

Christian Koehler, PhD

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Education & Certification

PhD in Electrical and Computer Engineering, 2010 – 2015

Advisers: Anind K. Dey, Jennifer Mankoff, Ian Oakley

Carnegie Mellon University, Pittsburgh, PA

MSc in Computer Science with Specialization in HCI, 2009

Advisers: Anind K. Dey, Jan Borchers

RWTH Aachen University, Germany

Statistics and R certification, Summer 2020

Introduction to Statistics and data analysis in R

HarvardX, an online learning initiative of Harvard University

Expertise in HCI

Study Design (Survey and Interview Studies), Data Collection and Data Pipelines, Large-Scale Data Analysis, Rapid Prototyping, Human Behavior Modeling

Expertise in Data Science + AI

Applied Machine Learning, Deep Learning, Data Mining, Pattern Recognition, Descriptive Statistics, Regression Analysis, Inferential Statistics, Multivariate Statistics

Domain Knowledge

Smart Environments, Sustainability, Natural Language Processing, Digital Health, Context Awareness/Prediction, Mobile and Pervasive Computing

Technical Skills

Python, Java, SQL, TensorFlow/Keras, Spark, Android, R

Honors and Awards

- 2015 Honorable Mention Award for UbiComp 2015 paper “*Why We Use and Abandon Smart Devices*” given to the top 5% of UbiComp 2015 submissions
- 2011 FCT (Portugal) Graduate Student Fellowship; partial support for PhD by Portuguese Foundation of Science and Technology
- 2010 Carnegie Institute of Technology Dean’s Tuition Fellowship

Work Experience

Samsung Research America (SRA), Artificial Intelligence Center

Sr. Research Engineer (October 2015 – Present)

My research projects focus on how insights derived from users and users' data can empower the development of AI to build human-centric technology and improve user experience. I have worked on a number of interesting projects, including:

Shelter-In-Place User Research

In order to understand how shelter-in-place orders impact education, socializing, and mental health in teens I performed a survey study with 700+ teens age 13 to 22. The research was designed to understand how technology can help teens to stay connected and maintain their education level, while quantifying how the absence or presence of support technology impacts their mental health. The outcome of my work helps to shape the research roadmap of our lab. My key contributions involved **HCI** and **Data Science**:

- **Planned, designed, and executed large scale survey study** to investigate education, socializing, and mental health of teens
- **Initiated and managed collaboration with external research company** to recruit panel for user research
- **Wrote data processing and analysis scripts (Python + R)** in order to analyze data collected by user study

Samsung Bixby, Digital Voice Assistants

Samsung Bixby allows users to control devices, interact with digital content, and retrieve answers to question across multiple knowledge domains. My team was responsible to improve Bixby's Question & Answering (Q&A) capabilities by creating novel algorithms that can react to diverse questions in multiple domains. As an outcome, our work helped Samsung's mobile division shaping their roadmap. My key contributions involved **HCI** and **AI**:

- **Planned, designed, and executed multiple survey studies** to evaluate key user-facing features of the proposed Q&A system, and quantify users' information needs for various Q&A knowledge domains
- **Managed a crowd-source driven, iterative study initiative** to collect task-specific human utterance data that was crucial for the training and testing of the Q&A system
- **Wrote an initial utterance rejection algorithm (Python)** using insights derived from the collected utterance data
- **Co-authored patent** for a novel natural language understanding (NLP) Q&A system that is able to answer a broader range of user questions

Samsung TV, Cross-Domain Content Recommendation and User Analysis

In collaboration with Samsung's Visual Display (VD) group, my team developed a cross-domain content/product recommendation algorithm for future Samsung TVs. Furthermore, we quantified usage patterns observed in historical data collected from Samsung TVs. Our work was showcased to Samsung CEOs and high-level execs, and successfully helped secure additional funding for the VD group. My key contributions involved **Data Science** and **AI**:

- **Led and developed core deep learning and knowledge graph embedding-based algorithm** that utilizes sentiment aspects from product review data to make scalable cross-domain recommendations for millions of users
- **Designed and evaluated algorithms to derive descriptive statistics** of TV usage behavior to identify errors, and understand reasons for high and low user engagement
- **Co-authored patent** describing the underlying fundamentals of the cross-domain recommendation algorithm

Evaluation of Smart-Default System

The goal of this project was to develop a smart-default recommendation system that simplifies users' everyday life by suggesting them helpful device shortcuts. We used device usage data (e.g., phone interaction or smart home device logs) to infer behavior rules, and created a data mining approach that can filter thousands of candidate rules down to a representative set. The outcome of the project was showcased to Samsung CEOs and high-level execs during SRA's yearly research event. My key contributions primarily involved **HCI**:

- **Planned, developed, and conducted a think-aloud user interview study.** The goals were to evaluate the quality of the system-made recommendations, and to study the efficacy of a mixed-initiative system that allows participants to modify suggested rules. Single-handedly recruited interview participants through convenience sampling.
- **Co-led the design of pattern recognition approach** that efficiently creates representative set of candidate rules
- **Co-authored journal paper** (see 2018 IMWUT paper) showing that users preferred a mixed approach that allowed them to modify suggested rules as opposed to either a fully automatic or fully manual approach

Digital Health, Smart Applications for Health Management

In collaboration with Samsung's Digital Health group and external hospital collaborators, my team assessed the feasibility of using smart phones to manage chronic health problems. The insights we provided helped defining the future, ongoing health study with external collaborators. My key contributions primarily involved **Data Science**:

- **Performed feasibility analysis** of smart intervention system; derived descriptive statistics about data collected by study prototype

- **Created and evaluated research initiative proposals** for smart health intervention system. Made recommendations for new directions to internal and external collaborators

Samsung Pay, Purchase Location Estimation

Samsung Pay, Samsung's mobile payment app, wanted my team to develop algorithms that are able to determine a person's shopping location based on the collected longitudinal large-scale usage data. Their goals were to understand and improve user engagement, quantify potential errors in the payment system, and identify new business opportunities with new retail partners. Our work resulted in a novel notification system that shows users where Samsung Pay is available and promotes location-specific coupons. My key contributions involved **Data Science** and **AI**:

- **Led the design and development of a novel location estimation algorithm** that is able to recognize a location, even in absence of training data for that specific location
- **Wrote and applied algorithms to derive descriptive statics** for the collected Samsung Pay usage data; highlighted areas of low and high engagement, potential problem areas, as well as identifying user clusters that should be targeted with notifications
- **Analyzed Samsung Pay engagement for a marketing-driven campaign** to improve app engagement for Samsung Pay. Developed self-serving tools to help analyze and compare engagement before and after marketing campaigns.

Carnegie Mellon University

Graduate Researcher with Anind K. Dey (August 2010 – September 2015)

My research focused on understanding, modeling, and predicting human behavior (esp. spatiotemporal behavior) using Human-Computer Interaction methods and applied Machine Learning. I evaluated the use of conditional frequent-pattern trees for extraction of a person's spatiotemporal structure and the prediction of a person's indoor location. The results of this analysis were applied to efficient room temperature control in an effort to reduce the energy consumption of home and large office buildings. My research involved contributions to **HCI**, **Data Science**, and **AI**:

- **Led, designed, and executed numerous interview and survey studies** to evaluate user needs around thermal comfort and sustainability as well as a manual/automatic mixed initiative system for efficient temperature control
- **Developed automatic and manual temperature control systems** for homes and large office buildings. Worked with local stakeholders to understand concerns around temperature control as well as gaining access to campus-wide temperature control system.
- **Collected longitudinal large-scale temperature data** for CMU's computer science building
- **Developed and implemented algorithms** to efficiently control temperature and simulated their use with an architectural model for different climate zones
- **Authored and co-authored several publications** detailing the results of my work

Nokia USA Inc.

Research Intern with David Nguyen (May 2014 – August 2014)

As part of the Advanced Engineering group I combined machine-learning and human-centered design to make wearable technology more intelligent and allow users to track symptoms of their diseases. My key contributions were:

- **Planned and conducted user study** around the use of wearable technology. Led external contractors to implement and maintain data collection, analysis, and visualization pipeline
- **Designed and implemented user study** to collect wearable device usage data; used convenience sampling to recruit large number of participants from varying background
- **Co-authored award-winning publication** that detailed results of interview study around the use of wearable devices

Dissertation

Koehler, C. "Indoor Location Prediction Through Modeling of Human Spatiotemporal Behavior", Ph.D. Dissertation, Electrical and Computer Engineering Department, Carnegie Mellon University, September, 2015

Patents

Srinivasan, V., **Koehler, C.**, Jin H. "System and method for generating aspect-enhanced explainable description-based recommendations", U.S. Patent US20190392330A1, 2019

Srinivasan, V., **Koehler, C.**, Jin H. "Method for automating actions for an electronic device", U.S. Patent US20190065993A1, 2018

Workshop, Short Papers, and Posters

Ferreira, D., **Koehler, C.**, Okoshi, T., Park, J. W., Nishiyama, Y. "Workshop on Ubiquitous Mobile Instrumentation", Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing, UbiComp '16

Baumann, P., **Koehler, C.**, Dey, A., Santini, S. "A Population Model for Predicting Human Mobility", In Proceedings of the 2015 ACM international joint conference on Pervasive and ubiquitous computing. ACM

Ferreira, D., **Koehler, C.**, Karapanos, E., Kostakos, V. "Ubiquitous mobile instrumentation", Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing, UbiComp '13

Koehler, C., Dey, A., Mankoff, J. and Oakley I. "Motivate Environmentally Sustainable Thermostat-Use through Goal-Setting, Just-In-Time Recommendations, and Behavior Reflection", NIMD'10, Mobile HCI 2010, Lisbon, Portugal

Full Conference Papers

Gluck, J., **Koehler, C.**, Mankoff, J., Agarwal, Y., Dey, A. K. "A Systematic Approach for Exploring Tradeoffs in Predictive HVAC Control Systems for Buildings", 2015

Basu, C., **Koehler, C.**, Das, K., Dey, A.K., "PerCCS: Person-Count from Carbon dioxide using Sparse Non-negative Matrix Factorization" In Proceedings of the 2015 ACM international joint conference on Pervasive and ubiquitous computing. ACM

Lazar, A., **Koehler, C.**, Tanebaum, J., Nguyen, D. "Why We Use and Abandon Smart Devices" In Proceedings of the 2015 ACM international joint conference on Pervasive and ubiquitous computing. ACM

Koehler, C., Banovic, N., Oakley, I., Mankoff, J., Dey, A., "Indoor-ALPS: An Adaptive Indoor Location Prediction System", In Proceedings of the 2014 ACM international joint conference on Pervasive and ubiquitous computing. ACM

Koehler, C., Mankoff, J., Dey, A.K. "TherML: Occupancy Prediction for Thermostat Control", Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing, UbiComp '13

Journal Papers

Srinivasan, V., **Koehler, C.**, Jin, H. "RuleSelector: Selecting Conditional Action Rules from User Behavior Patterns", Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, Volume 1 Issue 2, 2018

Bauman, P., **Koehler, C.**, Dey, A. K., Santini, S. "Selecting Individual and Population Models for Predicting Human Mobility", IEEE Transaction on Mobile Computing, 2018

Dezhong, Y., Chen, Y., Dey, A.K., **Koehler, C.**, Geyong, M., Yang, L.T., Hai J. "Energy efficient indoor tracking on smartphones", Future Generation Computer Systems, 2013

Selected Mentored Projects

- 2020 **Intern Management (Samsung Research America, AIC)**
Managed 3 summer interns during their research projects with our lab. Their projects investigated the intersection of voice technology and AR to improve the usability of devices. I defined the project scope and led the development of research prototypes. In addition, I planned and executed a user study to evaluate prototypes created by the interns.
- 2015 **CURA (Carnegie Mellon University)**
Co-led 47 students in the creation of a functional prototype for a caregiver support system that uses tablets and wearable sensors to support and monitor patients with congestive heart failure, ALS, and home dialysis. The system was developed for the Henry Ford Foundation and is intended to be used by health care professionals in their daily work life.
- 2014 **iExpress (Carnegie Mellon University)**
Mentored two graduate students and helped them to create an ALS support system that allowed patients to maintain a certain level of independence even to the later stages of the disease by providing them with means to communicate with their caregivers through a combination of eye-tracking technology and a dedicated tablet application. The results of the project were featured in local news (<http://pittsburgh.cbslocal.com/2014/11/18/cmu-grad-students-create-new-technology-to-help-those-with-als/>)

Service

- 2012 – 2015 Vice-President & Social Events Chair
ECE Graduate Student Organization (EGO)
- 2013 Student Volunteer
International Conference on Ubiquitous Computing (UbiComp)
- 2012 Publicity Chair
International Conference on Ubiquitous Computing (UbiComp)
- 2011 Student Volunteer
Conference on Human Factors in Computing Systems (CHI)

Reviewer Conferences and Journals

2013 – present	Conference on Human Factors in Computing Systems (CHI)
2013 – present	International Conference on Ubiquitous Computing (UbiComp)
2015	Journal on Pervasive and Mobile Computing
2015	Pervasive Health
2014	International Conference on Intelligent User Interfaces (IUI)
2014	Mobile HCI
2011	Journal on Personal and Ubiquitous Computing
2010	Conf. on Tangible, Embedded, and Embodied Interaction (TEI)

Organized Workshops

2013 & 2016	UbiMi: International Workshop on Ubiquitous Mobile Instrumentation: Mobile devices as sensors on understanding human-behavior, routines and context inference
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References

Prof. Anind K. Dey

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Prof. Daniel Siewiorek

Buhl University Professor of Computer Science and Electrical and Computer Engineering
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