Preparing for the Avalanche of Social Robots

Initial Thoughts on the Creation of a World Organization for Safe Collaborative Robots

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This work-in-progress document is for high-school teachers' mentorship in Technical Leadership & Collaborative Innovation (TLCI). It builds on my 2019 Massachusetts' proposal to add a decision module D to the science, technology, engineering, arts and mathematics or STEAM curriculum (known as STEAM+D) I am humbled and honored to provide, for discussion purposes only, these improvised free-form comments building on Nobuko Kobayashi's Asia-Nikkei paper titled "Should we allow robots to become part of the family?"[1] and Antony Funnell's "The new laws of robotics – building on Asimov's science fiction legacy in the age of AI"[2]. The International Federation of Robotics reported "2.7 million industrial robots in factories worldwide in 2020, an 85% increase in the previous five years… 4.8% of which are collaborative robots (cobots) growing at 11% in 2019[3] and likely faster in the post-COVID years, capitalizing on the inherent benefits of digitization and robotics observed during the pandemic and ongoing developments in cognitive and clinical neurosciences, nanotechnologies and 3D automatic vision, among other mechatronics advances.

In health care, robots started by keeping hospital workers safe from pathogen-exposure risks; first performing monotonous blue-collar chores, like disinfecting rooms and cleaning laundry; then to nursing tasks by dispensing medication, feeding impaired people. They subsequently penetrated the operating room by necessity, partly to alleviate the fast-growing shortage of perioperative nurses coupled with the absence of perioperative education in many nursing colleges, as well as the worsening and protracted "[deficiencies] in both experiential and pedagogical knowledge of the perioperative environment, among new graduates. These skillsets include the ability to provide and engage in surgical interventions... and appropriate patient-care transitions that are highly dependent on communication aptitude, aseptic technique, inter-professional collaboration, and coping with fatigue."[4]

Having carved a vital and indispensable role in housekeeping, sanitation and nursing support services, robots were designed to gradually complement surgeons. As an illustration, "[a] complete paradigm shift has been achieved in ophthalmic surgery through the integration of advanced robotic technology, resulting in easier, more efficient…and better quality of care. Assistance facilitated by robots offers substantial improvements in terms of movement control, tremor cancellation, enhanced visualization, and distance sensing. Robotic technology has only recently been integrated into ophthalmology; hence, the progression is only in its initial stages."[5]

When we gaze at general surgery, "in the traditional operation, a senior surgeon leads a team of doctors and nurses working together in a collaborative process; and surrounding a patient on a surgery table. When robots perform the surgery, the spatial setup and distance undergo a complete transformation with the senior surgeon controlling the process remotely via a console, while the medical team stands off to the side and no one near the patient, save for the robot. By nearly taking the human component from the equation, surgery robots tends to have a negative impact on teamwork (less collaboration and more downtime on the support team's hands)."[6] Yet, their benefits are wide ranging, in terms of efficacy, timeliness, mean-time between failure (MTBF), viability and access to health care, especially in remote communities.

Social robots are the natural evolution in human-robot interaction (HRI), ranging from direction- and path-following to accompanying one or more persons in learning, guiding, adaptive side-by-side or other formations. At the 2021 EU conference on the future for European robotics, MIT Media Lab's research scientist Hae Won Park, "valued the benefits of social robots when engaging with young learners. She covered the potential of using socio-emotive AI to cater for each individual learner's need, and shared evidence on the relational bonding and working alliance that form between robots and children over time and its influence to help retention and achieving long-term goals."[7]

In other MIT simulation experiments by Dr. Hae Won Park *et al*, human-robot tutoring geared for "multi-task personalization" combined with continual learning over a long period (including lifelong learning) "appears to benefit both the data efficiency of model learning, the final proficiency of learned student models, and the amount of student learning gain… provide useful insight as technical validation in advance of a long-term in-person study, and may also prove useful in persuading institutions to engage in long-term HRI research as a scientific partner."[8]

For the elderly, living-in robots provide companionship, execute work varying from routine chores to education, entertainment and alleviating isolation and loneliness, although the jury is still out on the long-term sustainable positive impact and unintended hardships, including emotional codependency on mindless heartless robots. In geriatrics, living robots share a host of fundamental attributes with medical devices for mental health. That is why the U.S. Food and Drug Administration (FDA) entered the scene in 2009, hitchhiking on the experience of its European and Japanese counterparts, in certifying, for mild to mid-stage dementia therapy, the biofeedback medical device

designated as Socially Assistive Pet Robot (PARO). This robot builds on the neuroscience progress at the time and the long-standing knowledge derived from pet therapy. A single-blind, randomized controlled trial (RCT) trials corroborated improvement in social interaction, mood and general communication, for patients interacting with PARO.

Cognitive neuroscience-driven AI is fast evolving to emerge as the core engine of the upcoming generation of social robots. Leading designers and builders are striving to create social robots that privilege cognitive and transformational learning, self-knowledge, improvement and freedom of choice. In fact, social robots will increasingly influence the steady users' knowledge, perceptions, behavior, attitudes, emotions and beliefs, for better or worse, and on occasion, alas, surreptitiously. The regular software maintenance, that such complex AI architecture requires, is an opportunity for malware to infect even robots beyond the reach of the internet. The situation is much worse with the connected robots (Internet of Robotic Things). "Many incidents have been occurring, leading to serious injuries and devastating impacts such as the unnecessary loss of human lives. Unintended accidents will always take place, but the ones caused by malicious attacks represent a very challenging issue. This includes maliciously hijacking and controlling robots and causing serious economic and financial losses."[9] Thus, the malware's Sword of Damocles hangs over all robots' increasingly, from scareware, phishing disguised as empathetic response-generation dialogue, overt trust-building spyware to covert data and meta-data skimming Trojan-horse infections.

Immense robotic opportunities for wealth and serving and harming people, as well as biodiversity and the environment, in general, are on the rise with autonomous robots undertaking wholly or partly consequential tasks. These humanoids come with a potential for misuse, ranging from negligence to irresponsible and criminal behavior that must be prevented and checked given the staggering public health, moral and ethical implications that hang in the balance.

Rather than waiting for surprise and tragic events, it is therefore imperative to take advantage of the fleeting time to uphold innovators and users to higher standards, with mission-driven public education, smart regulation, intelligent policy-making, and appropriate summative- and formative-evaluation tools for evidence-based progress and impact. These governance prerequisites are trailing innovation, product development, production and usage everywhere.

As an illustration, Japan's policies tilted toward the vested interests of conglomerates such as Honda, the vertical Keiretsu establishment (Nissan, Toshiba, Toyota) and horizontal counterparts, such as Mitsui and Sumitomo. But, with the trailblazing work of Professor Takaaki Wakasugi (founder of Japan Corporate Governance Research Institute) and in particular, since Mr. Shinzo Abe became Japan's prime minister in 2012, unprecedented progress was made in governance. Yet, Japan must continue on its journey to level the political-playing field so that promising innovators can strive in the robotic realm, protect the vulnerable population, especially the youth and the elderly, and tackle the growing competition from China.[10]

Conclusion

Fast-tracking the development of collaborative robots is among the lessons learned by Japanese entrepreneurs and investors for the post COVID era. Collaborative robots (cobots) will be visible and interacting with everyone, literally everywhere. Even the most technologically-advanced countries are not prepared for such robotic avalanche! And the safety, privacy and competency issues already outpace the capacity of other countries to adapt and extract the full value from current and emerging products.

The opportunity window to prevent catastrophes is narrowing, especially with generative AI, and worst with agentic AI. A multilateral post-Asimov charter is overdue to define a safe "corridor of navigation" for robotic innovations and use of social/collaborative robots.

- Would an organization for robotic safety and privacy be imperative to guide and technically support each country, in administering such charter?
- If yes, could it also, through research, education and soft power, alleviate the competition, in regulatory laxity, among countries, which was at the expense of their own citizens, in prior innovation waves, that led to oligopolies?

At a first glance, one option would be to borrow from the experience of the ultra-light and flexible science-based structures such as the Office of International Epizootics (OIE), now renamed the World Organization for Animal Health, a fully-fledged U.N. organization. Judging from the history of recent multilateral organizations, incubating, building the critical mass, securing the U.N. commitment and rolling-out a fully operational agency will take no less than five years. Since issue resolution cannot wait, an interim option, among many, would be to set up an international-robotic task force, within the World Health Organization, with the collaboration of WHO members, the International Federation of Robotics, universities and think tanks worldwide. Although currently

underfunded, securing funds uniquely earmarked for the task force should not be a major issue, since the WHO is impartial, inclusive, and truly global, with cutting-edge public-health know-how and worldwide channels to access it, when necessary.

Note and References

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[9] Jean-Paul A. Yaacoub, Hassan N. Noura, Ola Salman & Ali Chehab: Robotics Cyber security: Vulnerabilities, Attacks, Countermeasures, and Recommendations, International Journal of Information Security (2021)
https://link.springer.com/article/10.1007/s10207-021-00545-8

[10] Prof. Takaaki Wakasugi was not consulted for this paper. He is a dear friend with whom I worked in Japan and China. He taught me Japan's corporate history, and its evolution from the pre-WWII Zaibatsu to the current post-Keiretsu governance.