What Kinds of Intelligent Machines Really Make Life Better?

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This piece is a commentary on the article: [*“Artificial Intelligence—The Revolution Hasn’t Happened Yet.”*](#)

Michael Jordan’s article on artificial intelligence (AI) eloquently articulates how far we are from understanding human-level intelligence, much less recreating it through AI, machine learning, and robotics.

The very premise that intelligent machines doing our work will make our lives better may be flawed. Evidence from neuroscience, cognitive science, health sciences, and gerontology shows that human wellbeing and longevity, our health and wellness, fundamentally hinge on physical activity, social connectedness, and a sense of purpose. Therefore, we may need very different types of AI from those currently in development to truly improve human quality of life at the individual and societal levels.

The current focus in research, development, and deployment of AI, machine learning (ML), and robotics is on *automation*. The overarching vision is that of replacing human work with machines in every possible context, but if in the future machines are doing all the work, what are people doing? Debates about the future of work currently focus on labor economic implications, but health and wellness implications are equally concerning. In a future in which AI does our thinking work, and robots do our physical work, we may stop having reasons to get out of bed in the morning.

Human augmentation is a complementary but fundamentally different use of AI, ML, and robotics than automation. Instead of doing work for people, intelligent machines that augment human abilities aim to empower and enhance people to enable them to do meaningful work themselves. This broad concept encompasses cognitive, physical, emotional, and social augmentation; machines that were originally invented to do work may prove helpful to people by not doing work at all, instead motivating people to do the work themselves. The field of *socially assistive robotics* (SAR) provides an existence proof. One of the newest and fastest-growing areas of robotics, SAR focuses on developing intelligent socially interactive machines that assist people through motivation and companionship rather than through physical means. SAR systems aid in challenging contexts including rehabilitation, behavior therapy, and skill training involving interactions with already large and rapidly-expanding populations spanning the age and ability spectrum, including autism, stroke, aging, and dementia, among many others.

Disembodied technologies (e.g., screens) are also applicable in these domains, but a growing body of evidence shows that interactions with physically embodied co-present social partners result in stronger and more sustained effects on behavior change, learning, and enjoyment.

Another challenging area of human augmentation is *human-machine collaboration*, which requires richer interactions and adaptation than automation alone. Removing humans from a context allows the automation process to redefine and adapt a given problem to solve it differently, in the interest of

efficiency and reduced cost. Collaboration, on the other hand, requires adjusting to the given context and environment, and in particular to the collaborators. Working well with people is a complex challenge, one that humanity continues to study, struggle with, and argue about. Human-machine collaboration presents promising avenues for leveraging human knowledge, skills, and qualities in ways that complement those of machines, thereby conserving human purpose.

Working with and helping people beyond physical interactions requires a much more profound understanding of people (a long-standing research pursuit) and of human-machine interaction (a recent one). It mandates a sustained productive interaction of experts in a multitude of disciplines (cognitive, social, and health sciences, human-centered design, computing, and engineering more broadly) that as yet do not know how to converse and collaborate effectively. Data sharing challenges and privacy concerns are only starting to fully emerge. This pursuit tests the willingness to work with highly messy, noisy, incomplete, inconsistent, and subjective human data that may not be amenable to clean mathematical models that are the current norm. Furthermore, empathy and open-mindedness are required in accepting how little we truly understand about people. This is a rich space of research challenges and impactful applications for AI, ML, and robotics.

Automation and augmentation are two ends of the AI, ML, and robotics application spectrum; it is time to improve their balance by significantly increasing our attention on and investment in methods and systems that directly augment and empower people, so we can continue to be, and stay, human.

Discussion

Further commentary by:

- [Rodney Brooks](#) (MIT)
- [Emmanuel Candes, John Duchi, and Chiara Sabatti](#) (Stanford University)
- [Greg Crane](#) (Tufts University)
- [David Donoho](#) (Stanford University)
- [Maria Fasli](#) (UNESCO)
- [Barbara Grosz](#) (Harvard University)
- [Andrew Lo](#) (MIT)
- [Brendan McCord](#) (Tulco Labs)
- [Max Welling](#) (University of Amsterdam)
- [Rebecca Willett](#) (University of Chicago)

Rejoinder by: [Michael I. Jordan](#) (UC Berkeley)

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