Denisa Qori McDonald, PhD

ML Researcher & Engineer | Representation Learning, Algorithm Design & Robust Evaluation

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Summary

ML researcher and engineer with a PhD in Computer Science, developing novel representations, temporal models, custom sequence algorithms, and reusable Python/PyTorch systems for noisy, sparse, partially observed multivariate data. My work spans wearable and physiological sensing and naturalistic social–behavior analysis, emphasizing interpretability and rigorous evaluation under distribution shift across users and environments, including subject–independent testing. I independently developed BioHCI, a 10,000+ line open–source ML experimentation framework, and have led research from data collection and computational analysis through method development, validation, and embedded deployment.

Technical Expertise

Machine Learning & Algorithm Design: Representation learning, temporal modeling, CNNs, LSTMs, CNN-LSTMs, linear and logistic regression, SVMs, clustering, tree–based models, VAEs, GANs, invariant feature design, sequence–distance methods, foundation-model adaptation architecture design (frozen language models, soft–prefix/projector architectures)

Evaluation & Experimentation: Subject–independent testing, evaluation under distribution shift, low–data regimes, cross–validation, baseline and controlled comparisons, model diagnostics and interpretability, computational benchmarking, reproducible experimentation

Programming & Scientific Computing: Python, C/C++ *(systems-level programming)*, Java, NumPy, SciPy, pandas, SQL/PostgreSQL, MATLAB, Git, Linux/Ubuntu

ML Systems & Deployment: PyTorch, scikit–learn, OpenCV, TensorBoard, CUDA, ONNX, NVIDIA Jetson, embedded inference, modular ML frameworks, reusable preprocessing and evaluation pipelines

Sequential Data, Signal Processing & Computer Vision: Multichannel physiological and sensor time series, video–based behavioral analysis, spatiotemporal feature extraction, wavelet and scale–space analysis, manifold learning, template matching

Education

Drexel University, Philadelphia, PA

Ph.D. Computer Science — December 2021

Dissertation: *"On the Real–World Interactivity Potential of Minimalistic Knitted Sensors at the Intersection of Artificial Intelligence and User Experience"*

M.S. Computer Science — September 2017

B.S. Computer Science, Magna Cum Laude — June 2015

Concentrations: Computing Systems & Computer Network Security

Minor: Psychology

Selected Awards & Fellowships

Best Paper Award, EICS/PACM, *Top 1% of submissions* September 2020

Best Presentation Award, ICMHI May 2023

Snap Creative Challenge Award, Snap Inc. August 2021

Jay Modi Memorial Award for Best PhD Research, Drexel University CS Department May 2019

International Research Experiences for Students, NSF–funded program December 2017

Research Experience

Independent Research — TemporalLens & Ongoing Collaborations

Independent Researcher (part–time) May 2023 — Present

- Developing **TemporalLens** (GitHub), an open–source study of cross–subject sEMG decoding and the amount of calibration data needed for a new user. Designed leakage–controlled evaluation protocols and comparisons to test whether generative augmentation and frozen–language–model conditioning improve on an encoder baseline.
- Implemented versioned subject splits and an end–to–end smoke pipeline for NinaPro DB2 data, covering preprocessing, CNN training, evaluation metrics, and run logging. The full cross–validation harness, generative models, and language–model experiments remain under development.
- Sustained research collaborations with CHOP and Drexel, producing an invited book chapter on advanced manufacturing of touch–sensitive textiles (2024) and a *Journal of Psychiatric Research* paper on automatic measurement of social gaze in autism (2026).

Center for Autism Research — Children's Hospital of Philadelphia, PA

Postdoctoral Fellow, Computer Vision & Behavioral Machine Learning April 2022 — April 2023

Highlights: Developed interpretable spatiotemporal models of head movement and gaze from naturalistic dyadic video, combining supervised and unsupervised methods to characterize developmental and autism–related behavioral structure.

- Designed interpretable monadic representations capturing the participant's head movement alone and dyadic representations capturing participant–partner movement dynamics for autism–related and developmental analysis; dyadic features outperformed monadic features across both studies: 80.0% vs. 69.2% for autism classification and 78.6% vs. 71.4% for developmental classification.
- Investigated the localization of meaningful head movement patterns during a face–to–face conversation using manifold learning, clustering, and template matching.
- Quantified the timing, duration, and interpersonal coordination of social gaze between conversation partners during naturalistic interactions.
- Modeled developmental variation in social behavior by predicting age from conversational head-movement dynamics and analyzing how movement structure changed across development.
- Collaborated with clinicians and autism researchers to define scientifically and clinically meaningful features, interpret model findings, and design evaluation strategies appropriate for heterogeneous naturalistic data.

Department of Computer Science & Center for Functional Fabrics — Drexel University, PA

Graduate Researcher, Machine Learning & Wearable Sensing November 2018 — January 2022

Highlights: Built high–accuracy models to recognize complex touch input on knitted sensors with minimal hardware, enabling real–world interactive use.

- Established a general modeling framework for touch and gesture inference from minimally wired textile sensors, showing how representation design and temporal modeling can extend interaction capacity under hardware constraints.
- Designed representations and sequence models for highly constrained capacitive signals collected via a single conductive yarn pathway with a 2–electrode design, overcoming spatial overlap in dense layouts (e.g., a 36–button surface), and later extending the architecture to a 4–connection–point design for richer gesture inference.
- Built PyTorch models for subject–independent touch localization and gesture recognition, including a CNN–LSTM deployed on an NVIDIA Jetson Xavier NX, achieving 89.8% held–out accuracy on 12–class gesture recognition and 66% subject–independent touch localization accuracy on a 36–button sensor, compared with 3% chance.
- Developed custom algorithms for multichannel signals: MSD, a SIFT–inspired invariant representation that improved class separability by 39× and reduced processing time by 50× over raw signals, and ELD, a generalized distance metric for variable–length continuous signals.
- Collaborated with computer science, engineering, textile science, and design teams to co-design sensor hardware, iterating on electrode placement and material properties to improve data quality and model performance.
- Designed and analyzed human–participant studies for model training, held–out testing on new data, and robustness assessment under real–world conditions (EMI, stretching, washing/drying, and on–body use).
- Investigated user perceptions of knitted sensors through a study with eight focus groups and formulated application design guidelines for real–world textile–sensing systems, including AR–supported interaction scenarios.
- Co–authored multidisciplinary publications and presented results to researchers and sponsors.

Advanced Interaction Research Lab — Drexel University, PA

Graduate Researcher, Physiological Computing & Machine Learning October 2015 — August 2018

Highlights: Designed adaptive systems using cognitive states inferred from fNIRS signals as implicit user input, and built the reusable ML infrastructure supporting them, spanning experimental design, multimodal data collection, preprocessing, modeling, and evaluation.

- Identified an unmet need for reusable physiological–signal ML tools in my lab and other HCI labs; independently initiated, architected, and developed **BioHCI** (GitHub), a 10,000+ line open–source Python and PyTorch framework for data preprocessing, feature construction, model comparison, cross–validation, and evaluation across multiple research projects.
- Developed a 30–class subject–identification model for segmented fNIRS signals, achieving 63% accuracy against a 3.3% chance baseline and demonstrating recoverable subject–specific structure without task engagement.

- Designed and experimentally evaluated foundations for two real–time adaptive systems using cognitive states inferred from signals collected with a minimal two–pad forehead fNIRS device: timing creativity–support suggestions without disrupting productive ideation, and providing learning support during mind–wandering while avoiding interruption during concentration. Conducted human–subject experiments and built supporting analysis and modeling tools.
- Developed end–to–end data–collection and processing infrastructure for multichannel fNIRS and complementary physiological modalities, including study protocols, Java analysis tools, relational databases for sensor and participant metadata, noise reduction, motion–artifact removal, hemodynamic–response modeling, and reusable signal–processing workflows.

Additional Research Experience

Human–Centered Ubiquitous Media — Ludwig Maximilian University, Germany

Visiting Graduate Researcher June 2018 — July 2018

- Evaluated machine–learning approaches for detecting workload–related brain states from EEG as a foundation for adaptive systems.
- Designed study protocols to evaluate whether models developed from controlled laboratory tasks could generalize to more naturalistic, real–world conditions.

Privacy, Security & Automation Lab — Drexel University, PA

Undergraduate Research Assistant April 2014 — September 2014

- Contributed Java–based user–interface and document–parsing functionality to Anonymouth, an open–source authorship–anonymization system using SVM–based stylometric analysis, and supported the design and execution of a user study evaluating the tool.

Selected Publications

Selected publications spanning algorithm and representation design, subject-independent inference, and real-world sequential modeling. Full publication list available on Google Scholar and personal website.

1. **Denisa Qori McDonald**, Richard James Vallett, Erin Solovey, Geneviève Dion, and Ali Shokoufandeh. Knitted Sensors: Designs and Novel Approaches for Real–Time, Real–World Sensing. *IMWUT 2020/UbiComp 2021. Acceptance rate: 20–25%.*

2. **Denisa Qori McDonald**, Richard James Vallett, Lev Saunders, Geneviève Dion, and Ali Shokoufandeh. Recognizing Complex Gestures on Minimalistic Knitted Sensors: Toward Real–World Interactive Systems. *arXiv 2023.*

3. Richard James Vallett, **Denisa Qori McDonald**, Geneviève Dion, Youngmoo Kim, and Ali Shokoufandeh. Toward Accurate Sensing with Knitted Fabric: Technical Considerations and Application Potential. *ACM EICS 2020/2021. Best Paper Award (Top 1% of submissions).*

4. Yankowitz, L. D., Pargi, M. K., DeJardin, E., Zampella, C. J., Guthrie, W., Pandey, J., Keith Bartley, G., Chen, D., **McDonald, D. Q.**, Manakiwala, A., Khanna, M., Keen, K., Buboltz, G., Yang, A., Herrington, J. D., Sariyanidi, E., Schultz, R. T., & Tunç, B. Automatic measurement of social gaze during naturalistic conversations in autism. *Journal of Psychiatric Research*, 200, 93–102. 2026.

5. **Denisa Qori McDonald**, Evangelos Sariyanidi, Casey J. Zampella, Ellis DeJardin, John D. Herrington, Robert T. Schultz, and Birkan Tunç. Predicting Autism from Head Movement Patterns during Naturalistic Social Interactions. *ICMHI 2023. Best Presentation Award.*

6. **Denisa Qori McDonald**, Shruti Mahajan, Richard James Vallett, Erin Solovey, Geneviève Dion, and Ali Shokoufandeh. Interaction with Touch–Sensitive Knitted Fabrics: User Perceptions and Everyday Use Experiments. *ACM CHI 2022. Acceptance rate: 24.6%.*

7. **Denisa Qori McDonald**, Casey J. Zampella, Evangelos Sariyanidi, Aashvi Manakiwala, Ellis DeJardin, John D. Herrington, Robert T. Schultz, and Birkan Tunç. Head Movement Patterns during Face–to–Face Conversations Vary with Age. *ICMI Companion 2022.* Workshop paper, peer–reviewed.

Mentorship, Teaching & Service

Research Mentor: Mentored seven graduate and undergraduate researchers across machine learning, physiological and wearable sensing, and computer vision.

Teaching Assistant: Data Structures and Algorithms (graduate–level), Database Systems, Software Design, Fundamentals of Computer Science, Operating Systems, Concurrent Programming , Web and Mobile App Development

Peer Reviewer: ACM CHI, *International Journal of Human–Computer Studies*

REThink CS@Drexel Graduate Assistant: Helped organize a research–engagement program for local STEM teachers and community–college faculty, including weekly discussions of research projects, ML applications, and strategies to broaden participation in computing.

Additional Technical & Industry Experience

"**Frankly, I Think**", *Co–founder*: Contributed to product design and development of a mobile application for collecting, analyzing, and summarizing user sentiment on social and political topics.

Technology and Product Development — Comcast Corporation, PA

Engineering Intern April 2013 — September 2013

- Contributed to a video–condensation project that reduced playback duration by 20% using subtitle–derived timing cues while preserving content quality.
- Tested set–top devices and services using Wireshark; investigated ZigBee RF4CE discovery, pairing, and interoperability issues, and developed Python scripts to summarize device behavior, identify failure points and support debugging.

Smart Grid/Smart Meter — PECO, An Exelon Company, PA

Engineering Intern April 2012 — September 2012

- Automated smart–grid data processing and reporting in Python and designed and maintained Microsoft Access databases for smart–grid and smart–meter planning.