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Who Will Be the Members of Society 5.0? Towards an Anthropology of Technologically Posthumanized Future Societies

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Abstract: The Government of Japan's "Society 5.0" initiative aims to create a cyber-physical society in which (among other things) citizens' daily lives will be enhanced through increasingly close collaboration with artificially intelligent systems. However, an apparent paradox lies at the heart of efforts to create a more "human-centered" society in which human beings will live alongside a proliferating array of increasingly autonomous social robots and embodied AI. This study seeks to investigate the presumed human-centeredness of Society 5.0 by comparing its makeup with that of earlier societies. By distinguishing "technological" and "non-technological" processes of posthumanization and applying a phenomenological anthropological model, this study demonstrates: (1) how the diverse types of human and non-human members expected to participate in Society 5.0 differ qualitatively from one another; (2) how the dynamics that will shape the membership of Society 5.0 can be conceptualized; and (3) how the anticipated membership of Society 5.0 differs from that of Societies 1.0 through 4.0. This study describes six categories of prospective human and non-human members of Society 5.0 and shows that all six have analogues in earlier societies, which suggests that social scientific analysis of past societies may shed unexpected light on the nature of Society 5.0.

Keywords: Society 5.0; cyber-physical societies; technological posthumanization; human-robot interaction; human-computer interface; philosophical anthropology; phenomenological anthropology; posthumanism; Ingarden; Industry 4.0

1. Introduction

The Government of Japan's Society 5.0 initiative seeks to employ emerging technologies to create a "super smart" cyber-physical society that is more "human-centered" (Harayama 2017, pp. 8, 10) than our current information society. However, an apparent paradox exists in any attempt to create a more human-centered society that involves surrounding the society's human members with rapidly expanding quantities and kinds of social robots, artificial agents, and other artificially intelligent entities that do not simply exist as passive tools to carry out the instructions of human operators but are instead able to learn, decide, and act for themselves in increasingly autonomous ways (Government of Japan 2016a, p. 13). Is such a society better understood as being "more" human-centered than past societies or "less" human-centered?

As a step toward resolving this ambiguity in the Society 5.0 paradigm, this study attempts to clarify exactly who will constitute the "members" of Society 5.0. It provides a systematic classification of the diverse types of human and non-human entities that can be expected to participate in Society 5.0, as well as an analysis of the societal dynamics that are leading to the emergence of such entities. By employing a qualitative anthropological approach that draws on (a) the concept of societal

"posthumanization" found within critical and philosophical posthumanism and (b) Ingarden's phenomenologically grounded model of the human being as a three-layered emergent whole, this study shows how the diverse human, robotic, and other anticipated participants in Society 5.0 differ qualitatively from one another and from the members of previous societies. Its categorization and analysis of the prospective membership of Society 5.0 illustrates that while the robotic, artificially intelligent, and technologically augmented human members of Society 5.0 may appear to be radically novel in nature, because of their reliance on futuristic technologies, they are actually the latest examples of categories of societal participants that have existed since Society 1.0 and the earliest human civilizations. It is hoped that this study's investigation of such issues can provide a clearer conceptual foundation for further research into the many ethical, legal, economic, philosophical, cultural, engineering, cybersecurity, public health, and risk-management questions (Government of Japan 2016a, 2016b; Takahashi 2018) raised by Japan's efforts to realize Society 5.0.

1.1. Japan's Strategic Initiative to Bring about "Society 5.0"

As part of its Fifth Science and Technology Basic Plan, in 2016, the Government of Japan (2016a, 2016b) announced its intention of realizing "Society 5.0", a transformative and strategically critical next stage in the development of Japanese society that will involve "merging the physical space (real world) and cyberspace by leveraging ICT to its fullest" (Government of Japan 2016a, p. 13), thereby providing "a common societal infrastructure for prosperity based on an advanced service platform" (Iwano et al. 2017, p. 1). Japanese governmental agencies, universities, and businesses are actively collaborating in development and implementation of the Society 5.0 paradigm (Government of Japan 2016b; Harayama 2017; Prasetyo and Arman 2017; Shibata et al. 2017; Ding 2018; Ferreira and Serpa 2018; Fujii et al. 2018).

1.1.1. Society 5.0's Application of the Industry 4.0 Paradigm

As Ferreira and Serpa (2018) explain in their review of the state of thinking on Society 5.0, Japan's Society 5.0 initiative is grounded in the "Industry 4.0" paradigm (Gorecky et al. 2014; Lasi et al. 2014; Kang 2018) that was developed in Germany in the first half of this decade. In essence, Society 5.0 seeks to take the rapidly evolving technologies that Industry 4.0 employs for production within businesses and to integrate them more deeply into the everyday lives of ordinary people. While manifestations of the Industry 4.0 paradigm focus on applying emerging technologies to enhance organizations' effectiveness, efficiency, and (ultimately) financial performance, the Society 5.0 initiative seeks to counterbalance that commercial emphasis by applying emerging technologies relating to social robotics, embodied AI, the Internet of Things, ambient intelligence, augmented and virtual reality, and advanced human-computer interfaces to qualitatively enhance the lives of individual human beings and to benefit society as a whole. If the Industry 4.0 paradigm is understood as focusing on creation of the "smart factory" (Hozdić 2015; Ferreira and Serpa 2018), then Society 5.0 is geared toward creating the world's first "Super Smart Society" (Government of Japan 2016a, p. 11, 2016b; p. 1; Iwano et al. 2017, p. 1; Harayama 2017; Ferreira and Serpa 2018).

1.1.2. Goals of the Society 5.0 Initiative

The goals of the Society 5.0 initiative are ambitious. As Bryndin (2018, p. 12) notes, the aim of Society 5.0 is nothing less than the "creation of equal opportunities for all and also providing the environment for realization" of each individual's potential; to that end, Society 5.0 will employ emerging technologies "to remove physical, administrative and social barriers to self-realization of the person". Similarly, Keidanren (2016, p. 10), the Japanese Business Federation, envisions that in Society 5.0, "Every individual including elderly people and women can live [a] safe and secured comfortable and healthy life and each and every individual can realize his/her desired lifestyle". The technologies of Society 5.0 are expected to not simply provide the minimum services needed for individuals' survival but to make life more meaningful and enjoyable; within Society 5.0, human-

technology interaction will be harnessed to "provide a sustainable, vibrant, livable people-centric world" (Medina-Borja 2017, p. 235).

Society 5.0 is also designed to bring economic benefits for individuals: by "providing the necessary goods and services to the people who need them at the required time and in just the right amount", Society 5.0 will "facilitate human prosperity" (Government of Japan 2016b, p. 1)—supported by enhanced legal regimes and education that will allow "Dynamic engagement of all citizens in the new economy and society" made possible by emerging technologies (Keidanren 2016, p. 14).

Beyond enhancing the lives of individual citizens, it is hoped that realization of the Society 5.0 paradigm in Japan will also benefit the nation as a whole: the digital-physical infrastructure of Society 5.0 will be "able to respond precisely to a wide variety of social needs" and will create "a society in which all kinds of people can readily obtain high-quality services, overcome differences of age, gender, region, and language, and live vigorous and comfortable lives" (Government of Japan 2016b, p. 1). Moreover, emerging technologies will be harnessed to solve problems relating to a dramatically aging society, a shrinking population, and natural disasters in order to realize a "rich and vigourous future" (Keidanren 2016, p. 10). Ways in which implementation of the Society 5.0 paradigm might simultaneously yield social, economic, and ecological benefits that enhance a society's sustainability and stability have been explored, for example, by Bryndin (2018).

1.1.3. Riskiness of the Society 5.0 Initiative

The Government of Japan (2016a) acknowledges that the Society 5.0 initiative is a conscious effort to push discontinuous innovation and the development of high-risk, high-reward technologies; there is a significant likelihood that some attempts to develop and implement Society 5.0 technologies will end in costly failure. Moreover, even if the envisioned technological platforms can be effectively implemented, there is a danger that their use by citizens may yield detrimental side-effects. For example, Takahashi (2018, p. 119) investigates the possibility that Society 5.0's ubiquitous smart systems may create new risks of addiction similar to those already seen in "internet addiction, online video game addiction, and smartphone addiction"—while simultaneously exploring the possibility that Society 5.0's novel technologies might also offer new means for preventing or treating addictions.

The Government of Japan (Government of Japan 2016a, 2016b) also recognizes major cybersecurity concerns that will be exacerbated by the diversity and heterogeneity of human participants in Society 5.0 and the integration of growing numbers of devices into the Internet of Things. As human beings incorporate networked technologies and devices ever more deeply into their bodies, minds, and daily routines in Society 5.0—resulting in a "high degree of merging between cyberspace and the real world"—the danger increases that successful cyberattacks might have direct and catastrophic effects on people's lives (Government of Japan 2016a, p. 14).

1.1.4. Society 5.0's Dependence on Transformative Future Technologies

The technologies needed to implement the Society 5.0 paradigm do not yet fully exist; creating them will require further advances in a wide range of fields. For example, the Government of Japan's plan (2016b) notes that Society 5.0 will feature enhanced forms of robotics, AI, nanotechnology, and biotechnology, an enhanced Internet of Things, and further exploitation of Big Data. In light of that reality, Kitsuregawa (2018) has investigated the need (and potential) for Society 5.0 platforms to employ Big Data approaches that can successfully handle the vast quantities of data generated by the Internet of Things, while Prasetyo and Arman (2017) have explored the role of next-generation group management systems in providing a "smart society platform" for Society 5.0.

From the Government of Japan's perspective (Government of Japan 2016a, pp. 11–12; 2016b, p. 1), continually pushing the boundaries of knowledge and technology constitutes "the roots of social transformation" and has the ability to create "groundbreaking value"; it expects that the permeation by emerging technologies of all spheres of life will "promote economic growth, the formation of a healthy and long-living society, and social transformation". However, the unpredictable, disruptive potential of such technologies is not unreservedly positive: Salgues (2018) suggests that the emerging

technologies that make implementation of the Society 5.0 vision possible (especially those relating to robotics, AI, networked digital platforms, and 3D printing) can generate both societal improvement as well as societal tumult, causing some long-established industries to rapidly vanish while unexpected new industries materialize to take their place. Indeed, the Government of Japan itself acknowledges (2016b, p. 1) that emerging technologies have already given rise to an "era of drastic change" in which structural alterations to social and economic reality are occurring almost daily.

1.1.5. Society 5.0 as the Ultimate Cyber-Physical Society

Both Industry 4.0 and Society 5.0 are premised on the creation of increasingly sophisticated "cyber–physical systems", which are characterized by their reliance on embedded, decentralized, real-time computation occurring within a network of heterogeneous physical objects (Gill 2008; Wang et al. 2008). When human beings (or social robots or AIs) are functionally integrated into a cyber-physical system (CPS) at the social, cognitive, and physical levels, it becomes a "cyber-physical-social system" (CPSS) (Liu et al. 2011) whose members may engage in "cyber-physical-social behaviours" within cyber-physical spaces (Ren et al. 2018). Through their interactions with one another, the members of a CPSS may give rise to "cyber-physical social networks" whose topologies follow the members' social connections (Ganti et al. 2008).

Even prior to explicit formulation of the Society 5.0 paradigm in Japan, it had been suggested that the growing use of cyber-physical systems would eventually generate impacts that extend beyond companies' internal industrial operations to transform society as a whole. For example, Monostori (2014, p. 11) suggested that if cyber-physical systems were harnessed to enhance human quality of life on a large scale, they may result in the creation of a "cyber-physical society, which already includes human, social, cultural spheres as well, above the physical- and cyber spaces". Likewise, Zhuge (2010, p. 1) argued that, "With the rapid development of information technology, the cyber space is connecting physical space, social space and mental space to form a new world—Cyber Physical Society". Such notions of "cyber-physical society" might be seen as conceptual forebears of the Society 5.0 paradigm that has now been developed within Japan—as well as of the similar concept of "Societies 5.0" that has been formulated independently by Wang et al. (2016) and Wang et al. (2018) in a manner that also builds on the concept of cyber-physical-social systems but is not directly related to the Japanese Society 5.0 paradigm.

Ferreira and Serpa (2018) make the link between cyber-physical systems and Society 5.0 explicit when they highlight Medina-Borja's assertion that the "new realm" of Society 5.0 will encompass a "cyber-physical world" that functions almost symbiotically alongside "the human world" (Medina-Borja 2017, p. 235). Yasuura (2017, p. 221), too, explicitly describes Society 5.0 as a society that has truly become a "Cyber-Physical System" that "is the mixture of the real world and the cyber world connected by ICT"; such cyber-physicalization of its world helps distinguish Society 5.0 from the four preceding stages of human society.

Indeed, Society 5.0 is premised on a "deepening of technological integration" that supports "collaboration, co-creation and human-machine interaction" (Ferreira and Serpa 2018, pp. 27–28). More specifically, it expands Industry 4.0's pursuit of "an integration between technology, virtual space and the human being, between the real world and the virtual world" (ibid., p. 27). As Medina-Borja (2017, p. 235) explains, in future societies, human beings and their natural and artificial environments will thus become "melded at multiple temporal and spatial scales" to create "cognitive cooperative systems" and "human-technology partnerships".

1.2. The Diversified Membership of Society 5.0

Society 5.0 will be increasingly diverse (Government of Japan 2016a); however, such diversity does not simply involve the inclusion of human beings from different backgrounds. Thanks to its profoundly technologized, cyber-physical nature, Society 5.0 will be able to incorporate into its societal structures and dynamics types of beings that had not previously been found within the world's societies. As the Government of Japan (ibid., pp. 13–14) explains, "In order to realize a super smart society, it is necessary to connect various 'things' via a network, create highly advanced

systems out of these things, and integrate several diverse systems so that they can coordinate and collaborate with each other"; in Society 5.0, the world's countless disparate "things" will become integrated into coherent "systems" via cyberspace.

More particularly, at first glance, consideration of the diversified nature of Society 5.0 suggests that it will involve at least two new types of "members" that were not present in any past human society, as discussed below.

1.2.1. Autonomous Robots and AIs as Participants in Society 5.0

Beyond its human members, Society 5.0 can be expected to include many types of non-human intelligent social actors as "participants" or even "members". For the foreseeable future, such artificial entities are not expected to merit or receive recognition as moral subjects (e.g., moral agents) or political persons (e.g., citizens) in the way that human beings are (Wallach and Allen 2008; Gunkel 2012; Sandberg 2014). Nevertheless, such artificial beings would appear not simply to be passive "tools" or anonymous parts of the environment; it seems possible that they might be capable of acting as true (if limited) non-human participants in society, in the same way that house pets and working animals have long been an integral part of human society in many parts of the world (Cohen 2002; Haraway 2003; Charles and Davies 2011).

Indeed, just as Society 1.0 and Society 2.0 were defined largely by their incorporation of wild animals and domesticated animals into humanity's societal structures and processes (Government of Japan 2016b; Harayama 2017; Yasuura 2017), it appears that Society 5.0 will differ from Society 4.0 largely by welcoming into itself a bewildering array of highly sophisticated social and emotional robots, embodied AI, nanorobotic swarms, artificial life, self-organizing and self-directing computer networks, artificial agents manifesting themselves within virtual worlds, and other artificial types of intelligent cyber-physical social actors.

While emerging technologies make the incorporation of diverse types of artificially intelligent entities into society *possible*, it is unfavorable demographic and economic realities that are seemingly making it *necessary:* Japan's decreasing birth rate and "hyper-aging society" (Government of Japan 2016a, p. 61) create an urgent need to address the country's declining labor productivity (Harayama 2017). There are not enough human beings capable of performing needed services; as a result, robots and embodied AI will play increasingly large roles in Society 5.0, thereby "shaping economic growth" and ideally contributing to "a healthy, long-lived society, which will lead to further social transformation toward realizing an abundant society in which each individual can live a vigorous life" (Government of Japan 2016a, p. 13).

The Government of Japan (ibid.) envisions that Society 5.0 will be "an environment in which humans and robots and/or artificial intelligence (AI) coexist and work to improve quality of life by offering finely differentiated customized services that meet diverse user needs". Such accelerating use of increasingly intelligent robots will no longer be confined to manufacturing but will play growing roles in "various fields such as communication" and "social service/work assistance" (ibid., pp. 17, 24, 54). Unlike the types of robots found in our contemporary Society 4.0, the robots of Society 5.0 will not simply serve as passive tools that require elaborate programming and wait to receive instructions from their human operators; rather, the robots, AI, and other automated systems and devices of Society 5.0 will demonstrate an increasing degree of autonomy (ibid., p. 13)—proactively gathering data from the environment, making decisions, and acting in order to provide beneficial services to human beings.

1.2.2. Technologically Altered Human Beings as Participants in Society 5.0

The human beings who are members of Society 5.0 will also find their bodies, minds, and daily life experiences transformed through the application of futuristic technologies. New types of medical devices and regenerative medicines and ongoing advances in neuroscience, robotics, AI, and the Internet of Things "will have a great impact on not only people's lifestyles" and on their way of being but also on "the foundation of its existence" (ibid., pp. 3, 22). Likewise, people will spend more time immersed in and actively exploiting cyberspace, as growing deployment of human-computer

interfaces that incorporate "augmented reality, affective engineering, neuroscience" and other techniques and insights will create an environment in which "the 'real world' and cyberspace have become highly integrated" (ibid., pp. 11, 17, 26). Such deep integration of emerging technologies into people's lives is meant not only to provide the sustenance and care needed for their survival as biological organisms but also to "guarantee citizens' richness in minds and high-quality way of life" (ibid., p. 7). In essence, Society 5.0 is the ultimate realization of the vision of a future high-tech networked society in which technologically supported human participants engage with robots, AI, and virtual entities in rich and beneficial ways that was explored in Japanese speculative fiction as early as the late 1980s (Shirow 2009).

Insofar as not all kinds of augmented reality and immersive VR technologies, neuroprosthetic implants, nanorobotic medical systems, and other transformative technologies will be needed or desired equally by all citizens, it can be expected that the diverging manner and degree of the use of such technologies will create increased diversity among the human members of Society 5.0; in its most extreme form, the uneven utilization of such technologies might even cause a society to fragment into numerous subsocieties that share the same geographical space but occupy psychological, cultural, and technological spaces (and "cyberspaces") that have little or no overlap between them (McGee 2008; Warwick 2014; Rubin 2008; Norberg-Schulz 1980; Erk and Uluoğlu 2013).

1.3. The Uncertain Place of Human Beings in Society 5.0

As Ferreira and Serpa (2018) suggest, the large-scale societal change represented by the integration of artificially intelligent social actors into human society brings with it considerable new practical, ethical, and security challenges. After all, it is one thing for specially trained employees of an Industry 4.0 company to spend a limited amount of time interacting with social robots or AIs within a specially prepared workplace environment in order to carry out some narrowly defined work-related task (Bradshaw et al. 2009; Gorecky et al. 2014); it is something different for millions of ordinary individuals—from children to the elderly—to incorporate such intelligent, social, artificial entities into their homes, their daily routines, and the most intimate aspects of their lives.

One particular locus of ambiguity in the Society 5.0 vision relates to the exact role that human beings will play within it: it seems possible that the diverse types of robots, advanced AI, sentient computer networks, responsive smart environments, and other non-human intelligent social actors who become incorporated into Society 5.0 will not only do work that had been previously performed by human beings but in some cases may possess physical, intellectual, emotional, and social capacities that exceed those of the human beings whom they are tasked with serving. Such a society will include at least two distinct sources of sensing, deciding, and acting: the natural "bioagency" possessed by human beings and the artificial "cyberagency" possessed by robots and AI (and, potentially, by neuroprosthetically augmented human persons) (Fleischmann 2009).

With aggressive pursuit of the Society 5.0 initiative, previously abstract and theoretical concerns about the respective roles of human beings and artificial entities in society become increasingly real. Indeed, the Government of Japan's aim in pursuing the Society 5.0 paradigm is to ensure a "prosperous human-centered society" (Harayama 2017, p. 10)—which suggests that while the Government will strive to maintain human beings' position at the *core* of society, they will not necessarily be *alone* within it. Harayama (2017, p. 10), a scientist and government official who played an important role in the development of the Fifth Science and Technology Basic Plan, appears to acknowledge that it will be a challenge to ensure that "we humans […] remain central actors" in a Society 5.0 that is so radically transformed by digitalization and innovative technologies; rather than allowing technological advances to determine the shape and character of society, it will be necessary to continually "focus on the word 'society' as the foundation for human life", which involves "focusing on how to build a society that makes us happy and provides a sense of worth".

1.4. Research Questions and Objectives

The Government of Japan (2016a, p. 62) recognizes the complex legal and ethical questions involved with implementation of transformative technologies such as those that provide the

foundation for Society 5.0. Likewise, Ferreira and Serpa (2018) note the urgent need for a broader discussion of the Society 5.0 initiative and its potential positive and negative implications. We would suggest that before attempting to investigate such issues in detail, a useful preliminary step is to clarify exactly what types of human and non-human beings can be expected to participate in Society 5.0 and to identify their distinguishing characteristics. To that end, this study posed the following research questions:

1. How do the diverse types of human and non-human members that are expected to participate in Society 5.0 differ qualitatively from one another?
2. How can we conceptualize the societal dynamics that will cause Society 5.0 to possess a different membership and makeup than our contemporary Society 4.0?
3. How do the anticipated members of Society 5.0 differ qualitatively from the members of Societies 1.0, 2.0, 3.0, and 4.0?

To address those questions, this study formulated and applied two conceptual frameworks: (1) a posthumanist anthropological model of human history in which Society 5.0 represents an emerging stage of the world's "technological re-posthumanization"; and (2) a phenomenological anthropological analysis of Society 5.0 as a combination of particular types of "natural" biological human beings, artificially augmented human beings, and metahuman, epihuman, parahuman, and nonhuman beings. These frameworks are meant to provide tools that can be employed in future interdisciplinary study of Society 5.0. They are offered as a response to the Government of Japan's recognition (2016b, p. 1) that the successful development of Society 5.0 is not simply an IT engineering challenge but will require insights from "all fields of humanities, social sciences, and natural sciences".

2. Methodology and Theoretical Background

This study relied on the gathering, analysis, and synthesis of secondary data in the form of published scholarly texts, and it employed a cross-sectional time horizon and purposive non-probability sampling method. As placed within the spectrum of research methodologies discussed by Bryman (2016) and Creswell and Creswell (2018), this study utilized an inductive approach, qualitative methodology, and phenomenologically-based research philosophy, which—while not yielding the same type of "reliability" or "validity" sought in positivist quantitative approaches (Golafshani 2003)—is capable of generating results with significant trustworthiness, credibility, relevance, and confirmability (Lincoln and Guba 1985).

In order to carry out this study's analysis of the anticipated membership of Society 5.0, it was necessary to rely heavily on two resources: (1) the anthropological concept of the "posthumanization" of societies recently developed among some philosophical and critical posthumanists; and (2) Ingarden's anthropological model of the human being as a three-layered emergent whole. Insofar as the former remains poorly defined in the existing literature and the latter is little-known outside of the Polish-speaking world, both are presented in some detail below.

2.1. The Anthropological Concept of the "Posthumanization" of Societies

2.1.1. Distinguishing "Posthumanization" from "Posthumanism"

"Posthumanism" can be understood as a diverse collection of scholarly approaches that seek to analyze phenomena in a way that breaks down traditional conceptual binaries such as those of "human vs. non-human" and "natural vs. artificial". Posthumanist scholarship seeks to "de-anthropocentrize" our study of societies by arguing, for example, that a society not only includes its human members but also non-human members such as our house pets or mythical or legendary figures whose existence we half-believe in. Posthumanism as a distinct and explicitly formulated academic approach is a recent invention: its origins are often traced to Hassan's reference to an emerging "posthumanist culture" in a 1977 journal article (Hassan 1977), and it developed rapidly in the 1980s, eventually giving rise to variants such as "critical posthumanism" (Herbrechter 2013), "cultural posthumanism" (Miah 2008), and "philosophical posthumanism" (Miah 2008). Among its

better-known theorists, practitioners, or proponents are scholars such as Badmington (2006), Ferrando (2013), Graham (2002, 2004), Haraway (1985, 1991, 2003), Hayles (1999, 2005), Herbrechter (2012, 2013), and Roden (2014).

The phenomenon of "posthumanization" is something related but distinct: it encompasses those processes or dynamics that are actually at work in a given society that have the effect of blurring the practical barriers between human and non-human and between the natural and the artificial and that cause the society to become de-anthropocentrized. The result of such dynamics is a society that has become at least partially "posthumanized". The processes of posthumanization would have existed in the world even if posthumanization as an academic approach had never been created, and the dynamics of posthumanization can be studied using either posthumanist or non-posthumanist research methodologies.

2.1.2. Defining Posthumanization

While many definitions of "posthumanism" have been formulated and debated, attempts to develop clear definitions of "posthumanization" remain rare. Those few texts that make explicit reference to the concept of posthumanization sometimes do so in passing, without specifying in detail what is meant by that term in the given context (Krustiyati 2012; Trendel 2017).

A few scholars, however, have attempted to develop richer and more nuanced accounts of what is meant by "posthumanization". For example, Herbrechter describes the dynamic of "posthumanization as the disappearance of the modern metanarratives of the Enlightenment and human emancipation" (Herbrechter 2013, p. 78). Herbrechter's understanding of posthumanization has been taken up and analyzed, for example, by (Dönmez 2016).

A review of the (extremely limited) existing literature on posthumanization makes it possible to identify three related strains of thought, all of which are relevant to posthumanization in the context of Society 5.0. These are (1) human-machine partnership, (2) human-machine integration, and (3) expansion of societal membership as manifestations of posthumanization.

2.1.3. Human-Machine Partnership as Posthumanization

The phenomenon of "posthumanization" is often identified with those processes by which contemporary human beings are growing to collaborate with computerized systems in ever more frequent, meaningful, and intimate ways. Hansen (2001, p. 63) suggests that such processes are eagerly welcomed by at least a portion of humanity, discussing "an embrace of a radical, technical posthumanization" that is seen as being diametrically opposed to "a resistance to humankind's fall into technology". Similarly, Poster (2004, p. 92) writes that "The new economy is one not of humanization but of posthumanization, of the deep symbiosis of humans with machines. [….] The digital economy […] organizes production around the partnership of humans with information machines".

2.1.4. Human-Machine Integration as Posthumanization

For other thinkers, the processes of "posthumanization" go farther and deeper than mere "collaboration" or "interaction" between human beings and machines. In particular, the concept of "posthumanization" is sometimes identified with the ongoing processes of "cyborgization" by which human beings are incorporating computers ever more deeply into their lives, minds, and bodies. Thus, Herbrechter (2013, p. 3) refers to "the current technology-centred discussion about the potential transformation of humans into something else (a process that might be called 'posthumanization')"; elsewhere, in discussing the account of "the continuing 'technical mediation' of the human" developed by Brewster et al. (2000, p. 9), Herbrechter identifies the process of "becoming-machine" with "cyborgization as the one, predominantly contemporary, form of posthumanization" (Herbrechter 2012, pp. 51–52). Similarly, in discussing Smelik's (2017) analysis of film and the posthuman, Clarke and Rossini (2017, p. xix) find cinematic depictions of cyborgs an embodiment of "profound desires for 'posthumanization' through fusion with machines and their technologies".

While the physical neuroprosthetic augmentation of human beings' bodies is one example of such posthumanization, it can also occur through human–machine integration functioning at a cognitive rather than a physical structural level; thus, Kim notes that "based on complex computational infrastructures, the technical distribution of cognition adequately posthumanizes humans even without including the transformation of the biological body" (Kim 2017, p. 398).

2.1.5. Expansion of Societal Membership as Posthumanization

For some scholars, the processes of "posthumanization" are not restricted to changes occurring in the minds or bodies of human beings; rather, human society as a whole can undergo a process of posthumanization (and become "posthumanized") even if no changes are made directly to the "internal architecture" of human beings—through the act of incorporating increasingly numerous, intelligent, and capable artificial beings into that society in the form of social robots, embodied AI, nanorobotic swarms, sentient computer networks, and other bearers of non-human agency. It is this type of posthumanization that makes it possible for some to "fear that the human race will become extinct due to posthumanization", as Kim (2017, p. 396) observes, before elsewhere arguing (p. 410) that "Consideration of the posthumanization of the human must expand further from the human cyborgization based on the anthropo-individual-centric liberal humanism".

Some concepts of posthumanization explicitly recognize that the phenomenon can manifest itself *either* through changes in human beings *or* in changes to the society that exists around them. For example, definitions have been proposed that describe the phenomenon of posthumanization as those processes "by which society comes to include many different types of intelligent social actors—beyond just natural biological human beings—who seek to perceive, interpret, and influence their shared environment and who create knowledge and meaning through their networks and interactions" (Gladden 2017, p. 143) and that assert that "The processes of posthumanization are those dynamics by which a society comes to include members other than natural biological human beings who, in one way or another, contribute to the structure, activity, and meaning of the society" (Gladden 2018, p. 31). Such a concept of posthumanization has been elaborated and applied, for example, by Grove (2018), in his reconceptualization of the field of knowledge management in the context of increasingly prevalent forms of artificial agency and "planetary-scale computation".

In this understanding, a society may become posthumanized as some of its human members augment themselves cognitively and physically through advanced cybernetic technologies (and thus cease to be simply "natural biological human beings") *or* as robots, AI, and other non-human intelligent social actors become incorporated into the society. Such a view is suggested, for example, by Pastourmatzi (2017, pp. 41, 43), who in a reflection on the fiction of Bruce Sterling cites both the artificial augmentation of human beings' natural biological brains and the potential future appearance of highly intelligent "nonhuman postbiological entities" that replace human beings as earth's dominant species as examples of "posthumanization".

2.1.6. Posthumanization in the Context of Society 5.0

Building on and synthesizing the perspectives presented above, the future Society 5.0 can be understood as "posthumanized" insofar as it is a vast, complex cyber-physical-social system that encompasses more than simply natural biological human beings as members and participants, as illustrated in Figure 1. This study's identification of the full universe of those participants and characterization of their differing natures are presented in the Results section below.

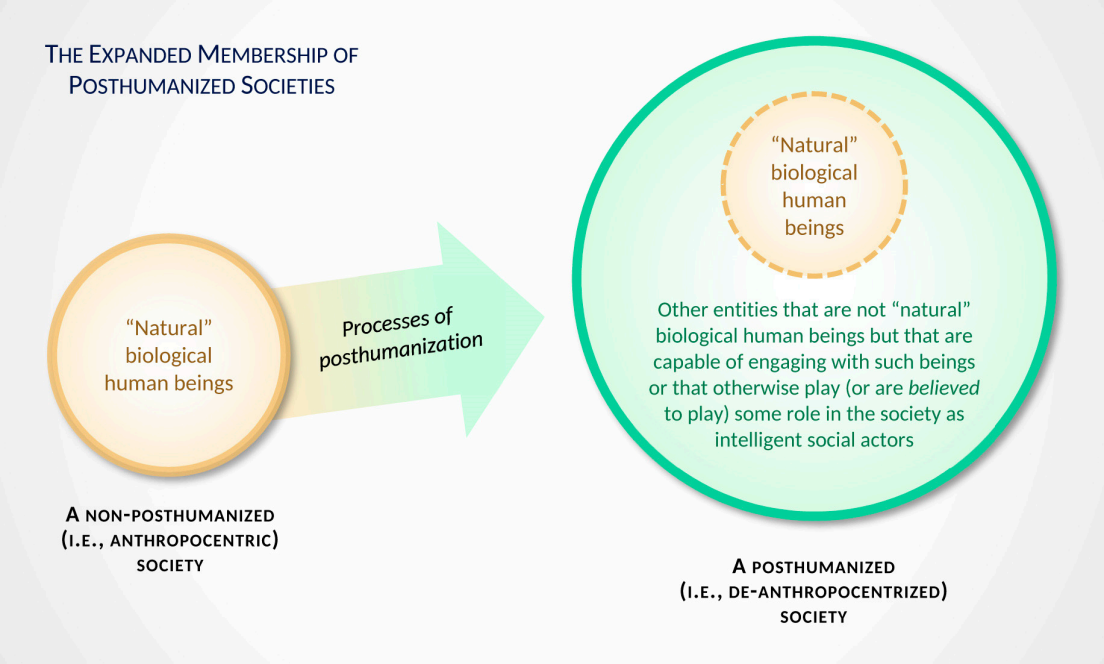

Figure 1. A society that has become "posthumanized" no longer has natural biological human beings as its sole members and participants.

2.2. *Ingarden's Anthropological Model of the Human Being as a Three-Layered Emergent Whole*

In order to categorize, describe, and compare the types of "ordinary" human, "otherly" human, and non-human beings that may become members of Society 5.0, this study relied on the anthropological model of the human being developed by phenomenologist Roman Ingarden, a student of Husserl who is considered one of Poland's greatest 20th-century philosophers, as well as one of the most influential figures in Polish cybernetics (Sienkiewicz and Wojtala 1991). His lifetime of research was driven to a great (though often underappreciated) extent by his interest in philosophical anthropology (Półtawski 1978). While grounded in classical ontology and phenomenology, Ingarden's model of the human being as a particular type of "relatively isolated system" also draws extensively on systems theory, theoretical biology, and developments in modern neuroscience. Ingarden developed his model through a number of works (Ingarden 1957, 1960, 1961, 1964, 1965b, 1968, 1974), with its most robust and mature formulation being presented in an exploration of the basis of human freedom (1970).

2.2.1. The Physical Body, Sensory-Emotional "Soul", and Intentional «I»

Within Ingarden's (1970) anthropological framework, the human being can be understood as an emergent whole that comprises three layers or spheres: (1) a physical body, which is identified with a person's "biological organism"; (2) a "soul" that is the site of unconscious (or preconscious) sensory experiences, emotional states, and personality; and (3) an «I» that enjoys a stream of conscious awareness and is capable of diverse forms of "intentionality" (Sokolowski 2000), including acts of thought, reasoning, and volition. The soul is continuously experiencing the totality of sensations and emotions produced by the body's interaction with the environment; however, in any given moment, the intentional «I» focuses its conscious attention on at most a small portion of the contents of the soul (Ingarden 1970).

Despite its reference to a "soul", Ingarden's model is not dualist but arguably emergentist: he contends that neither the rich experiences of the sensory-emotional soul nor the nuances of thought of the conscious «I» can be reduced simply to physical activity within the body; nevertheless, the body provides the "ontic fundament" (Ingarden 1960, 1961, 1964, 1965a, 1965b) from which the soul arises, and the «I» arises from the soul as the organizing center that personifies it and speaks on its

behalf (Ingarden 1970, p. 92). Ingarden's model might thus be compared with contemporary emergentism of the sort formulated by DeLanda (2011).

2.2.2. The Importance of Semipermeable Boundaries and Partially Sheltered Spaces

For Ingarden, the body is essentially a set of semipermeable membranes that allow some causal influences from the environment to enter a person's "soul" and be experienced by it, while selectively blocking other environmental phenomena from being experienced (Ingarden 1970, pp. 84–85). Similarly, the mind's filtering mechanisms relating to memory and attention ensure that in any instant, the «I» of conscious awareness is able to focus on only the tiniest portion of all that the soul has experienced during one's life, allowing one to think clearly without being subjected to an ongoing flood of distractions (Ingarden 1970, pp. 87–89, 95–96).

As human beings, the interaction of our rich array of semipermeable physical, emotional, and intellectual boundaries creates an ultimate interior space—the «I» of conscious awareness—that is both partially exposed to and partially sheltered from the influence of other human beings and the surrounding environment; it is this complex regulation of our engagement with the ultimate reality of the world that makes us who we are. Ingarden's three-layered model may be understood as a sort of ontologically and phenomenologically grounded philosophical anthropology, situated within the context of other multilayered, phenomenologically-based accounts of the human being such as those developed by Scheler (Scheler 1927; Geniusas 2015) and Stein (Stein 1917, 1922, 1998; Sawicki 2000); Ingarden (1960) acknowledges the influence on his thought of Scheler's analysis of the human person.

2.2.3. The «I» from a Posthumanist Perspective

Reference to the concept of an intentional «I» may appear controversial in an analysis of posthumanized societies, as posthumanist thought (broadly understood) includes not only "neohumanist" thinkers (Herbrechter 2013; Wolin 2006; Nealon 2008) who seek to salvage the human subject but also post-structuralist "antihumanist" thinkers (Ferrando 2013; Herbrechter 2013) who have proclaimed the death of the intentional self. For purposes of this study, though, reference to the «I» can be understood as a descriptive tool rather than a metaphysical claim. Thus, the everyday experience of suddenly becoming consciously aware of an ongoing sight, sound, or smell that one had previously not "noticed" might be described from an Ingardenian perspective as "stimuli having passed from the soul of raw experience 'into' the «I» of conscious attention"; here it is not particularly relevant whether that is taken literally or only metaphorically.

In this regard, Ingarden's model might be compared to Deleuze's two-layered anthropological model of the human being, illustrated in his allegory of the "Baroque house" (Deleuze 1993). Ingarden's model is thus by no means the only way in which potential participants in Society 5.0 might be categorized; however, we would suggest that it offers one useful approach for systematically drawing such distinctions.

2.3. The Diverse Spectrum of Entities Considered (Potential) Participants in Society

It should be noted that this analysis identifies as potential "participants" in a society many entities that would not be considered participants in other research contexts. If, for example, one is analyzing a given society from an epidemiological perspective, one might include as relevant "participants" in the society not only its human population but also insects, birds, rodents, and other creatures making their homes in and around human settlements that are capable of serving as disease vectors; however, one would not include corporations. Conversely, if one is analyzing a society to understand the economic impacts of the distribution of its tax burden, non-human creatures would be ignored but corporations would be considered relevant participants, insofar as they are legal persons whose financial activities are distinct from those of their human officers and employees.

Corporations (along with "cities", "states", "flags", "money", mythological and fictional characters, and many other types of entities) are what Ingarden (1931, 1957, 1960, 1961, 1964, 1965a, 1968) refers to as "purely intentional objects": they can indeed be said to "exist" in a particular and

limited fashion—but as mental constructs that depend on human consciousness for their existence in a way that raw physical matter does not. Although their mode of being as purely intentional objects differs radically from that of real human beings or other biological organisms, for purposes of this study's phenomenological anthropological analysis, even obviously folkloric or fictional characters such as Bilbo Baggins, Cinderella, Dracula, Godzilla, Sherlock Holmes, Harry Potter, Mr. Spock, and the Tooth Fairy can be understood to "participate" in a human society by meaningfully influencing the course and contents of activity within it. Echoes of the Ingardenian concept of purely intentional objects may be found in the (nevertheless quite different) contemporary concept of "memes" (Dawkins 1989; Bouissac 1992), which attributes a certain limited type of being and agency to political and religious ideals and literary or musical motifs themselves, and not just to the human beings who contemplate or transmit them.

Insofar as such fictional characters drive billions of dollars' worth of economic activity, inspire diverse forms of artistic creativity, affect the ways in which leisure time is spent and in which literacy skills and cultural awareness are acquired, serve as "companions" and role models for many people (especially the young), and provide a shared social experience and reservoir of cultural metaphors, such fictional characters arguably play as much of a role in shaping the meaning and activity of society as do domesticated animals or organizations such as governments and corporations. While the singular way in which such characters "exist" and influence society clearly places them in a different category from that of human beings (Thomasson 2003a, 2003b), from an anthropological perspective, ignoring their existence and dynamic impacts would paint an incomplete picture of a society. Indeed, they are especially relevant for this study, insofar as the notion of posthumanization provides a further conceptual basis for rationalizing how such entities might be recognized as "participants" in a society despite the fact that they are not human beings.

3. Results

3.1. Conceptualizing Society 5.0 as a "Technologically Re-Posthumanized" Society

The Government of Japan (2016b, p. 1) explicitly positions Society 5.0 within the ongoing development of humanity that has been unfolding since prehistoric times, driven by continual advances in technology; it describes Society 5.0 as the next step in the evolution of human society that began with Society 1.0 ("a hunter-gatherer society") and proceeded through Society 2.0 ("agrarian society") and Society 3.0 ("industrial society") to our current day Society 4.0 ("an information society").

Harayama (2017, p. 10) elaborates on that analysis, identifying Society 1.0 with "groups of people hunting and gathering in harmonious coexistence with nature", Society 2.0 with the formation of "groups based on agricultural cultivation, increasing organization and nation-building", Society 3.0 with "a society that promotes industrialization through the Industrial Revolution, making mass production possible", and Society 4.0 with "an information society that realizes increasing added value by connecting intangible assets as information networks". Like Society 4.0, Society 5.0 is a type of "information society"; however, it more explicitly applies emerging forms of ICT with the goal of creating "a prosperous human-centered society".

While there is much insight in the Government's assertion (2016b, p. 1) that "The history of humankind reveals that the evolution of human society has been fueled by technological advances" and Harayama (2017, p. 10) statement that "Traditionally, innovation driven by technology has been responsible for social development", this study's results indicate that the evolutionary path that has led to the advent of Society 5.0 has been a more complex and less linear one. We illustrate this below by distinguishing between "technological" and "non-technological" forms of posthumanization, in order to describe the emergence of Society 5.0 as a "technological re-posthumanization" of the world.

3.1.1. Differentiating Technological from Non-Technological Posthumanization

In today's world, the processes of posthumanization are often identified with the growing use of social robots, autonomous AI, and advanced human-computer interfaces. However, if—as

discussed above—posthumanization is understood simply as the processes by which a society comes to include members and participants other than just natural biological human beings (Gladden 2017, 2018), then it becomes apparent that the use of emerging 21st-century technologies is not the only way in which a society might become posthumanized. This fact was hinted at by Clarke and Hansen, who suggest (Clarke and Hansen 2009, pp. 7–8) that posthumanization can be identified with "an exteriorization or evolution by means other than life", which is a trait that humanity has always manifested but which is now undergoing "massive contemporary acceleration". Similarly, in analyzing Lyotard's essay "A Postmodern Fable", Herbrechter (2013, p. 7) concludes "that, on the one hand, there is no point in denying the ongoing technologization of the human species, and, on the other hand, that a purely technology-centred idea of posthumanization is not enough to escape the humanist paradigm". Drawing on Herbrechter (2013, p. 48), Marino-Faza (2017, pp. 138–39) suggests, for example, that the incorporation of vampires and other undead monsters into our contemporary "cultural imaginary" represents a form of posthumanization that is driven by "the fear of the different, of the Other" and that "questions the concept of identity"; such posthumanization is not dependent on emerging technologies.

The heterogeneity of such qualitatively different forms of posthumanization is made explicit in the distinction between "technological" and "non-technological" posthumanization (Gladden 2016). Processes of non-technological posthumanization can be understood as the "original" form of posthumanization, which from ancient times has expanded the boundaries of human societies to encompass members other than "natural" biological human beings. The Society 5.0 paradigm is most immediately connected with the dynamics of *technological* posthumanization; however, by analyzing and comparing the nature of technological and non-technological posthumanization, it becomes possible to discern ways in which humanity's long and rich experience with the dynamics of non-technological posthumanization may help prepare us for the arrival of Society 5.0 and allow us to conceptualize its complex and diverse universe of participants.

3.1.2. Three Historical Stages of Posthumanization

Equipped with the distinction between technological and non-technological posthumanization, it is possible to divide human history into three phases representing (1) the gradual non-technological posthumanization of ancient societies, roughly identified with Societies 1.0 and 2.0; (2) the "de-posthumanization" of modern societies that began with Society 3.0 and reached its extreme in Society 4.0, yielding highly anthropocentric societies; and (3) the ongoing technological (re-)posthumanization of high-tech societies that has begun in the last few decades and which is opening the door to the development of Society 5.0. This dynamic is illustrated in Figure 2, and each of the phases is considered in more detail below.

3.1.3. The Non-Technological Posthumanization of Ancient Societies 1.0 and 2.0

As is illustrated in Figure 2, the processes of non-technological posthumanization of human society began millions of years ago, eventually leading to a state of robust posthumanization of human societies around the world that continued unbroken throughout ancient times and all the way up to the 19th century, when it began to weaken. Throughout most of human history, the default condition of the world's political states, economies, and cultures was thus one of significant non-technological posthumanization: for example, the survival and success of many historical civilizations depended on their use of domesticated animals such as the cows, chickens, or pigs that provided food; the dogs that assisted with hunting and that protected flocks from predators; the oxen that plowed fields and powered mills; and the horses that pulled wagons and carried soldiers into battle. Likewise, throughout the majority of human history, various forms of belief in deities, angels, monsters, and the spirits of deceased human beings that are connected with folk spirituality or organized religion have exerted a strong regulating influence on the expectations for the roles that individual persons and institutions are supposed to play in society and on the structures and dynamics that members of such societies create among themselves.

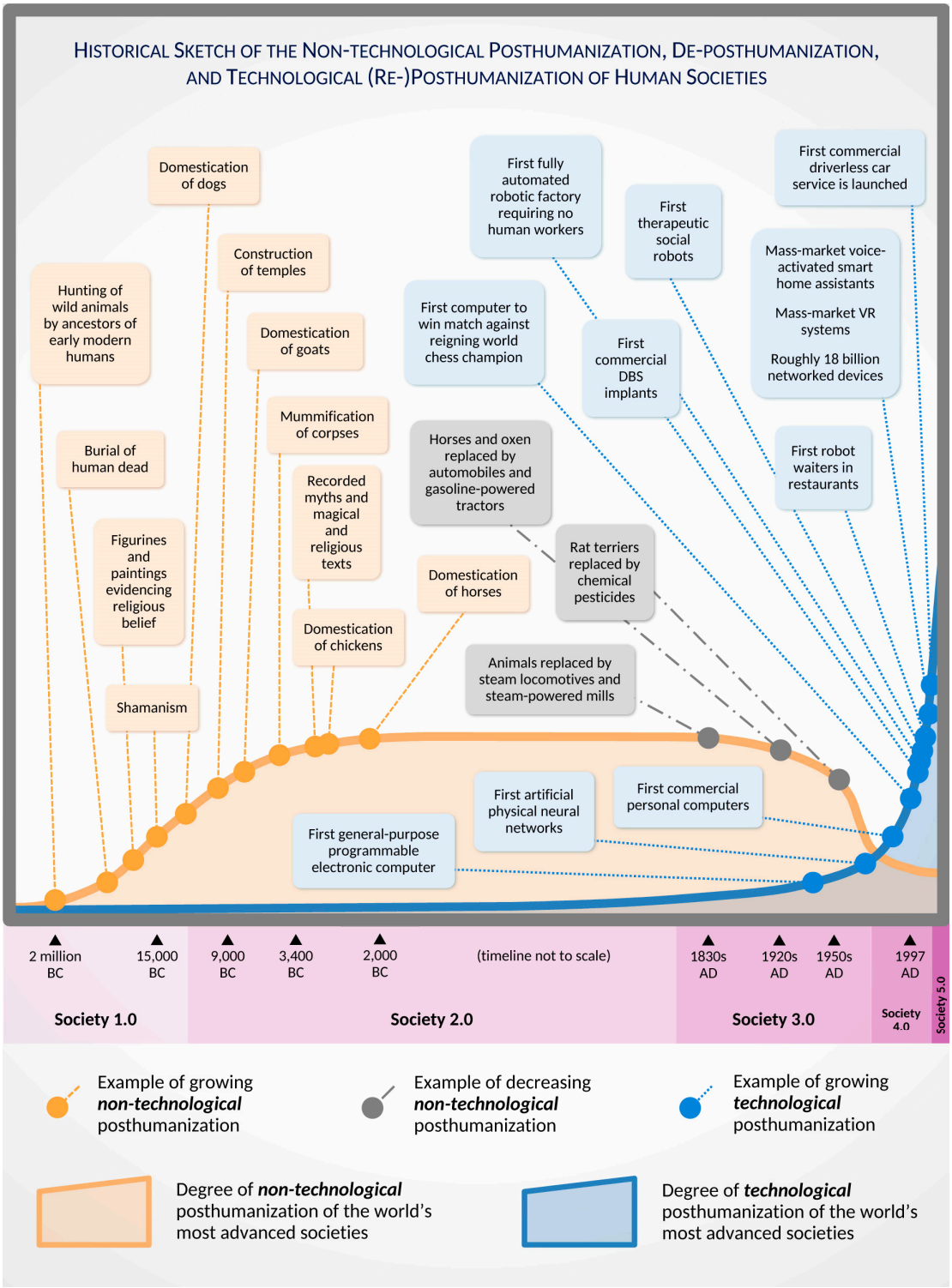

Figure 2. As exemplified by selected historical developments, processes of the (**a**) non-technological posthumanization, (**b**) de-posthumanization, and (**c**) technological (re-)posthumanization of society have set the stage for the emergence of Society 5.0.

The diverse historical examples of Societies 1.0 and 2.0 that incorporated such elements can be understood as non-technologically posthumanized (and thus partially de-anthropocentrized): while ordinary human beings stood at the core of those societies, they were by no means the sole "members" of the societies whose real or supposed existence and activities helped shape the societies'

unique strengths, weaknesses, and character. Such ordinary human beings knew (or believed) that within such societies, they "shared the stage" with the animals that they cared for and worked with, the deities that they believed in, the monsters that lurked at the edges of the known world, and the departed ancestors that accompanied and protected them—all of whom were incorporated into the societies' rich fabric.

For many millennia, the effective functioning of non-technologically posthumanized societies around the world was thus predicated on the inclusion of non-human intelligent social actors in the structures and activities of state institutions, commercial enterprises, and other organizations. Over time, such societies' human members developed robust and meaningful approaches for successfully collaborating with (or, in the case of imaginary entities, for coming to believe that they were successfully collaborating with) such non-human intelligent social actors.

As Figure 2 reflects, the gradual non-technological posthumanization of human society through its expansion to incorporate animals as sources of nourishment, labor, and companionship might be traced by pointing out selected historical developments ranging from the first hunting of wild animals by ancestors of modern humans, which occurred around 2 million years ago (Ferraro et al. 2013), to the domestication of dogs, around 13,000 BC (Larson et al. 2012), the domestication of goats, around 8500 BC (Fernández et al. 2006), the domestication of chickens, which may have occurred well before 2500 BC (Miao et al. 2013), and the domestication of horses, no later than 2000 BC (Jansen et al. 2002).

Similarly, the non-technological posthumanization of ancient societies through their expansion to incorporate non-human agents in the form of spirits of the deceased, monsters, semidivine heroes, deities, and forces such as destiny or fate is reflected, for example, in the earliest evidence of purposeful burials of deceased human beings, which dates to around 120,000 years ago (Pettitt 2010); the earliest known figurines and paintings that appear to provide evidence for religious belief, dating from around 35,000 years ago (Rossano 2006; Hillar 2012); the earliest shamanistic practices, for which increasingly suggestive evidence exists from around 15,000 BC (Harvey and Wallis 2016); the establishment of what some scholars consider to be the earliest known cultic center or temple, Göbekli Tepe, whose construction likely began sometime before 9000 BC (Magli 2016; Banning 2011); the earliest evidence of purposeful mummification of bodies of the deceased, sometime prior to 3400 BC (Jones et al. 2014); and the oldest surviving mythological, magical, and religious texts, including the "Kesh Temple Hymn" dating to 2600–2500 BC (Biggs 1971; Wright 1980) and the Pyramid Texts of Egypt's Old Kingdom, dating from before 2300 BC (Allen 2005).

3.1.4. The De-Posthumanization of Modern Societies 3.0 and 4.0

In Western societies, the powerful state of non-technological posthumanization that had existed since ancient times arguably started to break down in the early 19th century, as the industrialization of agricultural and manufacturing processes began to force animals out of their critical societal roles and Post-Enlightenment thinking began to challenge traditional spiritual beliefs and religious practices and to create a growing strain of secular culture.

As Figure 2 indicates, with the arrival of the First Industrial Revolution around the year 1800, the world's more advanced economies began to mechanize many processes that previously required intensive labor on the part of animals. Thus, by the 1830s, in many places, steam locomotives were being used to transport goods overland, replacing pack animals and the horses or oxen that had previously drawn carriages and wagons (Gibbs 2012). Likewise, in more technologically advanced regions of the globe, the rise of steam-powered mills eliminated the role that horses, oxen, and other animals had previously played in powering local mills (Temin 1966; Tarr and McShane 2008). During the 1920s, as part of the Second Industrial Revolution, horses and oxen that had previously been widely used for personal transportation and work on family farms were in many areas replaced with automobiles and gasoline-powered tractors (Schlebecker 1975; Parissien 2013). The development of new chemical industries also played a role in de-posthumanizing societies: for example, the rat terriers that had previously been ubiquitous on family farms throughout the United States—because of their ability to catch vermin—began a rapid decline in numbers in the 1950s, because the

widespread introduction of chemical pesticides had rendered them functionally obsolete (Kane 2003). Similarly, since the middle of the 20th century, societies with developed economies have (on the whole) become more secularized and less spiritual (Johnson and Grim 2013), their birth rates have fallen, and elderly family members are increasingly housed in specialized facilities rather than in the home with their adult children (McDaniel and Zimmer 2016).

While significant variations exist between contemporary societies, it is thus generally less likely in the world's more technologically and economically advanced societies that adults now share a home with large numbers of children, elderly parents, and extended family members (McDaniel and Zimmer 2016); that individuals acknowledge some religious affiliation and a belief in ghosts, angels, deities, or other supernatural entities or forces (Johnson and Grim 2013); that wild animals are routinely encountered by people in their everyday lives; that families raise their own animals as a source of food or raw materials for clothing and tools; and that domesticated animals are employed as a source of power or for transportation, farm work, and other forms of labor (Wilks 1999; Common and Stagl 2005; Pingali 2007).

Instead of experiencing extensive and diverse daily social interaction with (or, at least, social behaviors directed at) wild animals, farm animals, children, elderly relatives, deities, ghosts, or angels, the typical adult member of the workforce in a Society 4.0 economy came to have a much more homogenized and "de-posthumanized" everyday life experience than was true in earlier ages: to a significant degree, the daily face-to-face social experience of adult members of the workforce became confined to interaction with other adult members of the workforce. It is that *status quo* of the late 20th century that now promises to be upended by the "re-posthumanization" of society that is exemplified by the Society 5.0 paradigm—however, this time, such processes of posthumanization will be manifested not in the ubiquitous presence of farm animals but in growing societal roles for social robots, autonomous AI, and cyborgs.

3.1.5. The Technological (Re-)Posthumanization of Emerging Society 5.0

There are two complementary ways (Gladden 2016) in which contemporary societies are already becoming technologically posthumanized, offering hints of what is to come with Society 5.0. First, human beings are becoming more closely integrated with artificial devices and systems (and thereby becoming more "computer-like"). Second, computers are developing greater intelligence and more social, emotional, learning, and evolutionary capacities (and thereby becoming more "human-like").

The first dynamic is exemplified by human beings' growing use of mobile and wearable devices (Castells et al. 2007; Ernst 2016; Delabrida Silva et al. 2018), online social media (Sahlin 2015) and e-commerce (Qin et al. 2014), augmented and virtual reality systems (Bainbridge 2011; Craig 2013; Jerald 2015; Aukstakalnis 2017), and neuroprosthetic devices developed for purposes of therapy or human enhancement (Merkel et al. 2007; Gasson 2008; McGee 2008; Fleischmann 2009; Fairclough 2010; Gasson et al. 2012). The second dynamic is exemplified by the increasing sophistication and expanding use of technologies relating to social and emotional robotics (Breazeal 2003; Bradshaw et al. 2009; Kanda and Ishiguro 2013; Vallverdú 2015), the pursuit of artificial general intelligence (Gunkel 2012; Pearce 2012; Yampolskiy and Fox 2012; Ramamoorthy and Yampolskiy 2018), nanorobotics and swarm robotics (Barca and Sekercioglu 2013; Brambilla et al. 2013; Mavroidis and Ferreira 2013), synthetic biology and artificial life (Komosinski and Adamatzky 2009; Cheng and Lu 2012; Bera 2015), biological computing (Lamm and Unger 2011), and smart environments and the Internet of Things (Atzori et al. 2010; Evans 2012; Raj and Raman 2017)—which all result in the world becoming "re-enchanted", in becoming "wild" once again, as it becomes filled with myriad diverse sources of embodied non-human agency that can detect and respond to human beings' actions, emotional states, and even thoughts in creative, meaningful, and often unpredictable ways. Both of these dynamics result in a society whose membership has been expanded to include entities beyond just "natural" biological human beings, and both of these dynamics would be accelerated by implementation of the Society 5.0 paradigm in Japan or other countries.

Examples of developments in recent history that might be cited as milestones along this path to the technological posthumanization of societies and the advent of Society 5.0 include the

development of the first general-purpose electronic computer (ENIAC) in 1945 (Mauchly 1980); the creation of the first physical artificial neural networks, beginning around 1960 (Adhikari and Kim 2014); the introduction of the first commercial personal computers, in the 1970s (Freiberger and Swaine 2000); the first computer to win a match against a reigning world chess champion, in 1997 (Campbell et al. 2002); the establishment in 2001 of what was likely the first fully automated "lights-out factory" that requires no human workers, operated by the Japanese robotics company FANUC (Metzger 2016); the creation of the first commercial deep brain stimulation (DBS) implants, around 2002 (Gardner 2013); the first use of therapeutic social robots (e.g., PARO), around 2004 (Shibata et al. 2004); the introduction of robot chefs that prepare food and robot waiters that deliver food to tables in restaurants, around 2006 (Hong 2006; Chen 2016; Nguyen 2016); the growth of the Internet of Things to include roughly 18 billion networked devices (Nordrum 2016), along with the initial mass marketing of voice-activated smart home assistants (Chung et al. 2017; López et al. 2017) and VR game systems (Chang et al. 2016; Shelstad et al. 2017), all occurring around 2016; and the launch in 2018 of the first driverless car service in the US (Buncombe 2018; Young 2018).

3.1.6. 20th-Century De-Posthumanization as a Historical Anomaly

As Figure 2 suggests, the period extending from roughly the 1960s through the 1990s represents a historical anomaly of a sort that had not been seen for tens of thousands of years and (especially with the impending appearance of Society 5.0) might never be seen again: it was a period of extreme "non-posthumanization", in which the world's most technologically and economically advanced societies were *no longer* non-technologically posthumanized but had *not yet* become technologically posthumanized.

With the benefit of hindsight—as we now begin to appreciate the societal implications of emerging forms of artificial agency—it is possible to see that the dynamics of industrialization and de-posthumanization that occurred in developed economies over the course of the 20th century reflected not a transition to a permanent new anthropocentric order but a temporary period in which developed economies became atypically anthropocentrized and de-posthumanized.

The semi-automated factory assembly lines that became ubiquitous throughout developed economies in the 1960s and 1970s—and later, the "cubicle farms" (Danninger et al. 2005; Rockmann and Pratt 2015) of the 1990s, with rows of office workers sitting before identical desktop computers—arguably represented the most anthropocentric and non-posthumanized workplaces in history. Rather than being surrounded by much-valued domesticated animals that needed to be nurtured, cared for, trained, cajoled, and persuaded, within such environments the human worker stood alone and supreme as the sole intelligent social actor. Within the societies in which such automating technologies became prevalent, human beings found themselves surrounded by highly effective (but passive and asocial) electronic tools that would do exactly—and only—what they were instructed to do by their human masters. It is only in recent years that various forms of AI have begun to develop social and emotional capacities and degrees of autonomy that allow them to become meaningful companions and competitors to the creative, social human intellect (Kanda and Ishiguro 2013; Ford 2015; Pfadenhauer 2015; Sachs et al. 2015; Vallverdú 2015; Yakut 2018; Mazzone and Elgammal 2019).

3.2. Categorization of the Anticipated Participants in Society 5.0

Applying the concept of posthumanization developed above, it is possible to distinguish six types of potential entities that may come to be participants in or members of Society 5.0: (1) "natural" biological human beings; (2) artificially augmented human beings; and (3) metahuman; (4) epihuman; (5) parahuman; and (6) nonhuman beings. The differences between these types of entities can be characterized using Ingarden's model of the human being as a three-layered emergent whole; brief definitions of the categories are presented in the discussion of them below, while more formal technical definitions that draw on Ingarden's framework are presented in supplementary Figures S1 and S2. Note that there are some limited cases in which an entity may belong to more than one category simultaneously; these are highlighted in supplementary Figure S3. Selected examples of members of the six categories are presented in Figure 3 and discussed in the subsections below.

Figure 3. The technologically posthumanized Society 5.0 is expected to incorporate six categories of participants whose analogues existed in earlier non-technologically posthumanized societies.

3.2.1. "Natural" Biological Human Beings

"Natural" biological human beings are those that have not been qualitatively transformed by posthumanization; from a phenomenological anthropological perspective, a natural biological human being can be understood as an entity that possesses a physical body, sensory-emotional soul, and intentional «I» of the sort that are unextraordinary for the human being as an emergent whole, as described by Ingarden (1970).

Throughout the history of Societies 1.0 through 4.0, such natural biological human beings have served as the central actors responsible for gathering and analyzing data, making decisions, and undertaking actions within societies; they are the "glue" that has always held human societies together. In comparison to other types of actors that filled some role in societies (e.g., domesticated animals in Society 2.0 or, more recently, specialized artificial agents in Society 4.0), natural biological human beings are highly adaptable "generalists" who possess a wide range of sensorimotor and cognitive capacities; they learn new skills quickly, possess considerable imagination and problem-solving skills, and can function with a high degree of autonomy. However, they are also subject to physical limitations (e.g., the need for regular sleep) and possess many cognitive limitations (e.g., cognitive biases and imperfect memory) that often cause them to behave in irrational, ineffective, or even counterproductive and harmful ways within society.

The natural biological human beings who will enjoy membership in Society 5.0 are not a monolithic bloc of homogeneous entities: even before taking into account the bewildering variety of artificially augmented, metahuman, epihuman, parahuman, and nonhuman beings that will participate in Society 5.0, the category of "natural" biological human beings itself already encompasses a remarkably vast and diverse universe of entities. As Figure 3 suggests, that group includes both more and less "prototypical" cases. Among less prototypical cases one might identify persons who are comatose or asleep, who are physically impaired, who are suffering from dementia, who possess emotional disorders, or who are currently intoxicated or hallucinating; their state of physical and cognitive development may range from that of an embryo or infant to that of an adult or an elderly individual who is near death (Bogin 1999; Government of Japan 2016a, p. 22; Slater and Bremner 2017; Hooyman and Kiyak 2018; Webster et al. 2018).

In keeping with the phenomenologically descriptive nature of Ingarden's anthropology, it should be emphasized that the distinction between more and less prototypical cases is not a normative one entailing a value judgment, nor is it meant to suggest, for example, that children or comatose individuals are in any way less "human". Quite the opposite: the explicit highlighting of such manifold ways of existing "less prototypically" as a human being is meant to serve as a reminder of the fact that such conceptual stereotypes exist and must be actively challenged, if one wishes to appreciate the potential membership of Society 5.0 in its full diversity. As a historical matter, when scholars have attempted to imagine a generic "human being" as part of some thought experiment, they have often instinctively pictured a well-educated, healthy, conscious, adult human being (often of a particular gender, race, nationality, religion, and socioeconomic status) as a sort of prototypical placeholder that represents all human beings (Humphrey 1984, p. 7; Law 2011, p. 1). It has been suggested that 20th-century phenomenological approaches to studying the human being—despite their attempts to avoid such stereotypical thinking by temporarily "bracketing" cultural preconceptions and focusing on entities as they actually reveal themselves—may not, in themselves, be capable of avoiding such culturally driven "overrepresentation" of a particular vision of the human person (Ferreira da Silva 2015). It is possible, though, that the fact that Ingarden's anthropological model of the human being is based in a generalized systems theory (Ingarden 1974) may mitigate some of the problems associated with phenomenologically grounded anthropologies that employ a more explicitly anthropocentric approach. Moreover, one of the values of critical posthumanist thought is that it continually reminds us that there is no "typical" human being that can serve as an object of study; it is impossible for any single individual to possess the full and astonishingly diverse set of traits that all particular human beings collectively do (or may) possess. The Ingardenian phenomenological framework utilized in this text might thus be beneficially understood in light of that posthumanist *caveat*.

As Figure 3 suggests, there are also more or less "prototypical" human uses of technology. Within the context of technological posthumanization and Society 5.0, the routine use of "simple" everyday technology is not enough to disqualify a person from being a "natural" biological human being; the fact that one wears clothing, uses eyeglasses or a hearing aid, drives an automobile, or uses a telephone or desktop computer does not exclude one from the category of natural biological human beings. The use of conventional medicines, surgical procedures, somatic cell gene therapy (SCGT), and medical devices is also consistent with status as a natural biological human being, insofar as such technologies are used for restorative therapeutic purposes and do not qualitatively transform an individual's physical body, sensory-emotional soul, or intentional «I» to possess capacities that exceed or differ from what is common among human beings.

3.2.2. Artificially Augmented Human Beings

An "artificially augmented" human being is still undeniably a true human being; however, it has undergone some significant alteration or enhancement, as a result of which its capacities are no longer simply those of a human being still existing in its purely "natural" biological state. From a phenomenological anthropological perspective, such an alteration involves grafting some new physical element onto the "ontic fundament" of a person's existing physical biological body or granting the person extraordinary new powers over the environment, which are reflected in the fact that the person's «I» of conscious awareness is able to "intend" the surrounding world in ways that are not possible for ordinary members of society—for example, by "willing" certain environmental changes into existence.

For example, a person who has lost an arm in an accident and receives a sensorimotor neuroprosthetic robotic arm developed using groundbreaking technologies (Farina and Aszmann 2014; Pazzaglia and Molinari 2016) that possesses enhanced (or different) capacities has not undergone a change that radically alters the person's fundamental nature as a human being; at the same time, though, the creation of such a sophisticated, intimate, and enduring human-machine interface means that the person is no longer simply a "natural" biological human being. Rather, the individual has become artificially augmented.

According to the definitions formulated here, not every use of technology gives rise to "artificially augmented" human beings. In a sense, driving an automobile, typing at a computer, wearing eyeglasses, or even wearing clothing creates an artificial human-machine interface. However, such technological devices do not become "integrated into" their users' bodies: the interface is a superficial one that is regularly and effortlessly broken (e.g., by getting out of a car or removing one's glasses before going to sleep) in a way that does not require any invasive procedures or alterations to a person's physical biological body.

The types of technologies that would give rise to an artificially augmented human being in the technologically posthumanized Society 5.0 involve the physical incorporation of a device into an individual's body; such devices include deep brain stimulation (DBS) implants (Kraemer 2011), retinal implants (Linsenmeier 2005; Weiland et al. 2005; Viola and Patrinos 2007), and cochlear implants (Ochsner et al. 2015), along with future visual cortical implants (Thanos et al. 2007) and memory implants that build upon emerging technologies for memory modification (Han et al. 2009; Josselyn 2010; Ramirez et al. 2013). Such devices may be wirelessly networked and, to some extent, remotely controllable (Denning et al. 2010; Clark and Fu 2012; Zheng et al. 2014), thereby incorporating their human user into the Internet of Things. Often the state of existing as an artificially augmented human being is a reversible one; such augmentative devices can typically be removed, returning their users to their previous state as natural biological human beings. However, in some cases, the use of such devices is meant to be continuous and permanent, and in almost all cases it creates a more stable and enduring human-machine interface than that which is created when natural biological human beings don a pair of eyeglasses or get behind the wheel of an automobile.

It may appear arbitrary to consider the use of some technologies (such as clothing and eyeglasses) a characteristic of "natural" biological human beings, while the possession of other technologies (like cognitive neuroprostheses or robotic limbs that grant superhuman capacities)

causes an individual to be classified as an artificially augmented human being. Indeed, it has been suggested that attempts to identify futuristic technologies as instruments of a novel "cyborgization" are misguided, as even the use of simple or archaic technologies gives rise to cyborgs. For example, it has been argued that the (now commonplace) act of watching a film is a sort of cyborgizing experience in which moving images knit together the human body and an external apparatus (McReynolds 2015), while printed books and even Paleolithic art can be understood as powerful virtual reality technologies (Ryan 1999, 2001) whose effects are not entirely dissimilar from those of the futuristic neural jacks and cyberdecks of cyberpunk fiction (Charrette et al. 1989; Shirow 2009). If the term "cyborg" is taken to mean (more or less) "a tool-using human being", a human being who is both biological and technological, then it becomes quite reasonable to argue that, in a sense, human beings have always been cyborgs (Hakken 1999; Clark 2003).

However, if the word "cyborg" is employed in that sense for practical reasons, it becomes useful to find another term to describe those human beings (ubiquitous in science fiction and increasingly present in the real world) who have undergone more radical forms of technological transformation. Here, "artificially augmented human being" is used in that sense: the term acknowledges the fact that within the context of an analysis of prospective members of Society 5.0, a "full-body" cyborg who possesses infrared vision, superhuman strength and memory, and a radically non-humanoid morphology and who requires regular recharging and specialized robotic maintenance is "posthumanized" in a way that someone who wears eyeglasses or clothing is not—and that such a being would participate differently in society, as a result.

The extent to which a human being may be artificially augmented remains unclear. Attempts to conceptualize the limits beyond which a human being may not be further technologically augmented without dying or ceasing to be "human" have been undertaken in both works of speculative fiction (e.g., the concept of a quantifiable "essence loss" (Charrette et al. 1989)) and more serious scholarly analyses (e.g., the concept of "Factor X" (Fukuyama 2002)). The fact that, for example, an insect can undergo a radical structural and functional metamorphosis (Ingarden 1961, pp. 321, 325–26; 1965b, pp. 54, 57–58) without ceasing to be the same insect would seem to challenge any a priori presumption that biological entities are inherently incapable of preserving their identity and nature through quite dramatic change.

While the types of emerging technologies that will give rise to such artificially augmented human members of Society 5.0 are novel—and Society 5.0 will thus differ in important ways from any previous human cultures—throughout history, non-technologically posthumanized societies have included individuals who satisfy the definition of artificially augmented human beings. For example, political and military leaders who possess great influence or authority within a society are, in effect, "artificially augmented" human beings; they have been granted a social power to control other human beings and to reshape the environment in a way that exceeds the direct physical capacities of their natural biological bodies: they can construct roads and bridges and palaces and wage warfare against other populations not using their bare hands but by speaking instructions that cause other human members of their society to act in a particular way (French and Raven 1959; Weber 1968; Brauer and Bourhis 2006; Fiske and Berdahl 2007). In such cases, a leader's artificially augmented capacities are brought about not through neuroprosthetic technologies but through the non-technological mechanisms of social roles, expectations, and institutions. Similar dynamics are found in societies in which priests, shamans, or other spiritual leaders are believed to possess supernatural powers; within their communities, such individuals are not seen as "ordinary" members of society but as persons whose capacities to shape the environment have been augmented beyond what is naturally possible (Holdrege 1990; Sharabi and Shalev 2018). While the presence of artificially augmented human beings will take on a new form in Society 5.0, it is thus not an entirely new phenomenon but an element that has been present in diverse human societies throughout history.

3.2.3. Metahuman Beings

In recent decades, the term "metahuman" has been employed to describe diverse types of superhuman, otherly human, quasi-human, or non-human beings, in contexts ranging from psychological

analyses of human nature (Maslow 1971) to discussions of artificial intelligence (Jaki 1988; McCorduck 2004), manifestos for theoretically grounded posthumanist performance art (Del Val and Sorgner 2011; Del Val et al. 2011), posthumanist scholarship (Tirosh-Samuelson and Mossman 2012; Ferrando 2013), and popular culture (Milán 1986; Charrette et al. 1989). Such definitions disagree dramatically in meaning, which highlights the still unsettled state of terminology used to describe posthumanized beings. (Such unclarity is further evidenced by the fact that other researchers (e.g., Goertzel 2007) have used the term "metahuman" to describe entities that we would refer to below as "epihuman".) Nevertheless, in several such uses of the term it is possible to discern a shared notion of the "metahuman" as an individual being whose origins lie in the human but which has undergone an irreversible transformation to become a sort of quasi-human "other".

Drawing on Ingarden's anthropological model, a "metahuman being" is defined here as one whose entire body has been transformed in a way that gives it a different quality from the body of a natural biological human being. As a result of that qualitative physical change, the metahuman being's sensory-emotional "soul" and intentional «I» may be structured or function somewhat differently than those of a natural biological human being; however, they are still essentially human in nature. Because of that fact, societies may readily recognize that such beings possess a moral status and political rights no different from those of natural biological human beings.

In the case of the technologically posthumanized Society 5.0, such metahuman beings may include persons who have been genetically engineered through germline gene therapy (GGT) to possess superhuman or non-human capacities (Stock 2005; Kelly 2013) or transgenic human beings with genes introduced from non-human animals or plants (Savulescu 2003; Wilson and Haslam 2009). While these represent new ways of being, it is possible to identify other forms of entities that have been participants in human societies for millennia that similarly satisfy the definition of "metahuman" beings. For example, from ancient times, diverse human cultures have accepted the presence of ghosts and incorporeal spirits of deceased human beings, corporeal undead, and revenants of ambiguous corporeality as "participants" in human society (Davis 1977; Campany 1991; Scurlock 1997, 2016).

In some cases, such historical metahuman beings have been viewed negatively: they have been believed to exist as a part of human society, but as the bearer of some metaphysical "abnormality", a threat that lurks ominously at society's edge. For example, historically, various cultures have demonstrated folk beliefs in the existence of vampires (Bane 2010; Bräunlein 2012), draugar (Chadwick 1946; Venables 2015), zombies (Venables 2015), and other corporeal undead that had once been natural biological human beings but that, after death, were transformed irreversibly into dangerous quasi-human "others" that are aesthetically repellent, amoral, and metaphysically deficient. At the same time, many historical cultures have held that after the death of its physical body, a natural biological human being may become positively transformed to acquire a new manner of existence; this concept is formally expressed, for example, in the traditional Catholic teaching regarding the "*communio sanctorum*", according to which the saints already in heaven are believed to remain an invisible part of human society and, through their prayers, work actively to aid those human beings who are still going about their everyday lives on earth, just as those living on earth can aid the souls in purgatory that are preparing to enter heaven (The Holy See 2003, pp. 268–72).

There are indications that this historical dichotomy by which metahuman beings in non-technologically posthumanized societies may be viewed *either* as dangerous, corrupted beings *or* as benevolent, exalted beings may manifest itself in the case of the technologically posthumanized Society 5.0, as well. This is suggested, for example, by the contemporary debate between bioconservatives (Fukuyama 2002; Roache and Clarke 2009; Bardziński 2015) who argue vociferously that such alteration of the human species is a dangerous, immoral debasing of human nature that should be prevented and transhumanists who argue that the creation of such beings is a positive step in the evolution of humanity that should be energetically pursued (Bostrom 2005; Roache and Clarke 2009; Bardziński 2015).

3.2.4. Epihuman Beings

The term "epihuman" has been used recently in contexts that suggest a being whose capacities or performance are just "beyond" those of an ordinary human being (Hall 2007; Tucker 2007; Yampolskiy and Fox 2012; Manzocco 2019). Here, though, we draw upon the original meaning of the Greek prefix "epi-" as "being upon" or "being supported upon a surface" (Liddell and Scott 1897, p. 524) to describe an entity that is somehow "built" or "rests" upon ordinary human beings. Employing this study's phenomenological anthropological model, an "epihuman being" can be defined as an entity whose physical "body" comprises one or more human ontic fundaments that are functionally linked in a special way. In effect, an epihuman entity is an emergent collective whole that is "built upon" a foundation of multiple human beings.

In the case of the technologically posthumanized Society 5.0, such epihuman beings might include collective "hive minds" that have been created by establishing direct technologically facilitated links between the brains of a society's human members, allowing real-time communication through neuroprosthetic devices or other advanced brain-computer interfaces (Fleischmann 2009; McIntosh 2010; Roden 2014, p. 39). Such sophisticated multi-agent systems may allow people in different places to experience one another's sensory perceptions, emotions, or even memories; such hive minds are able to manifest shared sentiments and arrive at collective decisions that—while grounded in the cognitive activity of the hive mind's individual members—are the sentiments and decisions of the emergent epihuman entity *as a whole*, and not of its individual members.

While the possibility of creating such neuroprosthetically facilitated hive minds is a novel one that is only becoming feasible along with the development of Society 5.0 technologies, there are many other types of epihuman entities that have been prominent features of human cultures since ancient times. Such higher-order entities lack the single material "core" that an individual human person possesses; they are instead held together across generations by links such as a common language and culture (Ingarden 1961, pp. 320–22; 1965b, pp. 52–54). For example, families, clans, religious communities, nations, governments, and commercial organizations (Hendry 2016) all satisfy the definition of "epihuman" entities formulated here: it is quite natural to speak about a particular family's "plans", a country's "decision to develop its own space program", a religious group's "hopes" and "fears", or a company's "strategic objectives"; such emotions, decisions, or goals are attributed to the collective entities as a whole and may or may not reflect the emotions, decisions, or goals of all their individual members.

Viewed from this phenomenological anthropological perspective, the advanced human-computer interfaces that may lead to the emergence of new types of "hive minds" in Society 5.0 are seen as parallels to the ancient processes of public debates, voting, societal roles and expectations, and other (non-technological) mechanisms for creating collective entities and arriving at shared decisions that have been employed in non-technologically posthumanized societies throughout human history.

3.2.5. Parahuman Beings

The term "parahuman" has been employed in various contexts (Nikolchina 2005; Hall 2007; Tucker 2007; Yampolskiy and Fox 2012; Beckman 2013; Stadler 2017; Manzocco 2019) with no universally accepted meaning; in general, though, the term suggests entities that are not in themselves human but that accompany, resemble, or exist alongside human beings. Drawing on this study's phenomenological anthropological model, here a "parahuman being" may be defined as an entity that possesses an ontic fundament whose materials, structures, processes, or systems are not directly dependent on the sort of ontic fundament associated with a natural biological human body but which nonetheless displays significant human-like characteristics.

In the case of the technologically posthumanized Society 5.0, such parahuman beings might include future robots that possess a human-like physical form (i.e., "androids") (Silvera-Tawil and Garbutt 2015; Watanabe et al. 2018) and a human-like degree of artificial general intelligence (Yampolskiy and Fox 2012; Ramamoorthy and Yampolskiy 2018), as well as artificial entities encountered within virtual reality that resemble human beings in their appearance and behavior

(Jerald 2015; Barfield and Williams 2018). While the technological nature of such entities is a novel feature of Society 5.0, the incorporation of parahuman entities into human society is an ancient phenomenon.

For example, in many cultures around the world, a society's human members have long interacted regularly with beings such as horses, dogs, dolphins, apes, cats, and other highly intelligent animals that display emotions, learning capacity, and other forms of mental activity that appear human-like to at least some degree. It is because such beings seem to possess some human-like mental characteristics that they do not simply share a space with human beings but can instead "accompany" us in our lives in meaningful ways as (limited) participants in our society (Plous 1993; Wilks 1999; Tovey 2003; Buller and Morris 2007; Hobson-West 2007). Similarly, in many historical societies, human beings have believed that they shared the world with entities such as angels and demons, anthropomorphic monsters, or a personal deity that possesses some human-like mental characteristics and takes an interest in the affairs of the society's human members (Beckman 2013). Drawing on Ingarden's (1931, 1957, 1968, 1988) analysis of the mode of being of fictional characters, from a phenomenological ontological perspective, even literary characters that are universally known to be creations of the human imagination may nonetheless "exist" in a certain sense (Thomasson 2003a, 2003b) and participate (in their own limited fashion) in a society's fabric by contributing meaning and influencing the society's dynamics. Parahuman beings have thus been a longstanding fixture of non-technologically posthumanized human societies: the incorporation of androids, artificial general intelligences (AGIs), and other parahuman beings into Society 5.0 is in one sense a novel development but, in another sense, it has strong precedent in earlier societies.

As the detailed definition of parahuman beings presented in Figure S2 suggests, for purposes of this study's phenomenological analysis of potential members of Society 5.0, the key criterion for parahuman beings is that they at least occasionally give the *impression* of possessing a human-like "soul" and intentional «I». The way in which Society 5.0 will be experienced by its human members will depend on whether androids, AGIs, and other synthetic beings appear to their human acquaintances to possess human-like minds: the fact that human beings cannot know firsthand whether such artificial beings *actually* possess human-like mental experiences is not relevant for categorizing such beings in this anthropological framework—although the question of whether artificial beings are indeed sentient and sapient is, for example, a critical one when carrying out political, ethical, or theological investigations of such beings' rights and responsibilities (if any) and appropriate roles within society (Wallach and Allen 2008; Gunkel 2012).

Similarly, the phenomenological anthropological justification for classifying fictional literary characters as parahuman (rather than nonhuman) entities is the fact that while the reader of a novel or viewer of a film rationally understands that such characters do not actually possess a "soul" or «I» (and would readily admit as much, if asked), the process of immersion in a fictional work is so transformative that readers or viewers can temporarily forget that its characters are "only" fictional and begin to wonder what the characters are feeling, what their motivations are, what they are planning to do next, etc. (Ingarden 1931, 1957, 1968; Ryan 1999, 2001).

3.2.6. Nonhuman Beings

For purposes of this study, a "nonhuman" being can be defined from a phenomenological anthropological perspective as an entity that does not possess a sensory-emotional system or intentional system that gives the impression of being significantly human-like.

Rocks, flowers, insects, houses, pieces of furniture, books, stars, clouds, rivers, and countless other types of nonhuman entities fill our lives; however, most of these cannot be considered "members of" or "participants in" human society. Nevertheless, in non-technologically posthumanized societies, there have been some types of beings that have been considered (limited) participants in the fabric of the societies, despite the fact that they did not display any human-like mental activity. For example, in some cultures it is possible for a particularly large, ancient, rare, beautiful, sacred, or otherwise notable tree to be considered a sort of "member" of the local community and a meaningful participant in society (Stone 1972, 2010; King et al. 1997; Dafni 2006; Cloke and Pawson 2008; Selvamony 2014),

even if it is not able to speak or demonstrate emotions. Similarly, non-anthropomorphic monsters, impersonal deities or supernatural forces, and examples of simple animal life that evidently lack human-like sensation, emotion, and self-awareness have, in different times and places, been considered by a society's human members to be meaningful contributors to the society.

In the case of the technologically posthumanized Society 5.0, nonhuman beings that might contribute meaningfully to such a society—and come to be considered "members" of it—despite their lack of human-like mentality might include synthetic biological computers whose behavior is not modelled on that of the human brain (Lamm and Unger 2011), nanorobotic swarms (Mavroidis and Ferreira 2013), and AGIs that possess radically nonhuman cognitive structures and dynamics (Yampolskiy 2015a, 2015b).

4. Discussion and Recommendations

In addressing this study's first research question, Figure 3, and Figures S1 and S2 and the related discussion have illustrated qualitative differences between the diverse types of human and non-human members that are expected to participate in Society 5.0, understood in terms of Ingarden's philosophical anthropology. The second question—about how it is possible to conceptualize the societal dynamics that will cause Society 5.0 to possess a different makeup than Society 4.0—has been explored through the account of historical processes of non-technological and technological posthumanization, as illustrated in Figure 2. A suggested answer to the third question—about how the anticipated members of Society 5.0 differ qualitatively from the members of Societies 1.0 through 4.0—emerges when the responses to the first two questions are considered together. Having developed such frameworks for categorizing, analyzing, and understanding the anticipated participants in Society 5.0, below we point to some implications of what they tell us about the likely nature of life in Society 5.0 and offer recommendations relating to further study and implementation of the Society 5.0 paradigm.

4.1. Society 5.0: Is There Really Anything New Here?

There is rightfully much trepidation about the incorporation of increasingly sophisticated robots and AI into future societies: quite serious questions exist about the growing societal role of artificial agency from ethical, legal, political, economic, engineering, and cybersecurity perspectives. However, this study's results suggest that at least from an anthropological perspective, Society 5.0's inclusion of diverse non-human entities as participants is "nothing new"—but instead something quite ancient, a return to the unpredictability, "wildness", and continual encounters with the "other" that characterized Societies 1.0 and 2.0, thanks to the prevalence of diverse non-human agency resulting from a heavy reliance on animals as key participants in society and the societies' religious and spiritual dimension.

It should be noted that while Society 5.0 will be technologically posthumanized in a way that no previous society has been, it will not cease to possess the elements of *non-technological* posthumanization that remain present within our contemporary Society 4.0. Instead, we can expect Society 5.0 to be a radically posthumanized society that includes all the forms of technological *and* non-technological posthumanization reflected in Figure 3. A glimpse of Society 5.0's future reality can already be seen, for example, in the work of Schmickl et al. (2013), who have sought to create hybrid animal-robotic societies (or "collective adaptive systems") in which real biological honeybees live and labor alongside honeybee-like robotic nodes and schools of fish include both robotic and natural biological members. If one imagines a future society whose human members carefully tend mixed hives of robotic and biological bees in order to produce honey for their consumption or swim leisurely amidst hybrid schools of fish whose robotic members help the biological members to interact with the human swimmers, then one is picturing a society that is both non-technologically *and* technologically posthumanized in rich and meaningful ways. The cyber-physical infrastructure underlying Society 5.0 has the potential to allow it to become just such a society in which diverse "naturally" human, "otherly" human, robotic, animal, and other participants engage to create a world that is vibrant, diverse, and exotic, while remaining human-centered.

Recommended Historical Social Scientific Analysis of Technologically Posthumanized Societies

Building on the previous observation, an overarching point suggested by this study's results is that because the "novel" types of technologically posthumanized beings that are expected to participate in Society 5.0 all have analogues in earlier, non-technologically posthumanized societies, a detailed social scientific analysis of the dynamics of earlier human cultures and civilizations (drawing, e.g., on anthropology, economics, history, linguistics, political science, psychology, and sociology) may be able to offer unexpectedly robust and relevant insights into the nature of Society 5.0 and the expected behaviors of its diverse human and non-human participants. It is thus recommended that anyone seeking to study or implement a seemingly "novel" element of the Society 5.0 paradigm should first search for ways in which its non-technologically posthumanizing analogues were (successfully or unsuccessfully) incorporated into earlier societies.

4.2. Can the Society 5.0 Paradigm be Applied Outside of Japan?

While the origins of the Society 5.0 paradigm lie in Japan, the Government of Japan (2016b, p. 1) envisions that many Society 5.0 platforms and technologies will be developed "within an internationally open innovation system", and preliminary efforts are already underway to apply the paradigm in other countries. For example, Ratti (2018) describes how an experimental initiative drawing on concepts from the Government of Japan's Society 5.0 plan is being implemented in the Autonomous Region of Sardinia in Italy, while Sarif (2017) explores ways in which the Society 5.0 paradigm might be applied in Malaysia, particularly within the sphere of higher education, and Romli et al. (2018) investigate ways in which Society 5.0 technologies might be used in the Malaysian context to strengthen parent-child relationships and parenting literacy.

Despite such interest in applying elements of the Society 5.0 paradigm internationally, it remains unclear whether the Society 5.0 vision as a whole can be readily applied outside of its original Japanese cultural context. This dynamic may differentiate Society 5.0 from the Industry 4.0 paradigm, which in the span of less than a decade has been taken up as a useful organizing concept by businesses far beyond its place of origin in Germany. It will be remembered that Industry 4.0 primarily involves innovative approaches to applying emerging cyber-physical technologies for the automation of manufacturing processes (Gorecky et al. 2014; Lasi et al. 2014; Kang 2018). Because they depend preponderantly on technological (rather than cultural) factors, new practices regarding high-tech manufacturing processes can be transferred between different countries and cultural contexts with relative ease: a new type of automated cyber-physical assembly line that is efficient and effective when implemented in a factory in Germany is likely to also prove efficient and effective when implemented in a factory in China, Brazil, or the United States.

Full implementation of the Society 5.0 paradigm, though, reaches much more deeply into a society's culture. It impacts not just the workplace activities of the small percentage of individuals who work in high-tech factories but is instead intertwined with the daily routines of all members of society: it involves the use of advanced cyber-physical technologies to transform the nature of education, healthcare, entertainment, social relationships, and other aspects of daily life, in order to address a wide range of perceived social needs (Government of Japan 2016b) and to facilitate individuals' desired lifestyles, support their self-realization, and make their lives more meaningful, vibrant, and enjoyable (Bryndin 2018; Keidanren 2016; Medina-Borja 2017).

While it might appear reasonable within the Japanese context to expect that incorporating social robotics, ambient intelligence, virtual reality, cyberspatial interfaces, neuroprosthetics, and other cyber-physical technologies into the most intimate aspects of one's daily routine will add more meaning, vibrancy, and joy to one's life, it cannot be presumed that such technologies would be embraced in the same way by—or have similarly positive psychological, social, and cultural impacts on—people in other countries and cultures.

Indeed, it has been observed that the Japanese attitude to emerging technologies differs significantly from that of other countries. For example, it has been argued that Japanese society manifests a unique "robophilia" that is partly a response to the traumatic experience of having suffered the devastation wrought by atomic bombs during World War II, with the subsequent

unspoken resolution that Japan would never again fall behind the world's leaders in technological innovation (Gilson 1998; Budianto 2018). Moreover, it has been suggested that Japanese culture's ancient mix of Shinto and Buddhist worldviews naturally encourages the recognition of a sort of inherent animating "soul" or "spirit" not only within rocks, trees, and streams but also within robots, which thereby enjoy a sort of implicit kinship with human beings; that mindset differs from the attitude prevalent in Western cultures influenced by Cartesian dualism, where artificial intelligence is understood as a process of calculation that is readily separable from the physical substrates upon which it is performed (Morris-Suzuki 2012; Coeckelbergh 2013; Richardson 2016).

Recommended Analysis of the Cultural Underpinnings of Society 5.0

Based on the observations above, it is recommended that when policymakers, government agencies, and businesses in other countries are considering implementing elements of the Society 5.0 paradigm, they incorporate into their analysis an explicit investigation of how those elements of the Government of Japan's Society 5.0 initiative have been shaped by the unique political, philosophical, spiritual, aesthetic, and other cultural dynamics of Japan and whether changes will need to be made when adapting such elements of Society 5.0 for use in a very different cultural context.

4.3. How Will Government, Academia, and Industry Collaborate to Realize Society 5.0?

By its very nature, realization of the Society 5.0 vision in Japan will require close and effective strategic collaboration between government, academia, and industry (Government of Japan 2016b), which is already underway. For example, Fujii et al. (2018) have explored the role of Japanese electronics manufacturers in collaborating with academia and consumers to create the technologies, services, and societal change that will underpin Society 5.0, while Shibata et al. (2017) have investigated the need to update and transform curricula to successfully educate those who will be called upon to manage the future technologies of Society 5.0. Likewise, Ding (2018) has analyzed the novel government-academia-industry relationship that will be needed to implement Society 5.0, along with the challenge for the Government of Japan and industry to implement the radical long-term changes needed to fully realize the Society 5.0 paradigm while simultaneously maintaining short-term competitiveness and prosperity in a difficult economic climate.

Recommended Development of Transdisciplinary Frameworks Offering a "Shared Vocabulary"

A major challenge facing any initiative that requires such close collaboration between government, academia, and business is the fact that each of those spheres possesses its own specialized conceptual frameworks, methodologies, vocabularies, best practices, and workplace cultures that may be inscrutable even to intelligent and well-trained personnel in the other spheres. (Indeed, dramatic differences exist even among government agencies, among academic disciplines, and among particular industries.) Historically, one of the driving forces behind the creation of the field of cybernetics in the 1940s was a desire among researchers from diverse disciplines to develop a common vocabulary that would allow them to understand one another's work and forge transdisciplinary insights (Wiener 1961). Related fields such as systems theory have also attempted to develop vocabularies and principles that are applicable across diverse disciplines, as has (more recently) the field of enterprise architecture.

Some transdisciplinary framework of that sort will need to be adopted by proponents of the Society 5.0 paradigm in Japan, in order (for example) to allow the neuroscientists, computer scientists, and ergonomists who are developing a novel type of cyber-physical human-computer interface to seamlessly communicate, debate, and strategize with the manufacturers who will produce it and the government policymakers who are specifying its desired performance characteristics, regulating its operation, and funding its deployment on a society-wide scale.

As part of the contribution sought from academia, the Government of Japan (2016b) has called for input and reflection on the Society 5.0 paradigm from the humanities and social sciences. The frameworks and analyses developed in this study are aimed at providing one such conceptual

"bridge" that facilitates transdisciplinary analysis of the strengths and weaknesses of the Society 5.0 paradigm and potential benefits and dangers of its implementation. By employing an approach grounded in Ingarden's phenomenological systems theory and attempting to get at the deepest philosophical and anthropological foundations of Society 5.0—and its unique universe of expected participants—it is hoped that this work can offer tools and insights (and pose new questions) that will be of relevance to policymakers, ethicists, scientists, systems engineers, technology manufacturers, managers, service providers, and others involved with making Society 5.0 a reality.

5. Conclusions

The Government of Japan's development and promotion of the Society 5.0 paradigm is not simply a theoretical exercise but a concrete real-world project whose future direction is expected to affect the lives of many millions of people in Japan and other countries where application of elements of the paradigm is being explored. Insofar as this study makes it easier to analyze potential positive and negative implications of a transition to Society 5.0 (which have so far been relatively little studied), it may thus hold some practical value.

The qualitative phenomenological anthropological and posthumanist anthropological approach taken in this study represents just one of many possible ways of seeking to understand the bewilderingly diverse array of human and non-human entities that are expected to participate in a fully realized Society 5.0. Nevertheless, it is hoped that the conceptual frameworks proposed and analyses offered here can contribute positively to facilitating much needed further analysis of the theoretical basis and real-world implications of Japan's pursuit of the Society 5.0 vision and its meaning for the future of humanity.

Supplementary Materials: The following are available online at www.mdpi.com/2076-0760/8/5/s1, Figure S1: Characteristics of Potential Types of Members of a Posthumanized Society (Part One), Figure S2: Characteristics of Potential Types of Members of a Posthumanized Society (Part Two), Figure S3: Possibilities for an Entity to Simultaneously Belong to Multiple Categories of Posthumanized Being.

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Characteristics of Potential Types of Members of a Posthumanized Society: Part One

	A "natural" biological human being			An artificially augmented human being	
	Prototypical case	With a liminal ontic fundament	With a liminal sensory-emotional "soul"	With an augmented ontic fundament	With an augmented intentional «I»
Ontic fundament (see Ingarden (1960, 1961, 1964, 1965a, 1965b, 1970))	A single natural human biological ontic fundament that has not undergone therapy to preserve or restore "typical" human sensory, cognitive, or motor capacities (and which (a) has not received a graft of artificial, non-human elements that become fused with the ontic fundament and become a part of it, giving it significant and substantial non-human functional capacities and (b) has not been wholly transformed in some qualitative way that affects all of its components).	A single natural human biological ontic fundament that has undergone therapy with the effect of preserving or restoring ordinary human sensory, cognitive, or motor capacities (and not to give it significant and substantial non-human capacities), but which (a) has not received a graft of artificial, non-human elements that become fused with the ontic fundament and become a part of it, giving it significant and substantial non-human functional capacities and (b) has not been wholly transformed in some qualitative way that affects all of its components.	A single natural human biological ontic fundament that has not received a graft of artificial, non-human elements and has not been wholly transformed in some qualitative way that affects all of its components – but which may or may not have undergone therapy with the effect of preserving or restoring ordinary human sensory, cognitive, or motor capacities (and not to give it significant and substantial non-human capacities).	A single whole comprising a single natural biological human fundament that may possibly have had selected non-essential parts removed and which has had grafted onto the remaining fundament some artificial, non-human (and potentially non-biological) elements that become fused with the ontic fundament and become a part of it, giving it significant and substantial non-human functional capacities (often representing a form of "enhancement").	A single ontic fundament of the sort possessed by (a) a natural biological human being, (b) an artificially augmented human being with an augmented ontic fundament, or (c) a metahuman being.
Sensory-emotional component (see Ingarden (1970))	A sensory-emotional (human) "soul" possessing and currently demonstrating unextraordinary capacities and behavior.	A sensory-emotional (human) "soul" that may possess and currently be demonstrating unextraordinary capacities and behavior or that may be temporarily or permanently functioning in an atypical or limited capacity.	A sensory-emotional (human) "soul," which may be structured or behave somewhat differently than in natural cases, as a result of the transformation of the ontic fundament.	A sensory-emotional (human) "soul."	A sensory-emotional (human) "soul," which may be structured or behave somewhat differently than in natural cases, as a result of the transformation of the ontic fundament.
Intentional component (see Ingarden (1970))	An intentional (human) «I» possessing and currently demonstrating unextraordinary capacities and behavior (and only such capacities and behavior).	An intentional (human) «I» that does not possess extraordinary cognitive capacities, extraordinary powers over nature and matter, extraordinary powers over other human beings (often representing a form of "enhancement"), or other functionality that is not ordinarily human.	An intentional (human) «I» that does not possess extraordinary cognitive capacities, extraordinary powers over nature and matter, extraordinary powers over other human beings (often representing a form of "enhancement"), or other functionality that is not ordinarily human.	An intentional (human) «I», which may be structured or behave somewhat differently than in natural cases, as a result of the transformation of the ontic fundament.	An intentional (human) «I» that has been granted extraordinary cognitive capacities, powers over nature and matter, or powers over other human beings (often representing a form of "enhancement") or other functionality that is not ordinarily human.

Characteristics of Potential Types of Members of a Posthumanized Society: Part Two

	A metahuman being	An epihuman being	A parahuman being	A nonhuman being
Ontic fundament (see Ingarden (1960, 1961, 1964, 1965a, 1965b, 1970))	A single ontic fundament that is "dependent on" (in Ingarden's (1960, 1964) sense of the word) the fundaments of a natural biological human being (or on the fundaments of more than one natural biological human being) for its existence but which has been wholly transformed in some qualitative way that affects all of its components, giving it significant and substantial characteristics not possessed by the ontic fundaments of natural biological human beings (often for purposes of "enhancement").	(a) Two or more ontic fundaments possessed by (1) natural biological human beings, (2) artificially augmented human beings, or (3) metahuman beings, potentially along with (b) some ontic fundament belonging to infrastructure that facilitates communication between and coordination or control of the constituent fundaments.	An entity possessing a type of ontic fundament (or collection of ontic fundaments) whose material composition, structures, processes, or systems are not directly "dependent on" those of a human being's ontic fundament.	May or may not possess an ontic fundament.
Sensory-emotional component (see Ingarden (1970))	A sensory-emotional (human) "soul," which may be structured or behave somewhat differently than in natural cases, as a result of the transformation of the ontic fundament.	Emergent higher-order dynamics that resemble human sensation or emotion and that build on behaviors of the constituent human beings but are attributable to the collective entity as a whole.	The entity at least occasionally gives the impression of possessing sensation and emotion that are human-like to a significant degree.	Does not possess a sensory-emotional system that is a human "soul" or does not give the impression of possessing sensation and emotion that are human-like to a significant degree.
Intentional component (see Ingarden (1970))	An intentional (human) «I», which may be structured or behave somewhat differently than in natural cases, as a result of the transformation of the ontic fundament.	Emergent higher-order dynamics that resemble human intentionality and that build on behaviors of the constituent human beings but are attributable to the collective entity as a whole.	The entity at least occasionally gives the impression of possessing intentionality that is human-like to a significant degree.	Does not possess an intentional system that is a human «I» or does not give the impression of possessing intentionality that is human-like to a significant degree.

Possibilities for an Entity to Simultaneously Belong to Multiple Categories of Posthumanized Being

An entity that is a: / ... can also be a:	"Natural" biological human being (prototypical case)	"Natural" biological human being (case of a liminal ontic fundament)	"Natural" biological human being (case of a liminal sensory-emotional "soul")	Artificially augmented human being (with an augmented ontic fundament)	Artificially augmented human being (with an augmented intentional «I»)	Metahuman being	Epihuman being	Parahuman being	Nonhuman being
"Natural" biological human being (prototypical case)		No	No	No	No	No	No	No	No
"Natural" biological human being (case of a liminal ontic fundament)	No		**Yes** [1]	No	No	No	No	No	No
"Natural" biological human being (case of a liminal sensory-emotional "soul")	No	**Yes** [1]		No	No	No	No	No	No
Artificially augmented human being (with an augmented ontic fundament)	No	No	No		**Yes** [2]	**Yes** [3]	No	No	No
Artificially augmented human being (with an augmented intentional «I»)	No	No	No	**Yes** [2]		**Yes** [4]	No	No	No
Metahuman being	No	No	No	**Yes** [3]	**Yes** [4]		No	No	No
Epihuman being	No	No	No	No	No	No		No	No
Parahuman being	No	No	No	No	No	No	No		No
Nonhuman being	No	No	No	No	No	No	No	No	

1 = A "natural" biological human being with a liminal ontic fundament and liminal sensory-emotional "soul"

2 = An artificially augmented human being with an augmented ontic fundament and augmented intentional «I»

3 = An artificially augmented metahuman being with an augmented ontic fundament

4 = An artificially augmented metahuman being with an augmented intentional «I»