

Leon Valentin Sierau

Causal Inference, Probability & Statistics

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DOCTORAL RESEARCHER

Hamburg, Germany

I came to causal inference and probability from psychology, with a lasting interest in cognition and intelligence.

RESEARCH EXPERIENCE

Research Associate & PhD Candidate

Oct 2024 – Present

Institute for Data Science Foundations, Hamburg University of Technology (TUHH) | Advisor: Prof. Nihat Ay Hamburg, Germany

- **Causal-effect identification.** Developed an intervention calculus for max-linear Bayesian networks that identifies certain policy effects beyond standard d -separation-based methods. Built a reproducible Python validity check using exact and Monte Carlo comparisons; first-author UAI 2026 publication. [[Python code](#)]
- **Causal world models under mechanism shifts.** Developing a model-based reinforcement learning architecture that factorizes a causal world model into reusable stochastic mechanisms and infers active versions. Proved identification of two hidden mechanisms and an unseen combination from ordinary trajectories in a discrete POMDP; testing neural variants in Python.
- **Probabilistic graphical models.** Derived a necessary common-cause condition for universal approximation of Markov kernels by feed-forward networks of binary stochastic units; conference version at WUPES 2025 and a first-author extended version accepted for publication in *Kybernetika*.
- **Teaching.** Teach courses in Causal Inference and Machine Learning to Computer Science, Data Science, and Technomathematics students.

Research in Psychology & Cognitive Neuroscience

2016 – 2017

University Medical Center Schleswig-Holstein (UKSH)

Kiel, Germany

- Diplom thesis in non-invasive neurostimulation; co-authored a 24-participant tACS/EEG study of phonological decisions and neural dynamics (*Brain Stimulation*, 2019; second author).

EDUCATION

PhD Candidate, Statistics & Probability

2024 – Present

Hamburg University of Technology (TUHH)

Hamburg, Germany

Mathematical foundations of causality; structural causal models and causally interpreted Bayesian networks.

B.Sc. Data Science

2021 – 2024

Hamburg University of Technology (TUHH)

Hamburg, Germany

Graduated top of cohort. Highest mark (1.0) in Probability Theory (master's level), Stochastics, and Statistics; advanced coursework in graph theory, optimization, and combinatorial algorithms.

Diplom in Psychology (master's equivalent)

2012 – 2017

Kiel University (Christian-Albrechts-Universität zu Kiel)

Kiel, Germany

MATHEMATICS & COMPUTING

Mathematics	Measure theory, probability theory, statistical inference, graph theory, optimization, and combinatorial algorithms
Programming	Python; scientific computing, numerical simulation, Monte Carlo methods, and reproducible research
Modeling & ML	Causal discovery, causal-effect identification, probabilistic graphical models, and model-based RL

SELECTED PUBLICATIONS

- **Sierau, L.,** Nowell, F., & Ay, N. “A Stronger Calculus of Intervention for Max-Linear Bayesian Networks.” *Uncertainty in Artificial Intelligence (UAI)*, PMLR 337:6342–6365, 2026. [[first author](#)]
- **Sierau, L.** & Ay, N. “Common Cause Condition for Universal Approximation.” Extended version accepted for publication in *Kybernetika*. Conference version: Ay, N. & Sierau, L., *WUPES*, 2025. [[first author, accepted version](#)]
- Moliadze, V., **Sierau, L.**, et al. “After-effects of 10 Hz tACS over the prefrontal cortex on phonological word decisions.” *Brain Stimulation* 12:1464–1474, 2019. [[second author](#)]

PROFESSIONAL EXPERIENCE

Psychological Assessor German Federal Employment Agency

Dec 2017 – Sep 2021