Program in Public Informatics, Rutgers University, Revised 10/30/23

Robotics & Society
34:816:640:01 / 16:332:640:01

Wednesdays 1:00 pm to 4:10 pm
Fall 2023
Civic Square Building, Room CSB 170
Office Hours: Wednesdays 4:10 pm – 6:10 pm

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Class Canvas Site: https://rutgers.instructure.com/courses/251651
2023FA - ROBOTICS AND SOCIETY 16:332:640:01 & 34:816:640:01

This course will examine the interplay of robotics technology and society. A sequence of foundational discussions will provide both technical and social science students with core skills for effective cross-disciplinary exploration. The course will examine the interaction between social and technical systems to consider how new and existing technologies affect and are affected by society and policy, as well as giving students an understanding of the ethics, values, unintended consequences, and social implications of robotic technologies.

This is an interdisciplinary course, drawing on instructors, theory, and empirical work from, the social sciences, public policy, engineering, and natural sciences to introduce those with a robotics background to social science theory and methods and, for those with a social science and/or policy or planning background, a greater understanding of the technology world through course work with students from those disciplines and projects that deepen their technical knowledge. Students will critically examine recent technological advances in robotics with respect to whether, and how they meet social needs, and to learn about the social processes that shape technology artifacts and systems. They will focus on applications in which humans and robots closely interact. The module on research methods will provide students a critical understanding of the strengths and weaknesses of different methods and provide them the tools to be discerning consumers of research.

Syllabus topics include: implications of robotics for public policy (how policy develops in new areas to balance support for innovation and protecting the public interests); emerging robotics technologies that can impact society; broader workforce impact assessment; legal and ethical dilemmas; social dimensions of technology development; human-robot interaction in the context of smart spaces, buildings and settlements; social bias in design; and the interaction between technological and social systems.

Overall learning objectives for this course are for students to be able to:

1. Understand the big picture: what robotics will look like at scale in specific application domains, what ideas this suggests about the relationship between robots and society, and consequences for humans.

2. Understand the dynamics of social systems, organizations, and policy that affect the development and design of technology, with particular attention to robotics (e.g., what applications are funded and/or developed? What design choices are viewed as optimal?).
3. Understand social science methods for evaluating technology designs, and evaluating social implications. How will individual human users respond? How will society respond? What insights emerge as we shift from a microscopic to a macroscopic perspective?
4. Define and analyze a robotics problem from an interdisciplinary perspective: what are the social, values, and/or ethical choices embedded in the design or application? What are the robotics solutions that provide social benefits? And what are the tradeoffs involved in the critical design choices?

Prerequisite or corequisite: This course is open to graduate students who have taken a basic statistics course equivalent to Basic Quantitative Methods (34:816:515) or have equivalent training in descriptive and inferential statistics.

Robotics Research Community: This course is part of a National Science Foundation Research Traineeship (NRT) program, though the course is open to, and welcomes students from all disciplines. The purpose of the NRT is to create a new vehicle for graduate training and convergence research that integrates the technology domains of robotics with social and behavioral sciences, including psychology, cognitive science and urban planning and policy. Faculty participating in this course are collaborating in the NRT program; for more information on the NRT: https://robotics.rutgers.edu/

Textbook & Materials: Canvas is the website hosting the course and the readings/video/podcasts. There is no required textbook. Weekly readings are available on Canvas. Assignments should be submitted through Canvas.

Basis for Grades: Students working individually will carry out the practicum portion of the class session. For this, each week, students should prepare short (300 word) critical write-ups discussing articles, data sets, and other items they have found that relate to the topic of the day, and they offer comments to one other student (13 x 4% = 52% of course grade). Each week, three students will sign up to make short (5-minute) Powerpoint presentations in class instead of a writeup. In some weeks, an in-class exercise will substitute for the writeup.

Each student will also prepare an independent class project of their own choosing, and deliver a short presentation of it in the final class session as well as a 5000-word paper that summarizes results and reflects critically on this application of informatics techniques (48% of course grade). Use the IEEE style guide, citation format, and paper template for your paper. Style guide is at https://ieeeauthorcenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf. Paper template is at https://www.ieee.org/conferences/publishing/templates.html.

Each weekly module (class session) is divided into two parts: lecture and guided discussion on major concepts led by the instructor; and a practicum during which students immerse themselves in the relevant methods, contexts, and applications, and critically discuss them. The goal is to ensure that knowledge acquisition and critical reflection go hand in hand.

Academic Integrity

Rutgers' academic integrity policy will be strictly enforced in this course. Failure to comply with this policy can result in severe sanctions up to and including expulsion from the University. See the full text at http://nbacademicintegrity.rutgers.edu/home/academic-integrity-policy/. The following excerpt serves as a reminder that the student must: properly acknowledge and cite all use of the ideas, results, or words of others; properly acknowledge all contributors to a given piece of work; make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of unsanctioned materials or unsanctioned collaboration; obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions; and treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress; and uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Use of AI such as ChatGPT is fully permitted, but you must cite the tool, share the prompts used when querying the AI, and be able to explain any work that you submit.

Emergency Remote Participation

This is an in-person seminar class. If Rutgers declares a weather or other emergency, the class will pivot to the use of the Zoom video platform as needed. Zoom links will be accessible through the Canvas course management portal for this class.

Schedule of Classes

WEEK	DATE	TOPIC
		Part I Background
1	Sep. 6	Introduction and Overview
2	Sep. 13	Technology Assessment
		Part II Social & Behavioral Science Perspectives on Robotics
3	Sep. 20	Human cognition and decisions (psychology & cognitive science)
	Sep. 22	Rutgers Robotics Workshop!
4	Sep. 27	Systemic impacts of emerging technologies (economics & politics)
5	Oct. 4	Engineering as a social practice (sociology & anthropology)
6	Oct. 11	Ethics, Law & Public Policy
		Part III Social Science Research Methods for Robotics
7	Oct. 18	Observing
8	Oct. 25	Asking
9	Nov. 1	Interpreting Evidence
		Part IV Applications of Robotics
10	Nov. 8	Robotics at Home
11	Nov. 15	Robotics at Work
	Thanksgiving Break – No Class	
12	Nov. 29	Robotics in the Built Environment
13	Dec. 6	Robotic Solutions to Large-scale Social Concerns
		Part V Student Projects
14	Dec. 13	Final Student Presentations

Schedule of Topics, Readings, and Assignments

Part I Background

September 6 Introduction and overview, social dimensions of technology

Motivation: technological development is disruptive in good and bad ways that we need to better understand.

Perspective: we apply a broad social and behavioral science perspective to robotics, and although there are no technical prerequisites, students will draw on their relevant background in course assignments and discussions.

Approach: instructor will provide a brief overview lecture each week, then students will actively discuss the day's topic. It is meant to be highly participatory, a seminar rather than lecture format.

Topic: Social dimensions of technology. This week is an introduction to social theories that examine technology as artifacts as shaped by social, organizational, and political factors. Innovation as a social process is considered through an historical overview and case studies. We discuss whether, or to what extent, technology is "socially constructed" as compared to an objective optimization of a solution to a given problem. The concept of "systems" as applied to engineering problems and social problems is considered.

Objectives:

- Identify and critically discuss the major theoretical framings for social dimensions of robotics
- Access and understand the uses of key platforms used for researching robotics and society
- Appreciate the range of application areas and the importance of contextual considerations

Practicum: Create (free) account on GitHub and complete human subjects training.

Go to https://github.com/join?source=prompt-code and create an account which allows you to post, borrow, and collaborate on software and scripts.

Complete the online CITI training for human-subjects researchers. This training session raises important legal and ethical considerations regarding privacy rights, the allocation of risk to research subjects, and your duties as an informatics researcher. Begin the training at https://orra.rutgers.edu/citi. Upon successful completion of the training, email a copy of your certification letter to the instructor.

Required Readings:

Andrews, Clinton J. Preparing to design robots for social contexts, in *IEEE Technology and Society Magazine*, vol. 41, no. 1, pp. 15-17, Mar. 2022, https://doi.org/10.1109/MTS.2022.3147530.

Recommended Readings:

None

September 13 Technology Assessment

Much of the potential impact of robotics on human society lies in the future, hence there is great interest today in trying to anticipate consequences of widespread robot use. Any future-oriented inquiry rests on some worldview: are we technophiles, technophobes, hands-off, or hands-on, in one famous formulation? We consider approaches to forward-looking technology evaluation emphasizing the developer's perspective (market assessment, technology roadmap) and the public policy perspective (technology assessment). We learn how the practice of technology assessment has evolved to include a broad range of stakeholders and methods. We examine the strengths and weaknesses of alternative approaches to anticipating especially the unanticipated adverse consequences of widespread robotics deployments. Assessment techniques introduced here will be applied and refined throughout the remainder of the course.

Objectives:

- Become familiar with technology assessment tools used by developers
- Become familiar with technology assessment used to inform public policy
- Critically discuss the challenges of trying to anticipate unintended consequences

Practicum: Prior to this week's class, critically read a technology assessment you find interesting from one of the repositories listed below. Prepare one Powerpoint slide summarizing the target technology, assessment method, and key finding(s). Post the slide to the Discussions section of the course canvas site by 12 noon on Wednesday 9/13 (the day of class). Do not choose an assessment already chosen by another student. Present your findings briefly to the class.

U.S. Congressional Office of Technology Assessment archive at https://ota.fas.org/.

U.K. Parliamentary Office of Science and Technology catalog at https://post.parliament.uk/research/.

European Parliament Panel for the Future of Science and Technology catalog at https://www.europarl.europa.eu/stoa/en/publications/search.

Required Readings:

Andrews, Clinton J. If a colleague asks: "Will my innovation have unintended consequences?" *IEEE Technology & Society Magazine* (June 2021): 3-4. https://doi.org/10.1109/MTS.2021.3077045.

Coates, Joseph F. Historical lessons from technological disruptions: Will the storm always pass?, *Technological Forecasting and Social Change*, Volume 113, Part A, 2016, Pages 85-88, https://doi.org/10.1016/j.techfore.2016.10.032.

Guston, David. Innovation policy: not just a jumbo shrimp. *Nature* 454, 940–941 (2008). https://doi.org/10.1038/454940a.

Recommended Readings:

Steinert, Martin, and Leifer, Larry. Scrutinizing Gartner's hype cycle approach, *PICMET 2010 TECHNOLOGY MANAGEMENT FOR GLOBAL ECONOMIC GROWTH*, Phuket, Thailand, 2010, pp. 1-13. In IEEE Xplore.

Perrier, Nancy D., Randolph, Gregory W., Inabnet, William B., Marple, Bradley F., van Heerden, Jon, and Kuppersmith, Ronald B. Robotic Thyroidectomy: A Framework for New Technology Assessment and Safe Implementation. *Thyroid*, Dec 2010.1327-1332.http://doi.org/10.1089/thy.2010.1666.

Daim, Tugrul U., Yoon, Byung-Sung, Lindenberg, John, Grizzi, Robert, Estep, Judith, and Oliver, Terry. Strategic roadmapping of robotics technologies for the power industry: A multicriteria technology assessment, *Technological Forecasting and Social Change*, Volume 131, 2018, Pages 49-66, https://doi.org/10.1016/j.techfore.2017.06.006.

Gartner Hype Cycle for AI https://www.gartner.com/en/articles/the-4-trends-that-prevail-on-the-gartner-hype-cycle-for-ai-2021.

Part II Social and Behavioral Science Perspectives on Robotics

September 20 The human side of human-robot interaction [Guest Lecture by Jacob Feldman]

Humans are computational agents, like robots, though they make decisions in specifically human ways. Drawing on psychology and cognitive science, how can we model and predict human behavior? How can we use those models to better understand human-robot interaction? Also, humans are social agents. How can human social interaction be understood from a computational point of view? And how can we use this understanding to inform the design of robots? Can robots be made "social" in the same way humans are?

Dr. Jacob Feldman, Professor of Cognitive Science, will guest lecture. Bio at https://ruccs.rutgers.edu/jacob

Objectives:

- Learn how to approach tasks of modeling and predicting human behavior
- Consider how to use these models to better predict human-robot interactions
- Critically discuss whether robots can be made to be social agents

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report about psychological aspects of human-robot interactions. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Reading:

Stein, Jan-Philipp, and Ohler, Peter. Venturing into the uncanny valley of mind—The influence of mind attribution on the acceptance of human-like characters in a virtual reality setting, *Cognition*, Volume 160, 2017, Pages 43-50, https://doi.org/10.1016/j.cognition.2016.12.010.

Dautenhahn, Kerstin. Socially intelligent robots: dimensions of human–robot interaction. *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 362, Issue 1480, (February 2007), Pages 679-704, doi:10.1098/rstb.2006.2004.

Recommended Readings:

None

September 22 (Friday) Rutgers Robotics Workshop

The workshop is held annually as part of the NSF National Research Traineeship SOCRATES (Socially Cognizant Robotics for a Technology Enhanced Society) at Rutgers. This annual robotics workshop is held for faculty, students, and industry representatives. The workshop will have both internal and external speakers as well as a poster session for students to present their robotics research. The workshop panels will discuss robots in the age of ChatGPT as well as new robot technologies and the social impact. Please join us in person at the Civic Square Building (33 Livingston Ave, New Brunswick, NJ). Please register via the following form below.

Registration Form:

https://www.eventbrite.com/e/rutgers-robotics-workshop-2023-tickets-667712826037?aff=oddtdtcreator

Robotics Workshop Agenda:

8:30 - 9:00 Check - in

9:00 - 9:30 Introduction

9:30 - 10:30 Plenary Speaker, Ronald Arkin, Georgia Tech

Civilized Collaboration: Ethical architectures for enforcing legal requirements and mediating social norms in human-robot Interaction

10:30 - 10:45 Poster Spotlight Talks

10:45 - 11:30 Coffee break & Poster Session

11:30 - 12:30 Panel: Robots in the age of ChatGPT

12:30 - 1:30 Networking Lunch

1:30 - 2:30 Panel: New Robot Technologies and the Social Impact

2:30 - 3:15 Student Talks (NRT fellows/trainees)

3:15 - 4:00 Optional: Walk over to the CS Robotics Lab on 1 Spring Street for demo

For more information, visit https://robotics.rutgers.edu/#workshop

Written reflection due by September 26, 2023. Attend the Rutgers Robotics Workshop. Prepare a short (300 words) reflection on the experience and post it in the Discussion section of the course Canvas site. Also, offer several sentences of thoughtful comments on one other student's reflection. Don't comment on a reflection that has already received comments.

September 27 What are the economic and political impacts of emerging robotics technologies?

Technological changes can disrupt the economic and political systems that we use to allocate resources and set societal priorities. Automation, or the replacement of human labor with technological capital in work processes, disrupts relationships between employers and employees and changes the mix of activities within the economic system. The prospect of mass unemployment or under-employment disrupts politics, encourages political activities by economic winners and losers, and invites public policy interventions. The focus this week is on robot use in work and the various predictions of displacement considered in light of the history of past predictions and the empirical assessment of employment projections. For technology assessment, this topic raises questions about how confidently we can predict economic system consequences of robotic innovations.

Objectives:

- Assess the evidence regarding job losses associated with automation
- Explain how economic and political systems function
- Discuss how well we can predict future consequences of robotic innovations

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report about labor market implications of robotics. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Homework: Due today is a one page proposal for your final class project. Upload it to Canvas.

Required Reading:

Winick, Erin. Every study we could find on what automation will do to jobs, in one chart. *MIT Technology Review* (January 25, 2018). https://www.technologyreview.com/2018/01/25/146020/every-study-we-could-find-on-what-automation-will-do-to-jobs-in-one-chart/.

Handel, Michael J. Growth trends for selected occupations considered at risk from automation, *Monthly Labor Review*, U.S. Bureau of Labor Statistics, July 2022, https://doi.org/10.21916/mlr.2022.21.

Acemoglu, Daron, and Restrepo, Pascual. Robots and Jobs: Evidence from US Labor Markets, *Journal of Political Economy* 2020 128:6, 2188-2244. https://doi.org/10.1086/705716.

Spriggs, William E. "Stories to Work By." *Issues in Science and Technology* 38, no. 3 (Spring 2022): 47–52. https://issues.org/stories-work-narrative-technology-policy-spriggs/.

Recommended Readings:

Shiller, Robert J. *Narrative Economics: How Stories Go Viral and Drive Major Economic Events*. Princeton, NJ: Princeton University Press, 2019. Read chapters 13 (Labor- Saving Machines Replace Many Jobs) and 14 (Automation and Artificial Intelligence Replace Almost All Jobs).

October 4 How engineering practices shape the social impacts of robots

In this week, students will adopt perspectives from gender studies, sociology and anthropology to consider the ways in which technology can reflect implicit biases and social dynamics that may unintended and/or unacknowledged by the technologists. Topics include implicit gender biases (e.g., why are Alexa and Siri gender-typed as women?), the normative assumptions in design—design for the "average"—that lead to artifacts inaccessible to many and suboptimal to most; and other topics examining the ways in which human and societal relations and biases are reflected in technology design. For technology assessment, this topic highlights unintended social consequences.

Objectives:

- Discuss the extent to which technology embodies social norms and cultural stereotypes
- Identify assumptions used during the design process that can have social consequences
- Consider how to reduce bias during the design process

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report about social, gender studies, or anthropological aspects of human-robot interactions. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of

doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Reading:

Stone, Matthew. *Ethical Implications of Evaluation Metrics for Conversational Interaction: Engagement and its Alternatives*. Working paper.

Strengers, Yalonde, and Kennedy, Jenny. *The Smart Wife: Why Siri, Alexa, and other smart home devices need a feminist reboot*. Cambrdige, MA: MIT Press. Read chapters 2 (Rosie) and 3 (Pepper).

Emily Bender. *Resisting Dehumanization in the Age of AI*. Youtube video. https://youtu.be/wuU-5rGPbyg.

Recommended Reading:

Perez, Caroline Criado. *Invisible Women: Data Bias in a World Designed for Men*. New York: Abrams Press. Read chapters 7 (The Plough Hypothesis), 8 (One-Size-Fits-Men), and 9 (A Sea of Dudes).

October 11 Doing the right thing (ethics, values, law, and public policy)

Ethics, values, law, and public policy are explored through case studies to consider the role of the technologist in decisions about ethical, value, legal, and policy issues. How do technologists identify, consider, and make decisions about these issues? What is the role of the technology designer in making these decisions? What are the consequences? When do ethical considerations become policy considerations? This topic highlights the potentially divergent views that different stakeholders involved in technology assessment have regarding robotics deployments.

Objectives:

- Identify key ethical, legal, and policy issues associated with robotics
- Distinguish among ethical, legal, and policy issues and frameworks
- Describe how ethical, legal, and policy dimensions relate to one another

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report about an ethical, legal, or policy issue associated with robotics. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Readings:

Andrews, C.J. 2006. From professional ethics to technological citizenship, *Proceedings of the International Symposium on Electronics and the Environment*, Piscataway, NJ: IEEE, pp. 45–7.

Winner, Langdon. Do artifacts have politics? *Daedalus* (Winter, 1980), Vol. 109, No. 1, pp. 121-136. https://www.jstor.org/stable/20024652.

Open Robotics Institute. 2019. *Foresight into AI Ethics (FAIE): A toolkit for creating an ethics roadmap for your AI project*. https://openroboethics.org//ai-toolkit/.

Recommended Reading:

Stephan, Karl. (2015). *Ethical and Otherwise*. Stephan Publishers, San Marcos, TX. Read chapter 33 (Stuxnet).

Acquisti, A., Brandimarte, L., and Hancock, J. 2022. How privacy's past may shape its future: An account of privacy's evolutionary roots may hold lessons for policies in the digital age. Science 375(6578)(20 Jan 2022): 270-272. DOI: 10.1126/science.abj0826.

Hao, Karen. 2021. The Fight to Reclaim AI. *Technology Review* 124(4): 49-52.

Lapowski, Issie. 2021. Platforms vs. PhDs: How tech giants court and crush the people who study them. *Protocol*, March 19, 2021.

O'Connor, Cailin, and Weatherall, James Owen. 2019. Why we trust lies. *Scientific American* 321(3): 54-61.

Stinson, Catherine. (2021). The Dark Past of Algorithms that Associate Appearance and Criminality. *American Scientist* 109(January/February): 26-29.

Part III Social Science Research Methods for Robotics

October 18 Observing: behavioral patterns & traces, sensors & computer vision [Guest Lecture by Kristin Dana]

This part of the course provides an overview of different research methods, the interpretation of research results, and a critical assessment of findings from experimental research and statistical inference. Students will learn to be informed consumers of research results as well as learn the strengths and weaknesses of different methods to help them identify appropriate methods for obtaining information needed in their professional work. These methods are particularly helpful for fine-tuning robotics designs and identifying surprising human responses that warrant consideration during technology assessment. This week will focus on observational research methods that span direct observation by a researcher taking notes, indirect observation of behavioral traces left behind by people, and remote observation using sensors and computer vision techniques.

Dr. Kristin Dana, Professor of Electrical and Computer Engineering, will guest lecture. Bio at https://www.ece.rutgers.edu/Dana

Objectives:

- Identify several methods for performing research on human-robot interactions
- Understand the challenges in performing and interpreting observational research
- Explain how to match the research method to problem being studied

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing an observational study that you find interesting. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Readings:

Babbie, Earl. (2004). Qualitative field research. Ch. 10 (pp. 281-311 in *The Practice of Social Research*, 10th ed. Thomson Wadsworth: Belmont, CA.

Whyte, William H. New York and Tokyo: A study in crowding. *Real Estate Issues*, November 1979, pp. 1-17.

Sabonovic, Selma, Michalowski, Marek P., and Simmons, Reid. 2006. Robots in the Wild: Observing Human-Robot Social Interaction Outside the Lab. *AMC'06-Istanbul, Turkey*. IEEE Xplore.

Carlson, Jordan A., Liu, Bo, Sallis, James F., Hipp, Aaron, Staggs, Vincent, Kerr, Jacqueline, Papa, Amy, Dean, Kelsey, and Vasconcelos, Nuno. Automated High-Frequency Observations of Physical Activity Using Computer Vision. *Medicine & Science in Sports & Exercise* 52(9):p 2029-2036, September 2020. DOI: 10.1249/MSS.0000000000002341

Recommended Reading:

October 25 Asking: interviews, focus groups, surveys

Observational techniques are useful for documenting "what" people do when interacting with robots but not "why" they behave as they do. Thus there is value in asking people about their behavior. Interviews are guided one-on-one conversations that can reveal much about why people behave in certain ways. Focus groups are guided multi-person conversations that allow the researcher to learn not only about individual opinions but also from interactions among participants. Surveys provide a basis for quantifying attitudes, beliefs, and opinions expressed by large numbers of people using standardized questionnaires.

Objectives:

- Learn how to prepare for and conduct interviews
- Understand how to design, carry out, and report on focus groups
- Appreciate how to design good survey questions that elicit useful information from respondents

Practicum: This work will take place in class. Working in groups of three students, conduct and document an interview. One student will be the interviewee, a second will be the interviewer, and the third will be the recorder. The topic of the interview should be "How did you get interested in robotics?" Prepare a list of questions to be asked, record the interview on your phone or on Zoom, transcribe the interview into written text using a tool of your choice (e.g., on Apple iOS turn on Enable Dictation in Settings\General\Keyboard or ask Siri to "transcribe my voice memo" or "convert my voice memo to text." On Android turn on Live Transcribe.). Edit the transcript for clarity and accuracy. Upload the final transcript to Canvas/Assignments.

Homework: Due today is a bibliography of readings you are doing for your final class project. Upload it to Canvas.

Required Readings:

Rubin, Herbert J. and Irene S. Rubin, 2005. "Listening, hearing, and sharing social experiences" and "Why we do what we do: Philosophy of qualitative interviewing," in *Qualitative interviewing: The art of hearing data*. Thousand Oaks: Sage.

Krueger, Richard A. and Mary Anne Casey, 2000. "Overview of focus groups," "Planning the focus group study," "Developing a good questioning route," and "Participants in a focus group," in *Focus groups: A practical guide for applied research*. 3rd Ed. Thousand Oaks: Sage.

Fowler, Floyd J., Jr. 1993. "Designing questions to be good measures," "Designing and evaluating survey questions." Chapters 5 to 6 in *Survey Research Methods*. 2nd ed. Newbury Park, CA: Sage.

Recommended Reading:

Ambert, Anne-Marie, Patricia A. Adler, Peter Adler, and Daniel F. Detzner. 1995. "Understanding and evaluating qualitative research." *Journal of Marriage and the Family* 57(4) 879-893.

Salant, Priscilla and Don A. Dillman. 1994. "Practical surveys," "Cornerstones of a quality survey," "Deciding what information you need," and "Choosing a survey method." Chapters 1 to 4 in *How to Conduct Your Own Survey*. New York: John Wiley & Sons.

October 30 (Monday) **Special Lecture: Cybernetic Aesthetics: Modernist Networks of Information and Data [Dr. Heather Love, Univ. of Waterloo]**

Cybernetic Aesthetics draws from cybernetics theory and terminology to interpret the communication structures and reading strategies that modernist texts cultivate. In doing so, Heather A. Love shows how cybernetic approaches to communication emerged long before World War II; they flourished in the literature of modernism's most innovative authors. This book engages a range of literary authors, including Ezra Pound, John Dos Passos, Gertrude Stein, Virginia Woolf, and James Joyce, and cybernetics theorists, such as Norbert Wiener, Claude Shannon, Ross Ashby, Silvan Tomkins, Margaret Mead, Gregory Bateson, and Mary Catherine Bateson. Through comparative analysis, Love uncovers cybernetics' relevance to modernism and articulates modernism's role in shaping the cultural conditions that produced not merely technological cybernetics but also the more diffuse notion of cybernetic thinking that still exerts its influence today.

Extra Credit Discussion: Attend the special lecture. Prepare a short (300 words) reflection on the experience and post it in the Discussion section of the course Canvas site.

November 1 **Interpretation: Making sense of mixed evidence**

Students will learn to be informed consumers of research results as well as learn the strengths and weaknesses of different methods, along with assessing published research. These methods support quantitative modeling of economic and other social systems as they respond to disruptive technologies that are being assessed.

Objectives:

- Identify key features of quantitative and qualitative data on human behavior
- Discuss differences among exploratory, explanatory, and mixed research strategies
- Explain how to be a critical consumer of data reported by others

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing a mixed-methods study that you find interesting. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Reading:

Andrews, C., Day, J., Agee, P., Wener, R., Jin, Q., and Senick, J. 2023. Methods to Obtain the Occupant Perspective. Ch. 4 (pp. 60-82) in O'Brien, W., & Tahmasebi, F. (Eds.) *Occupant-Centric Simulation-Aided Building Design: Theory, Application, and Case Studies*. Routledge. https://doi.org/10.1201/9781003176985.

Brownlee, Shannon, and Bielekova, Bibiana. Ending the Reproducibility Crisis. *Issues in Science and Technology*, Fall 2021, pp. 82-88.

Davies, William. How statistics lost their power—and why we should fear what comes next. *The Guardian*, January 19, 2017. https://www.theguardian.com/politics/2017/jan/19/crisis-of-statistics-big-data-democracy.

Recommended Reading:

Bergstrom, Carl T., and West, Jevon D. *Calling Bullshit: The Art of Skepticism in a Data Driven World*. New York: Random House, 2020. Chapter 3 (The Nature of Bullshit), pp. 38-49.

Gould, S. J. (1985). "The Median Isn't the Message". Discover 6 (June): 40–42.

Part IV Application Areas

November 8 Robotics at Home: as complements to activities of daily living (chores, comfort, entertainment, health, safety, assistance) [Guest Lecture by Dunbar Birnie].

This week focuses on "Robotics for Everyday Living," examining robot use for tasks such as Strength and Mobility Assistance (e.g., to open doors, carry packages and navigate through crowds), the integration of socially cognizant robots (embodiment and control) that can infer user needs (cognitive modeling), interact via language (language and dialogue), see and interpret their surroundings (visual learning). Technology assessments of everyday robotics applications will reveal disruptions to social practices and unintended consequences associated with how humans respond to robotic assistance. A guest speaker will discuss how research and technology are commercialized and implications for technology assessment.

Dr. Dunbar Birnie, Professor of Materials Science and Engineering, will guest lecture. Bio at https://mse.rutgers.edu/fac/dunbar-birnie

Objectives:

- Understand the social practice theory framework for analyzing habitual behavior
- Identify emerging applications of robotics to activities of daily living
- Critically discuss how humans might respond to these robotics applications

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing a study everyday applications of robotics that you find interesting. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Readings:

Guang-Zhong Yang et al. The grand challenges of *Science Robotics*. *Sci. Robot*. Vol. 3, No. 14, eaar7650(2018). DOI:10.1126/scirobotics.aar7650.

Darnton, A, Verplanken, B, White, P and Whitmarsh, L (2011). *Habits, Routines and Sustainable Lifestyles: A summary report to the Department for Environment, Food and Rural Affairs*. AD Research & Analysis for Defra, London. https://www.adranda.co.uk/single-post/2017/01/26/Habits-Routines-and-Sustainable-Lifestyles-Summary-Report.

Recommended Readings:

November 15 Robotics at Work [Guest Lecture by Hal Salzman]

The use of robots in the workplace is a primary market for this technology.

Dr. Hal Salzman, Professor of Planning and Public Policy, will guest lecture. Bio at https://bloustein.rutgers.edu/salzman/

Objectives:

- Identify major applications of robotics in private and public enterprises
- Understand approaches for assessing the commercial suitability of robotics applications
- Critically discuss the potential policy responses to widespread robotics deployments

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing an application of robotics in the workplace that you find interesting. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present

their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Readings:

Paolillo, Antonio, et al. How to compete with robots by assessing job automation risks and resilient alternatives. *Sci. Robot*. Vol. 7, No. 65, eabg5561(2022). DOI:10.1126/scirobotics.abg5561, and Supplemental Material.

Montobbio, Fabio, Staccioli, Jacopo, Virgillito, Maria Enrica, and Vivarelli, Marco. Robots and the origin of their labour-saving impact, *Technological Forecasting and Social Change*, Volume 174, 2022, 121122, https://doi.org/10.1016/j.techfore.2021.121122.

Recommended Reading:

Gunkel, D.J. Mind the gap: responsible robotics and the problem of responsibility. *Ethics Inf Technol* 22, 307–320 (2020). https://doi.org/10.1007/s10676-017-9428-2.

Simões, Ana Correia, Soares, António Lucas, and Barros, Ana Cristina. Factors influencing the intention of managers to adopt collaborative robots (cobots) in manufacturing organizations, *Journal of Engineering and Technology Management*, Volume 57, 2020, 101574, https://doi.org/10.1016/j.jengtecman.2020.101574.

November 29 Robots in the built environment (smart buildings, smart cities, autonomous passenger vehicles, smart transit, autonomous freight vehicles).

Embedded technology in buildings and in transportation are the focus this week. How are robotic technologies being used to transform the built environment in different domains, from homes to offices to transportation? How will we optimize and make tradeoffs between human needs and preferences and the optimization of and by technology? Technology assessment for these applications will focus on how disruptive technologies become embedded and thereby transform the context of everyday life.

Objectives:

- Identify how elements of the built environment are incorporating sensors, actuators, and autonomous intelligence.
- Discuss how this might affect human autonomy and dignity
- Consider the implications for design of buildings and transportation systems

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing an application of robotics in the built environment that you find interesting. Prepare a short (300 words) critical discussion of

the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Homework: Due today is a preliminary data analysis and first draft paper for your final class project.

Required Readings:

Matthews, Peter, and Greenspan, Stephan. *Automation and Collaborative Robotics: A Guide to the Future of Work*. New York: Apress/Springer Science+Business Media, 2020. Read chapter 5 (Robots without arms), pp. 141-172.

Smart Buildings

Alanne, Kari, and Sierla, Seppo. An overview of machine learning applications for smart buildings, *Sustainable Cities and Society*, Volume 76, 2022, 103445, https://doi.org/10.1016/j.scs.2021.103445.

Hellwig, Runa Tabea (2015) Perceived control in indoor environments: a conceptual approach, *Building Research & Information*, 43:3, 302-315, DOI: 10.1080/09613218.2015.1004150.

Smart Transportation

Stayton, Erik, and Stilgoe, Jack. It's time to rethink levels of automation for self-driving vehicles. *IEEE Technology and Society Magazine*, September 2020, pp. 13-19. DOI: 10.1109/MTS.2020.3012315.

Gillespie, Tony, and Hailes, Steve. Assignment of Legal Responsibilities for Decisions by Autonomous Cars Using System Architectures. *IEEE Transactions on Technology and Society*, Vol. 1, No. 3, September 2020, pp. 148-160. DOI: 10.1109/TTS.2020.3014395.

Recommended Reading:

December 6 Robotic solutions to large-scale social concerns (climate change, war, famine, mass extinction events, pandemics). [Guest Lecture by Kostas Bekris]

Use of robots at a society-wide and global scales are considered across a range of domains, from bioengineering of climate to in warfare. This week integrates course topics from the semester, of technology design to ethical considerations and social impacts. It provides an opportunity to revisit and improve the technology assessment framework that we have developed over the semester.

Dr. Kostas Bekris, Professor of Computer Science, will guest lecture. Bio at https://www.cs.rutgers.edu/people/professors/details/kostas-bekris

Objectives:

- Identify ways in which large-scale robotic deployments might differ from niche applications
- Discuss the ethical implications for those deploying these robots
- Comment on potential unintended consequences of large-scale robotics deployments

Practicum: Due by 12 noon on the day of class. There are three parts. First, each student should find an article or report summarizing a study of robotics applications to large-scale societal issues such as climate change, epidemics, or warfare that you find interesting. Prepare a short (300 words) critical discussion of the article and post it in the Discussion section of the course Canvas site. Don't choose an article that another student has already chosen. Second, each student should offer several sentences of thoughtful comments on one other student's example. Don't comment on an example that has already received comments. Third, three student volunteers should each present their discussion in a short (5-minute) Powerpoint presentation in class instead of doing a Discussion writeup. Presenters should post their Powerpoints in the Discussion area to allow easy downloading during class.

Required Readings:

Swett, B.A., Hahn, E.N., Llorens, A.J. (2021). Designing Robots for the Battlefield: State of the Art. In: von Braun, J., S. Archer, M., Reichberg, G.M., Sánchez Sorondo, M. (eds) *Robotics, AI, and Humanity*. Springer, Cham. https://doi.org/10.1007/978-3-030-54173-6_11

van Wynsberghe, A., Comes, T. Drones in humanitarian contexts, robot ethics, and the human–robot interaction. *Ethics Inf Technol* 22, 43–53 (2020). https://doi.org/10.1007/s10676-019-09514-1

Recommended Reading:

Walsh, James Igoe, and Schulzke, Marcus. *The Ethics of Drone Strikes: Does Reducing the Cost of Conflict Encourage War?* Strategic Studies Institute, US Army War College, 2015. https://press.armywarcollege.edu/monographs/442/.

Part VI Student Projects

December 13 Final Student Presentations

Present results of student projects in class; solicit feedback

Objectives:

- Clearly present your research
- Learn about other socially cognizant robotics research from fellow students
- Provide constructive feedback to other students on their research

Each student should prepare a short (2-3 slides max) Powerpoint presentation about their project, upload it to Canvas, present it briefly (5 minutes max) to the class, and use the feedback received to improve their final paper.

Final paper due at 11:59 pm on Monday, December 18th via Canvas/Assignments