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The ecological questions of urban intelligence in the Anthropocene

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Abstract *To secure conditions of human flourishing in the Anthropocene, cities are undertaking design projects that can enhance the adaptiveness of their human ecology. One such design project involves creating new channels of urban intelligence, which in brief, are new ways of knowing and acting within the city. In this paper, I discuss the notion of civic robotics as a novel channel of urban intelligence and examine how they impact human ecology by conferring power, moderating ethics and shaping social hope. Two nascent but contrasting examples of civic robotics are presented. The first is Gita, which is a cargo-companion robot already implemented in Newcastle (UK). The second is Xavier, which is a public surveillance-sheriff robot that has been trialled in Singapore. These robots are then evaluated through the lens of power, ethics and social hope crucial to the project of human flourishing in the Anthropocene.*

Keywords *artificial intelligence, urban intelligence, civic robotic, ethics, Anthropocene*

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1. Introduction: Environmental changes and challenges of flourishing in the Anthropocene

Environmental factors and human ecology have always been tightly intertwined. According to Graeber and Wengrow, environmental changes played important roles in the formation of cities (286). Around 7,000 years ago, major geological shifts—stabilized flood regimes and sea levels from slower melting of polar glaciers in the Middle Holocence—led to the formation of well-watered soils and river deltas, which in turn attracted migratory game and waterfowl, and subsequently, human populations that hunted them.

In the Anthropocene, the tensions between drastic environmental changes and human ecology in cities have become more salient. Under the simultaneous pressure of rapid urbanization and extreme weather events, many cities have become vulnerable even to small environmental changes. More people now live in informal megacities with inadequate infrastructure and resources, and will be disproportionately impacted by life-threatening climatic events. Conversely, unbridled economic growth in wealthier cities is only likely to exacerbate the already precarious state of the global environmental commons.

Despite uncertainties of climatic change, many cities still aim to meet Sustainable Development Goals (SDGs) as a pathway toward greater flourishing. Flourishing is a term replete with rich meanings. Here, it can be defined as attaining a state where governance, socio-economic institutions and material infrastructure enables and sustains a wide range of human capabilities, such as being able to have good health, to enjoy freedom from violence, and to engage in play or recreation (Nussbaum 33-34). Attaining a wider range of human capabilities is argued to offer better odds of adapting to the unprecedented environmental conditions that cities will likely face in the near future.

The notion of ‘flourishing’ is however not uncontroversial. After all, existing socio-economic inequality and the uneven geographical impact of climate change all but guarantee that dividends of flourishing will be unequally and unevenly distributed. Furthermore, cities are typically net-producers of waste and pollution, and therefore play a significant

role in detracting from the prospect of flourishing. Nevertheless, cities as concentrations of human talents, entrepreneurial innovations and capital investments may still represent the most hopeful prospect toward flourishing.

In this light, cities will need to change quickly from net-consuming to net-producing systems; they must become more sustainable and resilient as fast as possible. Rapidly bereft of their productive hinterland because of higher frequencies of fires, floods, environmental degradation and global supply chain disruptions, many cities today are trying to produce and recycle energy, food, water, vaccines and other necessities either within their immediate geography or through their distant network. For example, in rapid cascade, the city-state of Singapore is planning to satisfy 30% of its nutritional needs internally by 2030, to produce COVID-19 vaccines locally, and to draw on new solar power from Western Australia via an undersea link (see Subhani, for example).

2. The impending focus on human ecology in cities

As cities undertake more elaborate process to secure conditions of flourishing, they are also engaging in the design of their human and urban ecologies. According to Park, human ecology is the interrelation of human beings as biotic, cultural and technological agents engaged in competitive, cooperative and other adaptive behaviors in the urban environment (1). According to this frame from the 'Chicago School', cities are perceived as evolving organisms subjected to processes of growth and decay, health and disease, interdependence, competition and cooperation between different human ecological niches (Judd 3). Human ecology foregrounds the vital interrelationships between the human species and its environment (Steiner 2). On a broader scale, the term 'urban ecology' focuses on organism-environment interactions within cities and other human settlements (4). The connections between human and urban ecology have become tighter because of rapid global urbanization in the Anthropocene. But for the purpose of this article, 'human ecology', as the more encompassing concept, will be used.

Taken as a whole, theories of human ecology employed by the Chicago School researchers are descriptive: they attempt to advance

the scientific understanding of cities by corroborating or falsifying theoretical propositions of urban processes through empirical methods (Judd 5). While this descriptive frame is necessary, it is insufficient for elucidating how adaptive human ecology for flourishing can be designed. One dependable approach of designing human ecology for flourishing is planning.

Although urban planning and development has been largely effective in improving separate and discrete components in the city, it still encounters substantial challenges when beholding the city as a complex system of human ecology. Improving one aspect of an ecological system without considering other aspects in the same system can undermine overall ecological robustness—a "system pathology" (Churchman 12). Rittel and Webber also alluded to the interconnectedness of human ecology in cities when they suggest that every 'wicked' problem that planners try to solve is often the symptom of another problem (165). Cities are also administered by distinct agencies or specialist departments—for instance, health, communication, transportation, food safety, water works, housing, parks and recreation, among others—often in separate and uncoordinated silos even though decisions made in one agency are likely to impact others made elsewhere (Bettencourt 10). Yet recognizing the city as an interconnected system of human ecology made up of overlapping and often competing interrelations and domains offers vital perspectives for effective design intervention.

For example, during the pandemic, public health authorities instruct frequent use of home-based test kits. But the cumulative disposal of these test kits, which are simultaneously biohazardous medical waste and ineradicable plastic waste, end up threatening the environment (Soh). Without accounting for the interconnectedness between public health decisions and their environmental impacts, public health decisions ended up undermining sustainable commitments elsewhere. Paraphrasing Steiner, the perspective of an interconnected human ecology is important for sustainable development (11). Despite this design challenge of wrestling with an interconnected human ecology, the idea of 'designing the human ecological system' is catching on. For example, to remain competitive and attractive to talents and capital, as well as to meet SDGs for the post-pandemic age, municipal leaders in many cities are contemplating how to re-design the human

ecology—creating new governance structures, work-life configurations, sustainable infrastructure and restorative (well-being) amenities, among many other key improvements in human and environmental interrelations (see ellenmacarthurfoundation.org, for example).

3. The controversial roles of learning and intelligence for a flourishing human ecology

If the frame of human ecology is key, then what are the important variables for its design? To address this question, it is vital to examine how human ecologies are different from the natural ecologies of plants and animals. One distinction is the rapidity of self-organized learning in human ecologies. Plants and animals become more adaptive by either modifying their bodies, or else their environment, unconsciously over evolutionary time frame. In contrast, human ecologies can change relatively quickly by conscious decision-making often occurring in rapid feedback cycles. Human ecologies can learn relatively quickly, and they can learn to learn (Bateson 293). Varied mechanisms of learning on different scales within the human ecology rapidly accrete intelligence. Following this, intelligence presents a likely and important variable in the design of human ecology.

For example, early in the pandemic, municipal governments in many places made 'hard choices' on lockdown that adversely impacted individuals and social units at all levels of society. Subsequently, it took less than a year to learn, in tandem with fits-and-starts of locking-down alongside rapid vaccine development, that blanket lockdown was not efficient and should never be used unless absolutely necessary. In turn, and within a relatively short span of time, vaccination-differentiated policies were introduced in place of blanket lockdown. New learning on how to cope with the pandemic is again likely with therapeutic treatments for COVID-19 on the horizon and new scientific discovery on how genes and blood sugar levels play crucial roles in the course of the disease (Ibrahim). Learning leads to the accretion of intelligence, which over time, allows human ecology to adapt more effectively to the uncertain and volatile pandemic environment. How to generate intelligence that can lead to more effective adaptation then appears to

be a key question for flourishing human ecologies.

Even so, what counts as intelligence for effective adaptation is controversial. Intelligence could be used for destructive ends (Sternberg 3). Technologies that leveraged on non-renewable fossil fuels were seen as conduits to more effective adaptation and greater flourishing in the past; but today, this view has become untenable (Dickie). Furthermore, intelligence as the application of useful learning or experience may be deemed by one party to be unambiguously and morally good; but it can still be judged arbitrary, unjust or even cruel by other parties. For example, vaccination differentiated measures—where vaccinated citizens get to access and enjoy urban amenities but where unvaccinated citizens are barred from places and services that they once could access and enjoy before the pandemic—reveal that what may count as useful intelligence nevertheless presents uneven impacts for different individuals even within the same human ecology. Furthermore, this example suggests that what counts as intelligence can also greatly influence, if not also significantly moderate, future ethical values in the city. In other words, and over time, this uneven and unequal treatment of equal citizens before the law not only is normalized but also becomes a precedent backed by legislation. The ethical choice of what intelligence to produce and implement, through learning, appears to be a question that cannot be addressed by intelligence alone.

4. Research questions, significance and aims

Nevertheless, flourishing human ecologies can still be defined by effective rapid learning that can result in actionable intelligence. The following three exploratory questions guide subsequent discussions. First, what counts as intelligence that the city and urban life generate—that is, "urban intelligence" (Mattern 21)? Second, to what extent is the growing implementation of "urban artificial intelligence" (Cugurullo) incipient forms of urban intelligence? And third, how does the use of urban artificial intelligence change individual behaviors, social relations, and even ethics, which in turn moderates how human ecology adapts to an uncertain and volatile environment? What kind of people will we become amid the proliferation of urban artificial intelligence

used to address many of our social needs (see Turkle, for example)? And to what extent is this urban artificial intelligence equitable, or ethical, for a flourishing human ecology? The rapid surge of scientific and technological enthusiasm for producing artificial intelligence has veiled these critical questions on the impact of artificial intelligence on behaviors, social relations and ethics, which are all vital components of a flourishing human ecology.

In this article, I explore one source of urban intelligence as the civic robot. The civic robot is a sub-set of social robots that work alongside individuals and small groups in social settings (Disalvo 58). Unlike intangible computer codes and algorithms, civic robots are tangible and embody artificial intelligence that engage diverse people in communicative exchange and learn from them. In turn, they adapt their behaviors to this learning. Civic robots also collect and produce data, which constitute new areas of learning. Conversely, people also learn from, and adapt to, these robots (Reuters). In this process, people create further innovations through these civic robots. Civic robots join a growing system of other autonomous tangible technologies such as the self-driving cars and buses, and the fully autonomous marketplace (see Amazon Go, for example) in cities. In this article, two civic robots will be discussed. They are namely, Gita and Xavier. While Gita can be described as a cargo-companion robot, Xavier is unambiguously a public surveillance-'sheriff' robot.

This exposition on how civic robots, as a class of urban artificial intelligence, change individual and collective behaviors is significant. While there is growing attention on the social and moral effects of tangible artificial intelligence (see Lyons and Nam, for example), however little is known about the long-term impact of exposure to social robots even as they become more commonplace (Vollmer, et al.). A sampling of previous studies suggests that computational objects can change the way people see themselves and others (Turkle); that people trust erroneous robots (Rutkin); and children can conform to the peer pressure exerted by robots (Vollmer, et al.). In short, people can change their minds and behaviors when interacting with civic robots. Conversely, the choices of what kind of civic robots to design and how civic robots are used not only alter the nature of urban intelligence but also constrain its further development.

The aim of this article is twofold. First, civic robots can confer new power in human ecology. Previous seminal work in human ecology has yet to acknowledge the impacts of urban artificial intelligence in human ecology even when civic robots are slated to perform even more socially significant roles in the near future. This article, written from the perspective of human ecology, therefore serves to acknowledge that the proliferation of urban artificial intelligence in cities is underway, and will in time, impact social relations. In describing this process, this article also projects some of the social promises as well as pitfalls of civic robots. Second, applied philosophical work on artificial intelligence remains fixated on articulating rules or principles that intelligent machines have to abide by, or else establishing a Code that can guide the governance of artificial intelligence technologies (Mittelstadt 501). Incontrovertibly, this is important work. Nevertheless, this literature has largely ignored how urban artificial intelligence shapes in-situ beliefs and behaviors of individuals and social groups in constant interaction with tangible intelligent machines, which in turn can mold their ethic and collective behaviors. In recognizing this important development found in the intersection of tangible artificial intelligence, urban studies, applied philosophy and social theory, this article aims to articulate how one might approach this productive but incipient intersectional space, and offer preliminary resolution on a sampling of its novel issues.

5. Intelligence and urban intelligence

The question of what is urban intelligence must first presume a definition of 'intelligence'. However, 'intelligence' is not an uncontested concept; there are multiple definitions and metaphors of this concept (Sternberg 27). On the question of 'what is intelligence' in the context of this article, Sternberg's summative answer, drawing from his life-long work on this subject, is sufficient. For Sternberg, intelligence is not about problem-solving on a standardized test but instead, it is about problem-solving in the real world (4). And despite multiple definitions of intelligence, all agree on one thing—it must involve the ability to adapt to the environment (79). Therefore, intelligence is no different than "adaptive intelligence" (2). Even so, Sternberg is agnostic on

the moral demands of adaptiveness before historically unprecedented environmental changes and resource scarcities. Is being more adaptive a goal confined to one's community or nation? Or is it one that is characterized by agape, or universal collective well-being, where no one is truly adaptive unless everyone is? In a radically unequal world, can one's greater adaptiveness come at the expense of others? Judging by the inequitable distribution of vaccines—or any other vital resource—in the world, it appears that being more adaptive to pandemic conditions in certain places does come at the expense of risking many lives in other places. Truly, where does the moral requirement of helping others in need prefigure in this picture of adaptive intelligence? Despite its limitations, adaptive intelligence remains the most relevant notion of intelligence in a milieu of unprecedented environmental changes.

Following this, what is urban intelligence? Mattern defines "urban intelligence" as a kind of knowledge that cities foster in their citizens (55). This intelligence is found not only in urban places—community archives and libraries, which are repositories of urban consciousness and intellectual riches (67)—but also live within bodies, minds and communities (69). For instance, and anecdotally, long-time residents of a certain community know where to purchase cheaper but fresher food, and when to rely on a shortcut without following Google Map's directions. This knowledge is considered intelligent because it enables individuals to better adapt to their environment, and is not easily processed or stored as computable information (69). At the communal level, members of a tightly-knitted community are able to identify strangers, and discern their intentions—what Jacobs has referred to as "eyes upon the street" (45). Urban intelligence, according to Mattern, involves, "site-based experience, participant observation, and sensory engagement" (71). Urban intelligence is an embodied capability of living reflective and engaged lives in cities.

Yet urban intelligence is not reducible to what the smart city does. There are multiple definitions of what 'smart' entails. Nevertheless, Sadowski defines 'smart' as being embedded with digital technology for data collection, network connectivity, and enhanced control (ch. 1). The smart city can be framed as a large scale socio-technical system designed to organize, collect, and analyze data, and furthermore, make predictions from data analysis in an attempt to manage and control

individual and collective behaviors in the urban environment. On this, smart cities are merely assemblages of automation; yet taken as a whole, neither automated data-analysis nor predictive decision-making of smart cities constitutes autonomy (Cugurullo). While the former follows prescribed instructions (algorithms) or configured pathways, the latter enables machines to learn and navigate an open and uncertain environment on their own. If civic robots are to proximate urban intelligence, then it should at least demonstrate some degree of autonomous learning.

Might novel forms of urban intelligence then emerge from the interrelation and interconnectedness between civic robots and adaptive people? In other words, how might a human ecology infused with civic robots that are capable of autonomous learning prompt new social behaviors and possibilities, which in turn can develop into more adaptively intelligent reconfigurations of urban living or urbanity (see Suchman, for example)? Mattern neither denies nor affirms this possibility—only that it is important to recognize that urban intelligence does not ways compute (22). Nevertheless, given the rapid introduction of many forms of urban artificial intelligence such as the completely autonomous supermarket, the self-driving car and bus, or civic robots in cities today, it has become important to examine their impacts on human ecology.

6. A tale of two civic robots: Gita (Newcastle) and Xavier (Singapore)

Gita is a compact cargo-carrying robot developed by Boston-based Piaggio Fast Forward (mygita.com) (see Figure 1). Designed to follow the user and to carry his or her cargo, Gita can carry up to twenty-three kg of goods, and move up to six miles per hour, and has a battery life of six hours. And relying on a simple interface, Gita uses an array of cameras to map and pair with the body of the user. Despite crowded places, Gita can still recognize its user through this pairing technology. This simple pairing approach takes into account that many senior citizens neither have access to smart phones nor knowledge of advanced technology.

Gita's capabilities have prompted research of its social potential. The National Innovation Centre for Ageing at Newcastle University tested three Gita robots with users, which included fifty participants over the age of seventy, in March, 2021 (Cookson). Researchers discovered that Gita not only served as a robotic companion that carries a user's cargo, but also promoted a healthier and independent lifestyle because users were found to be walking to shop more frequently. Gita is also programmed to emit soft lights and make endearing sounds that improve affective bonding with users. Moreover, children were found to want to visit their grandparents more when they have a Gita in the house. Officials in Newcastle city are considering how to establish a small fleet of Gita robots that residents can borrow for shopping.

Figure 1. Left: Gita (source: National Innovation Centre for Ageing); Right: Xavier (source: The Straits Times)

On the other hand, Xavier is a robot designed to "weed out 'undesirable social behaviors'" (Kok) [see Figure 1]. Developed by the Home Team Science and Technology Agency (HTX) in partnership with the Agency for Science, Technology and Research in Singapore, Xavier moves around on four wheels patrolling public areas to enhance public health and safety. Xavier is equipped with cameras with 360-degree field of vision and night vision, and has the ability to alert public officers in real time to offences such as errant smoking in public, illegal hawking, and illegal motorcycling and e-scooting behaviors on footpaths. Through machine learning of images and video analytics of errant behaviors, Xavier is able to recognize 'undesirable' behaviors and will broadcast and display warning messages on its frontally mounted screen. According to its designers, Xavier was designed to improve operational efficiency and reduce manpower needs for intensive surveillance and foot patrols (Kok). Furthermore, Xavier also helps to collect real-time data of street-level behaviors, which can help public officers to gain

better insights and allocate manpower resources efficiently.

At the point of writing, Xavier has only been used in a 3-weeks trial in September 2021. The long-term impacts of Xavier especially on citizens' privacy and interrelations, should use of this robot be scaled up, remain unclear. Nevertheless, observers were alarmed that not only might Xavier exacerbate an already intensive surveillance program implemented by the state, but also that there is no legislation in place that can constrain what the state can or cannot do with this specific technology (Agence France-Press).

Gita and Xavier have been selected for analysis for the following two reasons. First, they are, to the author's knowledge, recent and also widely published accounts of civic robotics in international media. For this reason, preliminary data gathered from public reports of these robots could be accessed and analyzed. This is no small advantage in the social research of artificial intelligence. According to Crawford, data from artificial intelligence industries are rarely shared because of privacy issues and the competitive advantage they represent (106). Furthermore, many privately owned artificial intelligence technologies are proprietary systems that preclude external probe or audit (142). While this preliminary data cannot offer a complete picture of these robots, they nevertheless facilitate a nascent examination that can jumpstart further research on (proprietary) civic robots on one hand, and on the other hand, mobilize scrutiny on proprietary systems that operate in the public sphere. Second, Gita and Xavier have been selected for their contrasting positions in civic robotics. While Gita, prima facie, offers to advance autonomy and sociality, Xavier aims to advance control and discipline of the social body. Yet both are presumed to enhance urban intelligence that can enable a more adaptive human ecology. Through their descriptive juxtaposition, new questions concerning power, ethics and social hope important to a flourishing human ecology in cities can be drawn out.

7. The ecological questions of power

Sattarov summarizes four main views of power as episodic, dispositional, systemic and constitutive (13). Power is episodic when

one individual exercises it over the other. Power is dispositional when it is an ability or potential of a person or entity to bring about political, social or moral outcomes. Power can be considered systemic when it is a property of various institutions and networks that create possibilities for the individual to act. Finally, power is constitutive when it produces social agency and actors.

Among these four views of power, dispositional power as the ability or capacity to enact change in the world stands out. Ineluctably, civic robots confer new intelligence to do things that were previously implausible or even impossible. Actionable intelligence is a form of power. For example, in Honolulu, Hawaii, a robot police dog has been used to check on the health status of the unhoused in parks and other public places during the pandemic (Euronews and AP). Knowing the health status of the unhoused during a pandemic permits new policing actions. This was unlikely before the introduction of the robot police dog for reasons of insufficient manpower and safety. Similarly, Gita now makes some degree of autonomy and independent living possible for many senior citizens, as Xavier has made real-time intensive surveillance of public places more tractable.

Civic robots do not just enable new actions, but also through their implementation, collects data on the world. Goodman and Powles suggest that the control of data and data analytics confers systemic regulatory power—permissions to do something, and prohibitions against doing something (482). Furthermore, as Lessig argues, regulatory power often aims to change behaviors (23). Through the collected data of how Gita is being used—for example, how many different trips to various destinations on a daily basis—the private urban lives of users can be captured in fairly vivid details despite imposed anonymity. In turn, this data offers information that can empower corporations to effectively target their advertisements, or be used to mold users' behaviors (Zuboff 7). This prospect of systemic regulatory power is clear. But far less articulated is the ethical direction, as well as the moral nature, of this power for a flourishing human ecology. Regulatory power can progressively permit new sociable categories in human ecology. Conversely, regulatory power can also successively foreclose and even prohibit possibilities within this ecology.

Gita, for instance, is likely to confer power that allows citizens to

live independently, for as long as possible, by offering help and perhaps some semblance of mechanical companionship. And when aggregated and subsequently shared as a fleet of Gita robots, citizens further gain the power to associate with other citizens who are using Gita through building new bonds and friendships. There may be conflicts among citizens when sharing Gita; but there will also be reconciliations when cumulative big data reveals more efficient patterns that facilitate effective sharing. On the other hand, Xavier is likely to confer this power in the direction of the state in the form of enacting continuous and granular monitoring and surveillance. Citizens may well enjoy the power that follows from living and working in a secure environment—but this will come at the expense of their privacy and data rights. Framed along these lines, if Gita permits the power of living independent and healthier lives, then Xavier offers the power to prohibit undesirable behaviors.

8. The ecological questions of ethics

Turkle was acutely aware that people can change when they start to develop increasingly intimate relationships with machines. Indeed, what kind of people will we become—to ourselves and toward each other—in the widespread implementation of civic robots? This is a key ecological question of ethics. Among different possibilities, might using a robot police dog to scan the body temperature of unhoused and vulnerable citizens be deemed as "dehumanizing" (Euronews and AP)? Using a robot police dog then atrophies what Glover calls "human responses" (22): the moral requirement to treat others with dignity and to demonstrate sympathy to their plight. According to Glover, atrocities become easier when such human responses are weakened (35). If robot police dogs can end up atrophying public officers' moral sensibilities for dignity and sympathy, then this technology not only has corroded their professional ethics, but it can also harden social sentiments toward the vulnerable and marginalized. Following this, an unreflective and uncritical use of civic robots especially targeting the most disadvantaged in cities has all the bearings of compounding human misery.

Consider Xavier, which was designed to weed out undesirable social

behaviors such as illegal hawking in Singapore. But might Xavier be re-programmed to distinguish between more and less justifiable illegal hawking activities? After all, there will be disadvantaged citizens with neither access to full-time employment nor employable skills but burdened with family or medical needs, and who end up engaging in illegal hawking activities under these trying circumstances. Can Xavier distinguish this class of hawkers from other illegal hawkers? Without discernment to judge between complex classes of 'undesirable social behaviors', Xavier cannot distinguish categorizing a case of outright felony and a misdemeanor warranting mercy. And without the prospect of mercy, Xavier then risks shaping a culture of automated law enforcement that takes ostensible behaviors as proxies of intentionality. This can only shape human ecology in the direction of dystopic distrust.

Or consider the case of Gita. Paraphrasing Turkle, might Gita as helper-companion to elderly citizens make us less likely to look for other solutions for their care? Formulating this differently, how might successive delegation of duties or obligations that once belonged to the scope of human care to intelligent machines shape people's ethical beliefs and principles? The creation of nursing homes has normalized the ethical belief that it is morally acceptable to relegate the elderly to the care of an alienating institution. In this light, is Gita merely a stop-gap that delays this inevitability, or is it an intelligent machine that ends up only reinforcing this delegatory ethics? By introducing Gita as a cargo robot cum mechanical companion, how is this technology shaping people's moral obligations to the elderly? Indeed, what can be said of the moral quality of a human ecology that normalizes mechanical companionship for the elderly?

Undoubtedly, civic robots such as Gita and Xavier have elicited many more moral questions than satisfactory answers. One possible response may be to take Turkle's warning seriously that autonomous machines do not simply do things for us, but also do things to us. Acknowledging this moral risk in the context of human ecology in cities then permits greater clarity in how civic robots should be designed, and how they might be put to more responsible uses. By imputing and including the impacts of the (human) self into the ecological framework of civic robots, designers may become astute and conscientious of their manifold moral impacts on people.

9. The ecological questions of social hope

In dark moments of human history, hope offers consolation (Ignatieff 21). Hope is the belief—conviction—that the future will be substantively different from, and better and freer than the past (Rorty 120). Whether hope manifests in the form of different vaccines, or in fleeting moments of global solidarity on the immensity of existential challenges that confront humanity, hope constitutes a source of endurance before the unendurable. In turn, people are motivated to develop social relations and institutions that can materialize their targets of hope. Substantive answers to the question, 'What may I hope?' (Kant 538), in the here and now, are therefore paramount to the progressive and sustainable development of human ecologies in the Anthropocene.

Because of the rapid technological advancements made in civic robotics, there has been little reflection, if any, on the nature of social hope that this technology may offer. The dream of civic robots sharing people's manual work, or perhaps completely freeing humans from physical and cognitive labor, is one common but often unspoken social hope. A less common social hope posits that civic robots can become mechanical companions as reliable as a trustworthy human being, and therefore for the first time in human history, people would be free from existential loneliness and helplessness. While these may be enduring forms of social hope, they are nevertheless hopes of the far future. In the here and now, amid eroding solidarities and strident schisms in contemporary society, it is vital to define nearer term hopes that civic robots may confer.

The case of Gita is instructive. As discussed, there are plans to consider using Gita in social organizations, where fleets of Gita can be shared between people who need this technology. Because of its relative novelty, sharing Gita is unlike bike-sharing or car-sharing. In all likelihood, sharing Gita can lead to new conversations between strangers and open new social possibilities. And because sharing practices often expand and bleed into other categories of sharing (Katrini 431), sharing Gita has all the bearings of being transformed into new sharing practices comprising of other resources and services. In other words, Gita can widen the cone of social possibilities for human ecology with every use—offering new courses of action that when

multiplied with how other people are using it, progressively broadens people's moral imagination on what they can do with Gita. In turn, a broadened moral imagination becomes the fertile ground of social hope.

On the other hand, the prospect of social hope is murkier for Xavier. Similar to any highly focused technology, Xavier was specified to perform surveillance and monitoring of public spaces, and to inform infractions where they arise. At least based on reports of the trialled prototype, there are no plans to adapt Xavier for civilian use. Should one then conclude that Xavier is agnostic to new social possibilities? Following this, Xavier is likely to repel civilians as they learn how to avoid its electronic gaze. In time, Xavier may end up forming an interdictory circle defined by its electronic gaze within which social life is both stultified and enacted—conformed—to what the authorities expect. In this way, Xavier is just as likely to drive new adaptations in the human ecology that it surveils. However, is the nature and direction of these adaptations consonant with the original hope of its designers and what a flourishing civil society desires?

10. Conclusion

Civic robots are expected to become more advanced in their capabilities beyond what Gita or Xavier can do today. They are also likely to become more commonplace in the near future, when different forms of civic robots are anticipated to impact human ecology in uneven but significant ways. The arguments in this article suggest that civic robots can be designed to confer power, shape ethics, and constitute new social hope important to a flourishing human ecology. Conversely, civic robots can be designed or used in ways that end up undermining and destabilizing the human ecology. Civic robots embody potential sources of urban intelligence: which kind of civic robots to design, and how they are used within complex human ecology in cities shapes and constrains urban intelligence in ways that cannot be fully apprehended ahead of time.

While it is true that the quality of urban intelligence will depend on how civic robots are used, it is also true that their designs constrain individual and social agency. In other words, the respective design of

the civic robot has already circumscribed, to a large extent, what is and what is not possible. As discussed, Gita appears to have all the likely bearings of expanding individual freedom and collective agency; individuals and social groups are starting to explore how to tap on the manifold social potentials of Gita. On the other hand, Xavier is unlikely to be used for civilian purposes and therefore misses the immense social potential from a bottom-up exploration. In turn, the subsequent development of each of these civic robots changes the nature of urban intelligence that can be produced.

Ineluctably, the key question may be what civic robots to design and what not to design. The civic robot to design is one that when integrated in human ecology, can produce the greatest freedom and agency, and hence, also constructive urban intelligence that further enables political, ethical and material conditions integral to flourishing. This is no easy task. As established earlier, urban institutions and enterprises are rarely concertedly developed in democratic cities. Instead, each is usually driven by vastly different political interests, jurisdictions and specializations, and different institutions only collaborate where common interests can be found. For this reason alone, it may be instructive to first formulate new overlapping areas of common interests between different groups, and then visualize their linkages, before mapping out the contours of their prospective interconnections. From the emergent urban intelligence that follows, it may become clearer which civic robots should be designed, and where these civic robots can be implemented in the most socially hopeful way. The disconcerted euphoria that surrounds radical innovations taking place in civic robotics today may well satiate the demands of talented minds and impatient capital; but it can never hope to satisfy the more exacting requirement of a flourishing human ecology amid an increasingly uncertain and volatile environment.

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