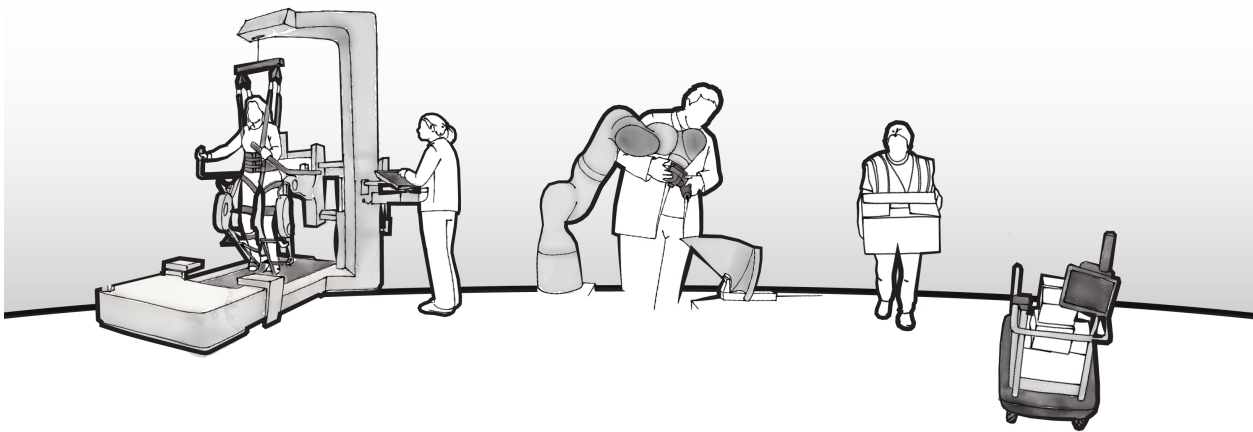


First International Workshop on Workers-Robot Relationships

Exploring Transdisciplinarity for the Future of Work with Robots

Cristina Zaga
University of Twente
Enschede, The Netherlands
c.zaga@utwente.nl

Maria Luce Lupetti, Deborah Forster, Dave
Murray-Rust, J. Micah Prendergast, David
Abbink
Delft University of Technology
Delft, The Netherlands
m.l.lupetti,d.f.forster,d.s.murray-
rust,j.m.prendergast,d.a.abbink@tudelft.nl



ABSTRACT

In Industry 5.0, cognitive robots and workers will engage in evolving and reciprocal relations, which we call workers-robot relationships (WRRs). To enable evidence-based work futures with workers, we must co-develop WRRs and understand their impact on work, workers, management, and society. To this end, we posit that the HRI field should work beyond disciplines and include value-driven and plural perspectives through transdisciplinary research done with and for workers. However, WRRs and transdisciplinarity pose unique technical, philosophical, and methodological challenges yet to be explored. We propose a workshop to engage the HRI community working on Industry 5.0, aiming at 1) taking stock of current WRR-related challenges in relevant disciplines, 2) collectively kick-off the exploration of a joint research agenda, 3) preliminary examining if and how transdisciplinarity could help the HRI community,

and 4) start discussing how to deal with such complex knowledge integration in practice.

KEYWORDS

workers-robot relationships, transdisciplinary research

ACM Reference Format:

Cristina Zaga and Maria Luce Lupetti, Deborah Forster, Dave Murray-Rust, J. Micah Prendergast, David Abbink. 2024. First International Workshop on Workers-Robot Relationships: Exploring Transdisciplinarity for the Future of Work with Robots. In *Proceedings of ACM Conference (Conference'17)*. ACM, New York, NY, USA, 3 pages. <https://doi.org/10.1145/nnnnnnnn.nnnnnnnn>

1 INTRODUCTION

Cognitive robots [6] will venture outside the laboratory into real-world settings thanks to their ability to deal with complexity and variability. In industry, cognitive robots set out to become part of the future of physical work (e.g., manufacturing, logistics, healthcare services, etc.), potentially assisting workers with physical tasks, supporting workflows, and improving productivity by learning in dynamic environments.

Robots and workforces will thus engage in evolving, reciprocal, and long-term interactions. Robots' learning capabilities will allow them to respond to and learn from workers, while workers

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

Conference'17, July 2017, Washington, DC, USA

© 2024 Association for Computing Machinery.

ACM ISBN 978-x-xxxx-xxxx-x/YY/MM...\$15.00

<https://doi.org/10.1145/nnnnnnnn.nnnnnnnn>

will learn from and adapt to these new robots on the work floor. Understanding how this reciprocal learning [7] evolves requires a new relational perspective that jointly considers change and learning processes between robots, workers, organizations, and other stakeholders. These emerging *workers-robot relations* (WRRs) have various configurations (i.e., single worker, worker-client relation, or a team of workers), are bound to environments with complex sets of protocols where various levels of autonomy may be possible (or not), and where power dynamics at play [15]. While WRRs promise new opportunities for innovation, cost reduction, and productivity, *the impact of cognitive robots on work, workers, and management is yet to be unveiled* [2].

The more WRRs perdure, the more workers' competencies and skills will evolve —some becoming underutilized, others getting stronger, e.g., collaboration and coordination. Operating in service settings will require cognitive robots to be socially competent [3] — but the sophisticated understanding of the social world needed for that is yet to be built. Furthermore, WRRs will also entail work to be performed in team settings while most HRI research in human-robot collaboration remains focused on dyadic interactions [9]. Moreover, workforces are characterized by a high degree of cultural diversity, educational levels, and degree of autonomy in the workplace, all aspects that remain largely unaddressed in HRI research [10].

Therefore, future WRRs bring to the HRI field a *multitude and diversity of challenges* from technical questions of enabling dynamic role allocation to the interactional need to understand emerging phenomena, such as co-adaptation. The unprecedented complexity of WRRs challenges the validity of widely adopted social theories, as learning robots do not adhere to the main assumption that technology can be considered an independent variable. Ultimately, researchers need to untangle the intricacies of the socio-technical systems WRRs are embedded in to produce insights for the future development of robotic capabilities while breaking free from techno-centric views and power struggles.

In line with the perspective of Industry 5.0 [1], which sees planetary, societal, and workers' well-being as central to the future of work, the notion of WRRs invites the HRI community to rethink how we do research and integrate knowledge from multiple perspectives beyond efficiency and optimization. To this end, roboticists, designers, ethicists, psychologists, and organizational scholars should collaborate with workers to enable evidence-based development of the future of physical work around WRRs. To realize this value-oriented, participatory research requires the community to embrace transdisciplinary research [16], promoting joint learning among academics and practitioners.

However, transdisciplinary ways of doing research are emergent and defined by flows of mutual learning between academics and non-academics, making it a hard process to detail and practice. Therefore, understanding how to produce transdisciplinary knowledge and how to deal with values, pluralism, and participation is yet to be defined in the HRI field.

We propose a workshop to focus on taking stock of current WRRs challenges, explore if and how transdisciplinarity could help the HRI community, and kick off discussing how to deal with such complexity in practice. The ultimate goal is to start identifying and engaging the HRI community working on Industry 5.0 perspectives

Table 1: Schedule of the 1st International workshop on WRRs

Introduction Workshop and Lightning Keynotes (60 min)

- Welcome presentation by David Abbink
- Lightning keynotes
- Discussion

Poster Session and Hands-On Activity (90 min)

- Coffee Break and Poster Session
- Disciplinary Reflection and How-Might We Work on WRRs

Panel Discussion (40 min)

- Panel discussion with invited speakers and Q&A

Wrap-up and Next Steps (30 min)

- Next steps and community building and collaborations
-

and collectively attempt first steps to make sense of how we can work beyond disciplinary boundaries for and with workers.

1.1 Workshop Themes

In our workshop, we address the following themes connected with the problem space of WRRs in HRI and the need for transdisciplinarity. Relevant topics include, but are not limited to:

Technical challenges in WRRs. While extensive research exists regarding workers-robot collaboration [4, 14], cognitive robots' capabilities will provide unprecedented opportunities for mutual learning, adaptation, and collaboration. But, *what are the key technical enablers and barriers in this technical design space?* Furthermore, *what technical challenges need to be solved to enable robots to get embedded in workers' teams (beyond worker-robot dyads)?*

Philosophical challenges in WRRs In WRRs, many values, perspectives, norms, and world views are at play, in socio-technical entanglements. Yet, in HRI, efforts that take a critical stance on the social implications of WRRs remain rare [11, 15], and related methodologies are scarce [8]. Thus, *how can we envision desirable novel WRRs regarding emerging entanglements, unfolding values, and plural perspectives? What can we learn from other disciplines to embed values entanglements and plurality in the design process?*

Participatory research challenges in WRRs Developing desirable WRRs that challenge traditional power struggles and respond to workers' needs requires participatory research practices. Participatory practices are extensively used in HRI [5], yet inherent issues of inclusivity and justice, i.e., not acknowledging power dynamics, costs of participation, and paternalistic tendencies [12], remain mostly unaddressed. Therefore, *how can we involve workers and stakeholders in the full WRRs transdisciplinary process? How can we take power dynamics between academics and workers into account?*

Methodological challenges in WRRs. While HRI has already been working in a multidisciplinary and interdisciplinary fashion for many years [13], many methodological challenges remain unanswered, such as *how can we decide on the relevant disciplines and stakeholders to involve? How can we allow for emergent knowledge production? What are the methodological barriers and enablers of knowledge integration in HRI to establish WRRs?*

2 WORKSHOP OVERVIEW

We plan a half-day workshop combining invited speakers' plenary talks and collaborative, hands-on activities (see Table 1). The workshop will be hybrid, allowing for both online and in-person attendance. Participants will share their work in an interactive poster session starting at the coffee break. The session continues with a hands-on reflection on their disciplinary and societal roles in understanding and shaping "how might we" practice WRRs research.

2.1 Invited Speakers

We invite keynote speakers and diverse panelists from various disciplinary angles related to WRRs to stimulate fruitful interactions and knowledge integration with the workshop participants. We plan two lightning keynotes from different disciplinary perspectives. Each keynote will engage with the audience for a ten-minute talk, followed by twenty minutes of discussions.

2.2 Audience and Participation

We target HRI researchers coming from various disciplinary traditions and working on WRRs. Participants will be invited to submit a one-to-four-page position paper related to the future of work with robots. We welcome a diversity of angles, engaging with one of the four challenges described in Section 1.1. Position papers articulating specific case studies are also very welcome.

Submissions will be subject to a peer-review process and accepted based on originality and topic relevance. At least one author of an accepted paper will be asked to attend the workshop and present.

The workshop and the call for contributions will be advertised through community mailing lists, social media, and the personal networks of the organizers. All necessary information and updates will be published on the dedicated workshop website.

2.3 Plan for Documenting the Workshop

The workshop's website will serve as a platform to document the workshop's activities and outcomes. The outcomes of the hands-on activity and the position papers will be published online (with DOI reference for each). The workshop's results will be considered for further dissemination as a position paper on WRRs (to be coauthored with interested workshop attendees).

3 WORKSHOP ORGANIZERS

Cristina Zaga is an assistant professor at the Human-Centred Design group at the University of Twente. Her research focuses on transdisciplinary and relational design methods for just futures of work and care.

Maria Luce Lupetti is an assistant professor at the Faculty of Industrial Design Engineering at TU Delft. Her research explores the role of critical design approaches in developing responsible and desirable artificial agents.

Deborah Forster is a cognitive scientist and a researcher in the HRI group of the cognitive robotics department at TU Delft. Currently practicing transdisciplinary research on the potential of worker-robot relations to shape the future of work.

Dave Murray-Rust is an associate professor in Human-Algorithm Interaction Design at the Faculty of Industrial Design Engineering.

He explores the messy terrain between people, data, algorithms, and things through a combination of making and thinking to build better futures for humans and AI.

Micah Prendergast is an assistant professor in Human-Robot Interaction at TU Delft in the Cognitive Robotics department. His research interests include computer vision, medical device design and robotic sensing, perception, and controls for the future of work.

David Abbink is a full professor in Human-Robot Interaction at TU Delft, at the Cognitive Robotics department at Mechanical Engineering, and Industrial Design Engineering. He focuses on understanding and shaping the future of physical work, with and for workers.

REFERENCES

- [1] Elias G Carayannis and Joanna Morawska-Jancelewicz. 2022. The futures of Europe: Society 5.0 and Industry 5.0 as driving forces of future universities. *Journal of the Knowledge Economy* 13, 4 (2022), 3445–3471.
- [2] EunJeong Cheon, Cristina Zaga, Hee Rin Lee, Maria Luce Lupetti, Lynn Dombrowski, and Malte F Jung. 2021. Human-Machine Partnerships in the Future of Work: Exploring the Role of Emerging Technologies in Future Workplaces. In *Companion Publication of the 2021 Conference on Computer Supported Cooperative Work and Social Computing*. 323–326.
- [3] Kerstin Dautenhahn, Alan Bond, Lola Canamero, and Bruce Edmonds. 2002. *Socially intelligent agents: Creating relationships with computers and robots*. Springer.
- [4] Chien-Ming Huang and Bilge Mutlu. 2016. Anticipatory Robot Control for Efficient Human-Robot Collaboration. In *The Eleventh ACM/IEEE International Conference on Human Robot Interaction* (Christchurch, New Zealand) (HRI '16). IEEE Press, 83–90.
- [5] Hee Rin Lee, Selma Šabanović, Wan-Ling Chang, Shinichi Nagata, Jennifer Piatt, Casey Bennett, and David Hakken. 2017. Steps Toward Participatory Design of Social Robots: Mutual Learning with Older Adults with Depression. In *Proceedings of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (Vienna, Austria) (HRI '17). Association for Computing Machinery, New York, NY, USA, 244–253. <https://doi.org/10.1145/2909824.3020237>
- [6] Hector Levesque and Gerhard Lakemeyer. 2008. Cognitive robotics. *Foundations of artificial intelligence* 3 (2008), 869–886.
- [7] Shufei Li, Ruobing Wang, Pai Zheng, and Lihui Wang. 2021. Towards proactive human-robot collaboration: A foreseeable cognitive manufacturing paradigm. *Journal of Manufacturing Systems* 60 (2021), 547–552.
- [8] Maria Luce Lupetti, Cristina Zaga, and Nazli Cila. 2021. Designerly ways of knowing in HRI: Broadening the scope of design-oriented HRI through the concept of intermediate-level knowledge. In *Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction*. 389–398.
- [9] Eike Schneiders, EunJeong Cheon, Jesper Kjeldskov, Matthias Rehm, and Mikael B Skov. 2022. Non-dyadic interaction: A literature review of 15 years of human-robot interaction conference publications. *ACM Transactions on Human-Robot Interaction (THRI)* 11, 2 (2022), 1–32.
- [10] Katie Seaborn, Giulia Barbareschi, and Shruti Chandra. 2023. Not Only WEIRD but "Uncanny"? A Systematic Review of Diversity in Human-Robot Interaction Research. *International Journal of Social Robotics* (2023), 1–30.
- [11] Sofia Serholt, Sara Ljungblad, and Niamh Ni Bhroin. 2022. Introduction: special issue—critical robotics research. *AI & SOCIETY* 37, 2 (2022), 417–423.
- [12] Mona Sloane, Emanuel Moss, Olaitan Awomolo, and Laura Forlano. 2022. Participation is not a design fix for machine learning. In *Equity and Access in Algorithms, Mechanisms, and Optimization*. 1–6.
- [13] Astrid Weiss. 2012. HRI Research: The Interdisciplinary Challenge or the Dawning of the Discipline?. In *Proceedings of the Seventh Annual ACM/IEEE International Conference on Human-Robot Interaction* (Boston, Massachusetts, USA) (HRI '12). Association for Computing Machinery, New York, NY, USA, 271–272. <https://doi.org/10.1145/2157689.2157789>
- [14] Katherine S. Welfare, Matthew R. Hallowell, Julie A. Shah, and Laurel D. Riek. 2020. Consider the Human Work Experience When Integrating Robotics in the Workplace. In *Proceedings of the 14th ACM/IEEE International Conference on Human-Robot Interaction* (Daegu, Republic of Korea) (HRI '19). IEEE Press, 75–84.
- [15] Katie Winkle, Donald McMillan, Maria Arnelid, Katherine Harrison, Madeline Balaam, Ericka Johnson, and Iolanda Leite. 2023. Feminist human-robot interaction: Disentangling power, principles and practice for better, more ethical HRI. In *Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction*. 72–82.
- [16] Cristina Zaga, Maria Luce Lupetti, Nazli Cila, Gijs Huisman, Anne Arzberger, Minha Lee, and Eduard Fosch Villaronga. 2023. Towards Transdisciplinary and Futuring Tools for DEI and Social Justice in HRI.