Action in light of information: What robots can teach us about algorithms

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Extended Abstract

What do algorithms *do?* This question is central to the ethics, design, and policy surrounding algorithmically mediated technologies in applications ranging from social media to banking to medicine. This contribution takes the example of algorithmically mediated robotics as a novel entrypoint to this question. Robots take unambiguous physical action in light of information processed by their control systems. In robotics, the common framing of algorithms' input producing output is thus rendered into input producing action. By sidestepping the need to characterize algorithmic output as (speech) act, the ethical implications of algorithms can be more directly analyzed when observed via robotic action. This paper contends that important and generally applicable aspects of algorithms are more visible in their robotic deployments, and suggests robotics as a key site for algorithm studies more broadly.

This paper highlights two main methodological benefits of studying algorithms within robotics: the relative tractability of the small numbers of robots available to study and the fact that robots take unambiguous action. Despite these benefits, substantial challenges remain, but the richer access that researchers have to the situated deployment of algorithms in robots provides unique insights that have the potential to contribute to studies of algorithms in other settings, such as their use in web and mobile applications.

Background: Algorithm Studies

Interest in critical algorithm studies has exploded following the permeation of algorithmically enhanced technologies into everyday activities. Some research has focused on issues raised by specific uses of algorithms such as search (Noble 2017) or inducing user choice (Kotliar 2021). Others have advanced guidelines for restricting algorithmic harm by denying them administrative power and the capability to do harm (Alkhatib 2021; Bellanova and Irion 2021). Understandably, the bulk of this work has focused on algorithms operating within software, particularly web and mobile software, because this is the most common platform through which most experience algorithms in daily life.

Beyond internet and software studies, algorithm studies have proliferated within political geography and security studies. The closest overlap between algorithm studies and robotics has been investigations of drones used in warfare. For instance, Suchman (2020) has looked at the "accuracy" of recognition algorithms used to select drone targets in counterterrorism warfare as a dangerous repurposing of the term as used in Cold War missile guidance systems. While

there is clear applicability of this work to fully autonomous robots, the work on semi-autonomous intelligence and ballistic drone operation has an understandably different focus on the role and effects upon operators and targeted communities.

Background: Critical Studies of Robotics

Critical studies of robotics has a long but episodic history, and the field has not generated the same intellectual critical mass as critical studies of computers or software more generally. As recently as 2018, workshops have urged the recognition of the field of critical robotics (Ljungblad et al. 2018); perhap tellingly, the workshop happened at a Human Computer Interaction (HCI) conference, rather than one focused on robotics. Robotics has been an occasional object of critical technology studies, but critical robotics has yet to develop its own intellectual center of gravity.

Compounding the difficulties in envisioning an entrypoint for information studies into this discourse, robots have only rarely been investigated as information systems. There have been studies of using robots within information settings such as libraries (Phillips 2017; Nguyen 2020), or their effects upon human social development (Turkle 2018), but these have not focused on robots as a deployment platform for algorithms.

Viewing robots as a platform for algorithm studies provides a path to unite critical algorithm studies and the emerging field of critical robotics such that information studies can play a central role in both. This has methodological benefits that redound to the benefit of both fields. In this paper, I will focus on just two.

Methodological Benefit #1: Tractability

Algorithms are typically studied as deployed in software, particularly web based software. As such, characteristics and limitations of this deployment medium can influence the shape of algorithm studies. Algorithms deployed in software, particularly web-based software, interact with thousands to millions of users in a complexly situated way. Robots are also deeply situated, but because of their physical instantiation, this situatedness is more tractable via methods of co-present observation. In studies of social media, for instance, “the algorithm” is often discussed in the abstract, despite the fact that its operation is often deeply localized to each user. In such work, “scale” is sometimes taken to be an essential property of algorithms. Robotics offers a way to complicate this picture, following recent critiques of scale as a property rather than a practice (Barrett and Orlikowski 2021). Localized spatiotemporal situation is something familiar to ethnographic researchers, and something which traditional ethnographic methods are well-suited to accommodate (Chun 2019). What’s more, especially in robotics research labs or companies, the humans who build or interact with robots are necessarily nearby when researchers observe the robots operating in person (Chun and Knight 2020).

Methodological Benefit #2: Unambiguous Action, In Light of Information

Subtle arguments about language and the constitution of social reality are needed to explain how the tagging of an image, the ranking of a search result, or the suggestion of a user to follow are *actions* (Hauser 2019). While important, such theoretical scaffolding can limit progress in algorithm studies if it is seen as a prerequisite to, for instance, evaluating algorithms ethically

(since ethics in at least some constructions concerns action). Robots unambiguously and uncontroversially take physical action in the world by virtue of motors and servos. Especially when combined with the ease of rich observation of such actions in specific contexts, this allows algorithm studies to bypass prerequisite theorizing about the nature of algorithmic action. In doing so, it enables scholars to 'scout out' the conceptual and ethical space that studies of other algorithmic deployment mediums will one day inhabit. In addition, as mentioned above, richer access to the human actors, interactors, and bystanders of robotic deployments enables a more nuanced account of how human action influences robotic development and how robotic deployments of algorithms impact daily life.

Robots take action in light of information. This framing is key to helping information studies assume a central role in critical algorithm studies as well as critical robot studies. What information? Whose information? Information from where? Even as complex algorithms make tracing the effects of information through to specific algorithmic outputs (and, in robots, specific physical actions) difficult, information remains a critical substrate of robotic agency. As such, aspects of robot action can be analyzed alongside human information behaviors, using the same terms. With such analytical tools available, complex human-robot assemblages can be analyzed using the same theoretical lens, breaking new ground in studies of human robot interaction (HRI) and human computer interaction (HCI) more broadly.

Challenges that Remain

This is not to argue that robots make all of the complexities of algorithms go away. Robots can be controlled and informed by a range of algorithmic techniques and designs, such as deep learning, and all of the emerging ethical, epistemic, and methodological issues of studying these techniques' use, such as a lack of accountability, remain. But with the site of study simplified, in that a researcher can study a small number of physical devices in a constrained spatiotemporal context, as opposed to a large number of spatiotemporally distributed users of a website or mobile app, my contention is that robotics has clear benefits to offer algorithm studies as it confronts its most pressing challenges.

Future Work

The author is engaged in a long-term multidisciplinary investigation of robotic deployments at UT Austin, funded by Good Systems, a UT Grand Challenge. This project will array a range of disciplinary lenses upon several robotic deployments for various purposes, including within the UT Libraries. Results from this project will inform algorithm studies and the role that information scholars can and should play in the study, critique, and use of algorithmic deployment platforms such as robots.

References

Alkhatib, Ali. 2021. "To Live in Their Utopia: Why Algorithmic Systems Create Absurd Outcomes." In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–9. 95. New York, NY, USA: Association for Computing Machinery.

Barrett, Michael, and Wanda Orlikowski. 2021. "Scale Matters: Doing Practice-Based Studies of Contemporary Digital Phenomena." *MIS Quarterly* 45 (1): 467–72.

Bellanova, R., and K. Irion. 2021. "Toward a Critique of Algorithmic Violence." *International*

Political Science Review. https://academic.oup.com/ips/article-abstract/15/1/121/6170592.
Chun, Bohkyung. 2019. “Doing Autoethnography of Social Robots: Ethnographic Reflexivity in HRI.” *Paladyn, Journal of Behavioral Robotics* 10 (1): 228–36.
Chun, Bohkyung, and Heather Knight. 2020. “The Robot Makers: An Ethnography of Anthropomorphism at a Robotics Company.” *J. Hum.-Robot Interact.*, 16, 9 (3): 1–36.
Hauser, Elliott. 2019. “Making Certain: Information and Social Reality.” Edited by Ryan Shaw. Doctoral Dissertation, University of North Carolina at Chapel Hill.
Kotliar, Dan M. 2021. “Who Gets to Choose? On the Socio-Algorithmic Construction of Choice.” *Science, Technology & Human Values* 46 (2): 346–75.
Ljungblad, Sara, Sofia Serholt, Tijana Milosevic, Niamh Ni Bhroin, Rikke Toft Nørgård, Pamela Lindgren, Charles Ess, Wolmet Barendregt, and Mohammad Obaid. 2018. “Critical Robotics: Exploring a New Paradigm.” In *Proceedings of the 10th Nordic Conference on Human-Computer Interaction*, 972–75. NordiCHI ’18. New York, NY, USA: Association for Computing Machinery.
Nguyen, Linh Cuong. 2020. “The Impact of Humanoid Robots on Australian Public Libraries.” *Journal of the Australian Library and Information Association* 69 (2): 130–48.
Noble, Safiya Umoja. 2017. *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York, NY: New York University Press.
Phillips, David. 2017. “Robots in the Library: Gauging Attitudes towards Developments in Robotics and AI, and the Potential Implications for Library Services.” MSc Dissertation, City University of London. https://core.ac.uk/download/pdf/147824519.pdf.
Suchman, Lucy. 2020. “Algorithmic Warfare and the Reinvention of Accuracy.” *Critical Studies on Security* 8 (2): 175–87.
Turkle, Sherry. 2018. *Alone Together: Why We Expect More from Technology and Less from Each Other*. New York: Basic Books.