
- Ingrid R Olson, **David McCoy**, Elizabeth Klobusicky, and Lars A Ross. “Social cognition and the anterior temporal lobes: a review and theoretical framework”. In: *Social cognitive and affective neuroscience* 8.2 (2013), pp. 123–133
- Ingrid R Olson, **David McCoy**, Elizabeth Klobusicky, Lars A Ross, and Ingrid R Olson. “Journal: Social, Cognitive, and Affective Neuroscience”. In: (2012)
- Lars A Ross, **David McCoy**, H Branch Coslett, Ingrid R Olson, and David A Wolk. “Improved proper name recall in aging after electrical stimulation of the anterior temporal lobes”. In: *Frontiers in aging neuroscience* 3 (2011), p. 16
- Lars A Ross, **David McCoy**, David A Wolk, H Branch Coslett, and Ingrid R Olson. “Improved proper name recall by electrical stimulation of the anterior temporal lobes”. In: *Neuropsychologia* 48.12 (2010), pp. 3671–3674

## Work Experience

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### University of California, Berkeley

GRADUATE STUDENT RESEARCHER

Berkeley, USA

Oct. 2019 - June. 2023

- Develop assumption-lean statistical inference methods for mixed treatments/exposures
- Create open-source statistical software packages utilizing ensemble machine learning and targeted learning for efficient estimation of mixture target parameters
- Create and apply new fast converging algorithms for interaction discovery

### University of California, Berkeley

GRADUATE STUDENT INSTRUCTOR

Berkeley, USA

Sept. - Dec. 2021 & Sept. - Dec. 2022

- Co-teach courses related to causal inference and targeted learning

### University of California, San Francisco

MEDICAL DATA SCIENTIST

San Francisco, CA

Oct. 2014 - Apr. 2020

- Develop artificial intelligence architecture for medical image classification and segmentation.
- Build machine learning tools for clinical applications
- Program advanced statistical analysis for various projects related to medical care and public health.
- Consult on epidemiology and research design.
- Develop novel tools for and apply standard statistics to high-dimensional scRNA-seq, microarray and imaging data

## Albert Einstein College of Medicine

RESEARCH PROGRAMS MANAGER

- Develop databases for pediatric neuroscience research.
- Create and design querying software.
- Ensure NIH and IRB compliance. Analyze EEG and MRI data.
- Perform pediatric cognitive assessments.
- Community outreach.

New York, U.S.A

Oct. 2013 - Oct. 2014

## United States Peace Corps

HEALTH AND COMMUNITY DEVELOPMENT VOLUNTEER

- Design and teach preventive medicine classes. Organize HIV support programs.
- Engineer water facilities to increase the accessibility of potable water.
- Work with youth populations to empower young men and women.
- Teach health classes on nutrition and prevention of communicable diseases.
- Tutor Ministry of Health personnel on the methods of analyzing epidemiological data.

Mali and Kenya, Africa

March. 2011 - Sept. 2013

## Center for Cognitive Neuroscience: Temple University and University of Pennsylvania.

COGNITIVE NEUROSCIENCE LABORATORY MANAGER

- Perform transcranial direct current stimulation experiments to improve memory.
- Meta-analysis.
- Perform cognitive experiments related to brain damage.
- fMRI and DTI analysis.
- Psychological assessments of cognitive capacity.
- IRB compliance. Overseeing of all finances, grants, and subject payments.
- Design, development, and programming websites, databases, psychological computer programs, and analysis

Philadelphia, USA

Sep. 2009, Mar. 2011 - Oct. 2011

## Honors & Awards

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2021	<b>Student &amp; Early Career Travel Award</b> , Symposium on Data Science & Statistics	Pittsburgh, U.S.A
2021	<b>Block Grant Tuition Award</b> , Biostatistics Research in EHS	Berkeley, U.S.A
2019	<b>Biomedical Big Data Fellowship</b> , Funding for Statistical Methods Development	Berkeley, U.S.A
2018	<b>Best Presentation</b> , Research in Radiology Meeting	San Francisco, U.S.A

## Presentation

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- **David McCoy**, Alan Hubbard, Alejandro Schuler, and Mark van der Laan. “SuperNOVA: Semi-Parametric Identification and Estimation of Interaction and Effect Modification in Mixed Exposures using Stochastic Interventions”. In: *Symposium on Data Science and Statistics* (2020)
- **David McCoy**, Alan Hubbard, and Martyn Smith. “Restrained Variational Autoencoder for Clustering Chemicals Based on Structure and Function”. In: *UC Berkeley Center for Computational Biology Retreat* (2019)
- **David McCoy**, Alan Hubbard, Alejandro Schuler, and Mark van der Laan. “CVtreeMLE: Cross-Validated Decision Trees with Targeted Maximum Likelihood Estimation for Nonparametric Causal Mixtures Analysis”. In: *Joint Statistical Meeting (declined)* (2020)
- **David McCoy**, Sara Dupont, Charle Gros, Julien Cohen-Adad, and et al. “Convolutional neural network-based automated segmentation of the spinal cord and contusion injury: Deep learning biomarker correlates of motor impairment in acute spinal cord injury”. In: *RSNA* (2019)

## Teaching

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Fall 2022	<b>Targeted Learning</b> , PH243A	University of California, Berkeley
Fall 2021	<b>Advanced Topics in Causal Inference</b> , 252E	University of California, Berkeley

## Computing

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## R

RSTUDIO, EMACS, VIM

Oct 2014 - Present

- Expert level programming with almost a decade of programming experience in data manipulation, mathematics application, machine learning and package development

## Python

SPYDER, SUBLIME, TEXTMATE

Oct 2016 - Present

- Advanced programming with experience in data manipulation, image analysis and artificial intelligence

## SQL

MYSQL, DBVISUALIZER

Oct 2017 - 2019

- Project dependent learning of SQL to meet research needs, not currently employing SQL

## Git

GITHUB

Oct 2019 - Present

- All current projects hosted on Github for software development and version control using Git.

## Software

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- **David McCoy**. *CVtreeMLE*. version 0.90. URL: <https://github.com/blind-contours/CVtreeMLE>
- **David McCoy**. *SuperNOVA*. version 0.70. URL: <https://github.com/blind-contours/SuperNOVA>
- **David McCoy**. *COVIDxRISK*. version 0.10. URL: <https://github.com/blind-contours/CovidxRisk>
- **David McCoy**. *HAIL*. version 0.10. URL: <https://github.com/blind-contours/HAIL>