On Relevance: Balancing Theory and Practice in HRI

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Human-robot interaction (HRI) is arguably the ultimate frontier of robotics: the machines we have created are getting closer to working alongside us. The commercial potential of HRI is vast, and while the wave of commercial interest is currently focused on artificial intelligence (AI) and Machine Learning (ML), HRI will soon follow. Similarly, the potential for HRI to do good on a large scale is equally vast. Yet, the majority of HRI research is entirely disconnected from, or even aware of, commercial and societal impacts.

Research is not always motivated by practical use, but the fraction of research that can remain divorced from the real world is diminishing. In the meantime, in academia, publishing and references garnered (via the h-index and other indices) are still the ultimate metrics of impact. Unfortunately, working with real-world HRI problems makes publishing harder, for three major reasons.

First, real-world problems involving real people are messy and do not lend themselves to clean formalization. Yet, nothing is more publishable than formalisms and math in any area of robotics. This sentiment is not a political statement; it is a fact easily verified by surveying papers in top publication venues.

Second, real-world problems involving real people require long-term commitment to interacting with users outside of the lab. Such commitment includes several major investments of research bandwidth, including: dealing with human subjects protocols and approvals, collecting data in environments one cannot control, and needing armies of students to analyze those data over months and more. All this delays publication and index-building.

Third, real-world problems involving real people are difficult to fit into highly constrained expectations for “clean” experiment design. Currently, a battle is being waged in which the social sciences are under attack (and their research funding is being severely cut) for not being able to replicate many of the most impactful 20th-century study results about human behavior. Much

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like the affinity for formalism and math in robotics, there is a push for reductionist studies at the expense of pursuing more complex but messier questions about human behavior.

Yet, at the very same time, economics, a mathematical field, is starting to recognize the value of psychology: the 2017 Nobel Prize in Economics was awarded to a psychologist for his work on the new field of behavioral economics, which shows how irrational human behavior is and how incompatible with long-standing, clean mathematical models.

HRI is stuck somewhere within these larger forces, but it is a very young field, too young to take sides in the larger battle. HRI so far is largely confined to research labs and online surveys. Until we have, as a field, earned the respect of others by impacting real user populations, in real-world environments, and on real-world problems, we should be open-minded, inclusive, and collaborative. In fact, we should always be that way.

Proclamations are fun but are rarely actionable. Here are seven specific actionable steps toward open-mindedness and a balance of theory and practice:

- (1) *Read broadly about human behavior*, not only within convenient, “vetted,” narrow sub-fields that only reinforce your point of view.
- (2) *Help to create data sets of messy real-world human behavior*. HRI needs datasets for multi-modal human-human and human-robot interaction from a variety of populations. The ideal is to acquire such data with participant consent for sharing for research use. The lesser but still useful option is to acquire such data with participant consent for sharing anonymized data, which requires removing enough of the facial features and voice but retains plenty for interesting research uses.
- (3) *Use real-world data in our HRI, ML, and AI classes and research*, instead of convenient datasets. It is estimated that about 5% of openly available datasets use real-world in-context (a.k.a. messy) data. Have your students use that 5% instead of the more convenient 95% so that they can address messier real-world problems, and motivate them to collect share more such data and grow that percentage.
- (4) *Require fieldwork for HRI students* in classes and research labs and personally commit to at least one day or one class per semester of being in the field (i.e., complex real world environments off campus and outside of a middle-income home and neighborhood), with follow-up discussions of what was learned and how it can impact ongoing and future research directions.
- (5) *Talk to and collaborate with people in industry to learn what challenges they are really facing*. Because industry is inherently incentivized by real-world impact while academic research is more effective at targeting longer timelines and populations that may be marginalized by industry, collaborations can be eye-opening for both partners.
- (6) *Create venues (a new conference?) for “real-world HRI” or “use-inspired HRI,”* where researchers who tackle real-world messy problems are not in the “alt” category but can publish, exchange ideas, and be part of a welcoming community.
- (7) *Measure impact not just by references* but also by aiding translation into the real world, toward improved quality of life for all, not just the well-off. Not everyone has to do research of this type, but many more in HRI should.

Behavior change and culture change are both hard, but these steps can allow us to be ambitiously optimistic about our impact in the long term while remaining grounded in the problems we face now. HRI may be the ultimate frontier of robotics, and as with any frontier, we have the responsibility to settle and shape it to be open-minded, inclusive, and relevant, so it will thrive.

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