

Framing the Psycho-Social and Cultural Aspects of Human-Machine Communication

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Abstract

In this introduction to the fourth volume of the journal *Human-Machine Communication*, we present and discuss the nine articles selected for inclusion. In this essay, we aim to frame some crucial psychological, sociological, and cultural aspects of this field of research. In particular, we situate the current scholarship from a historical perspective by (a) discussing humanity's long walk with hybridity and otherness, at both the cultural and individual development levels, (b) considering how the organization of capital, labor, and gender relations serve as fundamental context for understanding HMC in the present day, and (c) contextualizing the development of the HMC field in light of seismic, contemporary shifts in society and the social sciences. We call on the community of researchers, students, and practitioners to ask the big questions, to ground research and theory in the past as well as the real and unfolding lifeworld of human-machine communication (including what HMC *may* become), and to claim a seat at the table during the earliest phases in design, testing, implementation, law and policy, and ethics to *intervene* for social good.

Introduction

The community of human-machine communication (HMC) is showing great intellectual vitality. It attracts an increasing number of scholars drawn to the human-machine relationship as one of the central themes for understanding contemporaneity. The great effort that is required of us is to resist the simple fascination that machines exert on humans and assume the standpoint of critical witness to the sociocultural changes taking place under our gaze and advocate for social good. We introduce nine compelling and original articles which offer a substantial contribution specifically to Volume 4 (2022) of *Human-Machine*

Communication but also more generally to the field of HMC and neighboring disciplines. As a collection, these papers offer different lenses, ranging from narrativity (Prahl et al.), to pure philosophical inquiry (Gunkel), from content analysis (Richards et al.) to theory building (Gambino & Liu), from thorough reviews on specific topics such as robot sex (Dehnert) and supportive technologies (Beattie & High) to empirical explorations of robot penetration in three strategic sectors: (1) the domestic sphere including the trustworthiness of voice-based virtual assistants (Weidmüller), (2) the social presence of machine teachers in education (Kim et al.), and (3) the incorporation of exoskeletons in the factory (Kirkwood et al.). As editors, we are very grateful to these scholars for the variety of discourses they have introduced in their papers because this diversity in approach signals the presence of an enduring richness and difference of expression that is of vital importance to maintain in a scientific field. We are also very grateful to these contributors for the originality with which they have investigated themes, issues, and sectors of utmost relevance for the area of HMC.

Taking the Anticipatory Stance in Human-Machine Communication

This volume opens with an exemplary HMC case study conducted by Andrew Prahl, Rio Kin Ho Leung, and Alicia Ning Shan Chua. In “Fight for Flight: The Narratives of Human Versus Machine Following Two Aviation Tragedies,” Prahl takes up the 737 MAX accidents to understand how the relationship between human and machine was constructed by professional aviators in an online discussion forum within the criticalities of the recent developments of automation in the aviation sector. This fascinating and insightful narrative analysis of professional pilots’ discourse surrounding the tragedies touches on the constellation of technologizing factors that converge to constitute HMC in organizations (Evans, 2017; Fortunati & Edwards, 2021). As Prahl et al. maintain, by involving AI, sensors, judgment, and control, “the modern flightdeck is a quintessential example of the ‘cluster’ of technologies and processes that define modern workplaces where human-machine communication takes place” (Prahl et al., p. 29). Three encompassing narratives were identified in aviation professionals’ discussion posts in a global online forum: *human versus machine as a zero-sum game* (a win for automation is a loss for human workers), *surrender to machines* (a belief in the inevitable triumph of automation processes), and *an epidemic of distrust* (pervasive loss of whole industry credibility). Prahl et al. raise important questions about the study of HMC involving machines that are not ostensibly designed to communicate, discuss implications of automation for professional identity, and advance “the need to further study the factors that lead to both the resentment *of* and resignation *to* machines” (p. 39, emphasis in original). As Prahl et al. aptly conclude of the pilots’ narrative discourse,

their actions have spurred a discussion which offers a window into the future of the complicated relationship between human and machine. A decade from now, we are sure to be witnessing these same tensions in the countless other industries implementing automation. At that time, we may not look back to aviation and think ‘we’ve seen this movie before,’ but we can rest assured that aviation and the 737 MAX incidents provide a sneak preview. (p. 40)

Aviation is a paradigmatic sector for the history of automation. Here the first autopilot was introduced. The recent tragedies of air travel teach that the development of automation takes place in a world apart from the concrete practices of daily organizational life and if its outcome is not sufficiently communicated and explained, it cannot be integrated within the world of aviation effectively. From Prahla et al.'s research emerges clear evidence that the division of labor between machines and pilots has not been sufficiently outlined; consequently, neither has the division of roles between them. Therefore, the autonomy of the machines takes the power of decisions from pilots to elsewhere. Problematic management of human resources also emerges: aviation companies focus more on machines than on human pilots. This means that human resources management in this sector has become a sort of peripheral objective rather than the core of the related business model. In addition to being dangerous for both pilots and passengers, this strategy is self-destructive on the part of companies, because if they do not understand that they have to correct the trend the sector risks crashing. As Darling (2021) pointed out, "when talking about robots, anthropologists Alexandra Mateescu and Madeline Clare Elish like to use the term 'integrate' instead of the more commonly used word 'deploy' because, as Elish says, 'integrate' prompts the question 'into what?'" (p. 49). Relationships among automation and labor require holistic consideration of the complex contexts, systems, and structures in which they are formed.

Prahla et al.'s paper also leads us to reflect on the current ideology that drives managers not only in the aviation sector but also, for example, in the automotive sector and it highlights the immediate necessity to explore their opinions, attitudes, and behaviors on an empirical level. What do they imagine about machines, automation, and artificial intelligence? What do they think of the workers' value and role? How do they conceptualize workers: Are they viewed as error-prone remnants of the past or do managers think that it is economically advantageous to reduce the work they have to do? And what is (and should be) the role of regulatory bodies in the face of current developments in automation and artificial intelligence?

In the second article, Riley Richards and Associate Editors Patric Spence and Chad Edwards offer a broad perspective on research trends and trajectories in HMC. In "Human-Machine Communication Scholarship Trends: An Examination of Research From 2011 to 2021 in Communication Journals," Richards et al. present the results of a content analysis of articles published over the last decade in 28 communication-specific journals (9,000+ articles). The results paint a valuable picture of the incidence and influence of HMC scholarship relative to the larger scholarship in Communication Science/Studies. This is useful to understand the state-of-the-subdiscipline and identify areas of strength as well as gaps in our collective research endeavors. Richards et al. shed light on how HMC is being constructed through scholarly publication by determining the percentage of regional, national, and international communication journal articles centering HMC, and codifying the contexts of study and methodological approaches. As they report, only a small fraction of communication research pertains to HMC, but since 2018, 2 years before the establishment of the *Human-Machine Communication* journal, there has been rapid growth that "highlights both the need for the journal and the emergence of the field of study" (p. 52). Their analysis reveals that the most examined context of HMC concerns interpersonal communication/relationships, which is in line with a pervasive tendency among HMC scholars to approach machines as interpersonal or quasi-interpersonal others in communication

(Fortunati & Edwards, 2020), and that the most examined specific settings of interaction include VR/AR and HRI. They report that HMC scholarship reflects a mix of methodological approaches and an interdisciplinary character. Richards et al. conclude by highlighting the need for more qualitative, rhetorical, observational, critical, and theory-building work.

This content analysis brings us back to the useful exercise of questioning how the field of HMC research moves and where it goes. Researchers today experience a great tension between the need for specialization and the desire to keep an overview of the great analytical frameworks in which the issues they investigate are situated. This tension is difficult to handle because scholars are forced to mediate between these two divergent tendencies (Cacciari & Franck, 1981). The solution invoked by Richards et al. also is to maintain a strategy of inclusiveness. This strategy is of vital importance to framing the psycho-social and cultural aspects of HMC within society. Societies have become increasingly complex systems in which the potential increase in social relationships (offline and online) is accompanied by an unprecedented speed of change. In the last few decades, social sciences—understood as systems of knowledge, theories, and methodologies, which serves to explain the social world and its changes—have had to face at least four major disruptions that have had a notable impact on the world of knowledge:

(1) The globalization and internationalization of knowledge, research networks, and the scientific community, which on the one hand has enormously expanded the amount of scholarship produced in terms of books and articles (e.g., Knight, 2007) and on the other hand has intensified the competition between scholars to achieve status in a knowledge-production enterprise measured with bibliometric instruments (e.g., impact factor) (see Gingras, 2014).

(2) The advent of the internet, which has simultaneously offered a series of very useful tools (Wikipedia, search engines, automatic translators, automatic correctors, etc.) and built a parallel and intersecting reality with the offline one, where the production of knowledge from below is confused with multiple manipulation strategies from above (e.g., Elwood, 2008; Gläser, 2003).

(3) The lack of new theoretical frameworks and methods, since, in practical terms, we are using century-old methodological tools, excepting some new applications such as structural equation models, multilevel linear regression models, sentiment analysis, and text mining. We face, as Richards et al. point out, a dramatic lack of appropriate and updated theories to understand the meaning of machines in communication.

(4) The crisis of the university as a place traditionally dedicated to the production of knowledge but subject to the development of centripetal forces of dissolution of knowledge itself (on the one hand, difficulties in staying up-to-date given the sheer number of books and articles that should be read and difficulties in understanding society holistically due to disciplinary barriers that make fields of investigation increasingly narrow; on the other hand, students who are insufficiently skilled in literacy, written and oral expression, and critical thinking) (e.g., Christopherson et al., 2014).

Social sciences today are forced to face the challenge of complexity imposed by these four disruptions to continue interpreting society and predicting trends in social phenomena, structures, and dimensions: Communication is the first of these. Complexity does not mean that there is no longer anything simple in society, but that it is more difficult to get to the simple. What strategies have been applied to deal with complexity so far? Roughly, there

are three: (1) the development of specializations and fine-detailed analyses, (2) the shift in focus from causation to associations, and (3) the use of interdisciplinarity. These strategies have come with some advantages and some disadvantages, but because the disadvantages have often outweighed, we believe it is appropriate to consider alternative strategies for dealing with the complexity. For instance, one technique may be to resort to the so-called Pareto principle (or the 80-20 rule) to identify which are the most relevant factors (20%) to interpret for the current society. Another insight that Richards et al. give us is the need for building HMC theory. While we hope that this article will be an important stimulus for early and more established researchers to advance new theories, it is also crucial to work on our research questions. Framing the psycho-social and cultural aspects of HMC in a post-COVID era requires constructing a different picture of the relationship between society and technology. Humankind has experienced a new centrality of machines in their lives on a massive scale. To work or to teach/learn over the past few years has required extensive use of computers and mobile phones. What has all of this meant in terms of our cultural attitudes toward machines? What were the most relevant changes? Have we become friends with machines or do we feel subjugated? Or, to ponder from the more macro level, what do we want from machines?

Perhaps *meliorism*, in the unique sense it was figured in pragmatist social theory by William James (1977), is a useful perspective to dust off and resurrect at this juncture because it is the doctrine comfortable resting on the brink of both hope and despair for the future while emphasizing that the realization of specific futures depends on the choices we make in the present. Meliorism stands outside the deterministic binary of naïve optimism and cynical pessimism about the course of humanity to underline that the world can be made better by human effort: “It holds up improvement as at least possible; whereas determinism assures us that our whole notion of possibility is born of human ignorance and that the necessity and impossibility between them rule the destinies of the world” (p. 54). In the meliorist spirit, the what-if becomes as or more important than the what-is, and the task of social theorists and social life more generally is to link choice and consequence toward the realization of ameliorative futures (James, 1907/1991). Realizing the potentials of this new field of HMC requires being proactive rather than merely reactive to past and present developments. There is a greater chance for good if we are poised and ready to play a shaping role in the design, implementation, regulation, and socialization surrounding human-machine communication. This requires taking stock, based on the best available thinking to date, of *what we believe HMC needs to be and not to be, whether we are heading in the right direction, and which actions will be most beneficial.*

There is a productive tension generated by the field’s need to simultaneously study what is and anticipate what if. An anticipatory positionality recognizes the various ways in which historical and current conditions may, through human action and technological capabilities, lead to potential futures that benefit or burden our identities, ideation, relationships, cultures, and social structures to varying degrees of desirability. Staying abreast in our research and criticism often necessitates the use of anticipatory methodologies, including experiments or surveys which introduce plausible HMC partners, communication practices, and contexts of interaction that are not (yet) pervasive in naturalistic settings, as well as the use of anticipatory theoretical lenses which seek to address the possible alongside the actual of HMC. Experiments, in particular, have emerged as a useful design for the field’s

anticipatory posture (Richards et al., this volume). Often praised for high levels of control and maligned for contrived situations, experiments nonetheless offer a singular advantage in modeling possible futures by allowing the creation of bounded social realities reflecting communication conditions that may or may not come to pass, but which cannot (yet) be observed. Thus, there is always a tradeoff: experimental conditions are simplified and unrealistic, but they are also a rare means of generating data and serendipitous findings on simulated speculative futures of HMC. The key is that anticipatory designs must be informed and accountable to the teachings of the long history of communication and technology and naturalistic inquiry of HMC in the present (e.g., Prahel et al.).

Asking the Big Questions: The Other and the Hybrid in HMC

The next articles in the volume contribute in exactly those ways encouraged by Richards et al. (2022) because they feature HMC inquiry at the philosophical, theoretical, critical, and synthetic literature review levels. David Gunkel, in his essay “The Symptom of Ethics: Rethinking Ethics in the Face of the Machine,” offers an elegant and provoking application of “the symptom,” figured by Žižek as “that excluded ‘part that has no part’” (p. 68) to characterize the place of the machine in ethics. The essay progresses by first tracing Žižek’s unique operationalization of the symptom, then demonstrating how the machine is the symptom of ethics by its definitional always/already exclusion from the circle of moral philosophy, next considering the available but flawed contemporary attempts to accommodate the machine in ethics, and finally discussing the implications of understanding the machine as the symptom for the excluded other and communication ethics more broadly. “What we need to do in the face of the machine . . . is to recognize the symptom as such and allow it to question the entire history of ethics and its necessary and unavoidable exclusions” concludes Gunkel. “The challenge presented to us by the machine is not just a matter of applied ethics; it invites and entrains us to rethink the entire *modus operandi* of moral philosophy all the way down” (p. 80).

Gunkel’s essay offers an interesting integration of a philosophical perspective into the current debate about mental models and social representations of the place that humans, animals, and machines occupy in the universe (see, e.g., Banks et al.’s 2021 “Forms and frames: Mind, morality, and trust in robots across prototypical interactions”). Such models and representations form the basis of people’s perceptions, attitudes, and opinions about interactions with artificial agents. This paper provokes the invitation to further explore this theme from a psychological and sociological perspective. The HMC community has already investigated and discussed contemporary ontological boundaries between humans, animals, and machines at a qualitative level (Edwards, 2018; Etzrodt & Engesser, 2021; Guzman, 2020), but there is also the need to go for representative surveys capable of capturing whether the ontological frameworks that affect people’s attitudes and behaviors are changing and, if so, in which directions. As a scientific community, we should learn to live with the symptom of which Gunkel talks in his essay and to cultivate it, to understand the strategies with which individuals, groups, and societies cope with the permeation of machines into the social body. Not only will this help us make sense of the innovations and technologies which have shaped our daily lives, but also, in turn, to remodel those technologies

according to our needs and desires (Oudshoorn & Pinch, 2003); not only to give them meaning within other meanings but also to question ourselves about their social meanings and roles.

If a scholarly community asks itself small questions, it will always get small answers that satisfy the citadel of specializations but that leave the city of the general discourse completely unguarded. We must be daring with our research questions—even if we already know from the outset that it is difficult to find a convincing answer—because we are aware of the symptom, that is, of the “part that has no part.” We need to continue to explore how laypeople structure the world around them because the changes in the ontological order occurring on social and political levels then go on to enable or constrain transformations of the ethical and philosophical perspectives on rights. We also know that the history of humanity is marked by changes to the structure of the model of the universe. We need to better understand the evolution and history of human culture and to further explore the process of ontogenetic formation of the instability of the borders separating and linking the various spheres of nature, to understand the mental processes through which the tensions between these spheres develop and dissolve, to understand how ontological boundaries are conditioned by a series of historical and cultural sedimentations, and to examine how dreams and imagination relate to these tensions. Moreover, we must also reflect on how visual media—from television onward—have challenged the boundary between reality and its representation.

In effect, if the philosophy of today deals with the theme of accommodating the machine in ethics, the sociology of culture for at least a quarter of a century has been studying the commercial explosion of childhood cartoons, television series, films, and toys that have “the other” as a theme, from robots to hybrids (Fortunati, 1995). We argue that children’s consumption of these cultural artifacts worked as a precognizant strategy of what would happen a few years later in factories and the domestic sphere. The periodic return of the collective imagination to strange creatures arising from weakening ontological boundaries has been possible because these creatures have always been part of human beings’ cultural history.

In the fourth article, “Human, Hybrid, or Machine? Exploring the Trustworthiness of Voice-Based Assistants,” Lisa Weidmüller investigates the applicability of predominant models of trustworthiness to VBAs, which may be considered *hybrid* communication technologies in the sense they are often perceived to be more/other than simply machine. Historically, the trustworthiness of humans and machines has been conceptualized and operationalized distinctly. Whereas human-centered definitions of trustworthiness highlight dimensions of integrity, competence, and benevolence (or character, competence, and caring), machine-centered models stress reliability, functionality, and helpfulness. This opens a question as to which of these approaches to assessing trustworthiness (human, machine, or hybrid) best applies to the emergent ontology of “personified things” (Etzrodt & Engesser, 2021). Results of an online survey of German university students ($N = 853$) and staff ($N = 435$) demonstrated acceptable model fit for both human and hybrid trustworthiness models, but insufficient fit for the machine model; further, fit was moderated by prior experience with VBAs. As Weidmüller points out, this exploratory investigation draws attention to the important topic of valid and reliable instrumentation for measuring HMC

variables in ways suitable to the unique features of context. There are broad implications for the community to test to the extent to which variables, concepts, and constructs originally developed to investigate impressions of humans or machines will fit the human-machine mold, and to explore conceptual and operational hybridity.

Weidmüller's article and the emergent ontology of "personified things" studied by Etzrodt and Engesser (2021) reopen the specific question of hybridity between humans and machines. Voice-based virtual assistants represent the resurgence of the hybrid within the field of social robotics. As we said above, hybridity is not a new issue or a fruit of our contemporaneity. Rather, today's hybrid assemblages may be viewed as modern-day manifestations of ancient and original tendencies. Ancient Greek myths tell us that the boundaries between the various elements of nature were perceived as fluid; the Greeks originated a wonderful repository of hybrid creatures, which demonstrates the collapse of all kinds of borders between beings. Even the boundary between deities and humans was malleable to the point that their unions gave life to the demigods, or the half-human/half-gods, who were endowed with superhuman powers but were not fully divine. In fact, demigods were usually mortal, except in some very rare cases (e.g., Dionysus).

If the boundaries between deities and humans were permeable, even more so were those between humans and the world of animals, plants, and minerals. Let us start with the first family of hybrids, which consisted of fusions between humans and animals, and was perhaps inspired by fears of "unnatural" relations between the two (e.g., bestiality practices). To recall a few, there were the Harpies (women's head, vulture's body, dragon wings and claws, bear ears, and wolf teeth), the Sirens (bird-women with florid breasts, feathered wings, feminine face sometimes bearded, rapacious claws, lion's paws, and egg-shaped lower body), the Centaur (half man and half horse), and the Satyr (man's body with ears, tail, and possibly horse or goat hooves) (Gigante Lazara, 1986, p. 11). The second family is composed of the hybrids between humans and plants, and includes, for example, the Botuan, a man-plant with a human face, arms and feet, and a palm body, and the Wak-Wak, a mythical tree whose fruits, which were human beings, detached and fell to the ground when ripe. This tree, which probably represents a version of the Tree of Life, was present in numerous cultures with variations: in the Chinese version, children were born, in the Indian version girls, in the Arab version unidentified living beings, and in the European version women, or the tree itself was the transformation of human beings (Baltrušaitis, 1982, p. 130; Dal Lago, 1991, p. 228).

The third family included the human/stone hybrid. In many cultures, it is told that humanity was born from stones. It is also handed down that the Persian god Mithra was born from a stone; in Phrygia, the Great Mother Cybele was a stone fallen from heaven; according to the myth of Deucalion and Pyrrha, they became the progenitors of a new human race, since they threw stones behind them from which the new humanity was formed. The age-old personification and deification of stones explain why in ancient Rome, some altars and statues were reported to sweat, bleed, or even shed tears (Bloch, 1981, p. 101), a phenomenon that continues up to the present day.

The question of hybridization not only involved fusions between humans and other elements of nature, but also fusions between other elements of nature with each other. The fourth family included hybrids between animals and plants, such as pomegranates that

produced birds, or branches that, once fallen from the tree, dragged themselves along like snakes (Baltrušaitis, 1982, p. 131), as well as hybrids between animals and minerals, such as the zoomorphic depiction of nature as a whole (jaws, beaks, and faces were outlined on nature, which appeared threatening in every aspect; Baltrušaitis, 1982, p. 214). The idea of zoomorphic nature originated in the East—in the Chinese topographical system Feng-Shui, the earth's crust was seen as traversed by secret forces composed of a male matrix that corresponded to the blue dragon and a female matrix that corresponded to the white tiger—then passed through Egypt and arrived through Greece in the West. In the Renaissance, for example, Leonardo da Vinci suggested applying the same method he developed to observe and interpret the stains that formed on the walls to the reading of animal forms in nature. An analogous conception of the earth-animal is found in Mexico, where an insatiable toad-shaped monster devours not only the dead but also the sun and the stars at sunset (Neumann, 1981, p. 185).

The family of hybrids most interesting for our discourse is that including the hybridization between humans and inanimate objects. This innovation traces to Hieronymus Bosch, who painted objects in union with quadrupeds as well as human beings, such as vases equipped with a woman's bust and a donkey's head. In this integration of objects, it was once again the East that gave a rich life to the union of tools and human beings. The oldest depictions of object processions come from Japan in the form of an overturned bowl that runs on its handles, a suitcase with eyes and a mouth for a lock, and a sheathed knife that trots on two legs. Japan also had personified objects: these were kitchen utensils and humanized boxes with human form and intelligence. This trend continues up to the present day and manifests, for example, in the alphabets in which the letters are formed by human characters (Muratova, 1985, pp. 1359–1360). In this framework, the hybridization between humans and machines deserves special comment. The figure which probably embodies this phenomenon most directly is Talos, a being made of bronze, half-human/half-automaton, whose task was to protect Crete (Magnenat Thalmann, 2022). Because of its metallic nature, it could jump into the fire to become hot and then pursue enemies forcing them into a deadly embrace. Talos was kept alive by a single vein that crossed its body from neck to ankle, where it was closed by a nail or membrane to prevent spillage of its vital liquid.

Thus, at the level of culture, Talos's myth tells us that the hybridization of humans with machines is one of the most prominent archetypes of humanity. Arguably, the hybrid is such a vital cultural component of the archeology of imagination that it lives in every child. On this idea, Freud (1990) maintained that “the child is forced to recapitulate during the early stages of his [sic] development all the changes in the human race” (p. 234). Expanding Freud's intuition, Piaget and Inhelder (1970) stated that

the child explains human beings to the same extent that they explain the child, and often more, since if the first educates the second through multiple social transmissions, every adult, even if a creator nevertheless began with being a child. (p. 9)

In the same vein, Lévi-Strauss (1958) affirmed that the psychology of the very young child constitutes “the universal fund infinitely richer than that available to any particular society.” And again: “at birth, and in the form of sketched mental structures, every child bears the

entirety of the means which humanity has at its disposal from eternity to define its relations with the world” (pp. 119–120).

Other processes and elements, however, resonate with the hybrid and contribute to further shaping how humans experience it. They are the development of the psychology of the child and the various stages of the construction of reality as well as the formation and structure of the imagination. Symbolic thinking together with the original ghosts takes shape only from a certain point in the child’s life which is, precisely, in the proto-perceptive and proto-cognitive space. The newborn, at the moment of birth and in the earliest period of extra-uterine life, is scarcely able to differentiate the perceptive capacities addressed to the external world. Newborns are unable to perceive their organism as separate from what surrounds them, and thus they are unable to focus upon and distinguish the nuanced characteristics of external objects. In this context arises the experience of trespassing boundaries and the possible interchange and sliding of some characteristics from one object to another. This is where infants relive the dimension of the hybrid and, once experienced, this dimension will later claim its presence within the fully-developed structures of the individual, contributing to the constitution of dreams, daydream fantasies, and creative processes (Funari, 1988, pp. 27–29). In dreams, also, the experience of the hybrid presents itself as the phenomenon of condensation, which is the fusion of two images into a single composite image; for example, a person who unites the features of two distinct people (Piaget, 1982, p. 184). After this type of assimilation, thought cannot undo the union and fully differentiate the two people in a way that returns them to their original features. The composite image remains at least at an unconscious level in the imagination, even if we no longer remember it consciously. Durand offers us a great contribution in understanding how the hybrid is present in the imagination of children and also remains in our imaginations as adults, without there being an ontological first between the two. Indeed, it is impossible to scientifically establish ontogenesis and phylogeny of symbols, and so it is convenient, suggests Durand (1987, p. 29ff), to place oneself on what he defines as an “anthropological journey,” a place where there is a two-way reciprocal influence of inner drive and the surrounding material and social environment. At the conclusion of our discourse on the hybrid, we can see that voice-based virtual assistants can be perceived as hybrids because we have a pre-existing and primeval form of this concept.

Addressing the Domestic Sphere: Gender, Labor, and the Political Economy of HMC

The context in which the next three articles are situated is in the domestic sphere. HMC is analyzed at various levels in relation to communication, sexuality, and care. The domestic sphere is the dominant sphere of the capital system and is where the highest amount of value is extracted by the five giants of the web: Google (Alphabet), Apple, Facebook (Meta), Amazon, and Microsoft. These monopolistic multinationals have rapidly expanded especially in the West, creating a techno-information complex that has created an impressive capitalization, further facilitated by tax avoidance and political lobbying. “The combined yearly revenue of Amazon, Apple, Alphabet, Microsoft and Facebook,” writes Shira Ovide in *The New York Times* (October 12, 2021), “is about \$1.2 trillion, according to earnings reported this week, more than 25 percent higher than the figure just as the pandemic started

to bite in 2020. In less than a week, those five giants make more in sales than McDonald's does in a year." The domestic sphere, in addition to talking about an enormous extraction of capital value in areas such as communication, sex, and care, talks also about the hybridization that makes it impossible to distinguish the contribution of HMC from mobile communication and from that mediated by computer in the process of value formation. We cannot forget that, although each of these forms of communication contributes to altering in a specific way everything each finds in their paths, which makes it worth it to analyze them separately, they are all fueling the insatiable appetite of digital technology that is among the most powerful economic forces shaping the world today. This implies not only that the contexts in which communication, socialization, sex, and care occur has changed but also that their social meaning has changed since they have become fields of direct extraction of value in addition to their historical function as areas of domestic labor and thus of indirect extraction of value through the exploitation of the labor force (Fortunati, 2018).

In the fifth article, "Considering the Context to Build Theory in HCI, HRI, and HMC: Explicating Differences in Processes of Communication and Socialization With Social Technologies," Andrew Gambino and Bingjie Liu make a significant contribution to theory-building by demonstrating specific ways in which digital HMC processes may differ from interpersonal, face-to-face processes. In the first volume of *Human-Machine Communication*, Gambino et al. (2020) proposed an extension of CASA, stating that people do not necessarily apply social scripts associated with human-human interactions as claimed by CASA theory, but perhaps also social scripts associated with interactions specific to media entities. In the present paper, Gambino and Liu build their theoretical contribution via a comparison perspective, which has a long tradition in the history of communication studies as means to identify both the differences and similarities, the advantages and disadvantages of the various forms of in-person and mediated communication.

As Gambino and Liu point out, one of the challenges of theorizing HMC is that our research cannot always match the pace of technological development, which has necessitated a focus on affordances, features, and use practices with probabilistic effects across many media, technologies, and platforms (p. 112). For example, Carmina Rodríguez-Hidalgo, in the inaugural (2020) volume of *HMC* introduced a model of enacted communicative affordances which reconciles the robotics and communication science perspectives in light of unique aspects of communication with social robots. Gambino and Liu propose a brilliant and broadly-useful avenue for HMC theory-building rooted in "consideration of the relationship between *contextual* factors in HMC and those in theories of communication and relationships" (p. 112). The heart of the essay is an elaborated demonstration of how two existing theories of socialization and message production may play out differently in HMC and human interaction because of contextual distinctions. Wisely, Gambino and Liu chose to look at communication as being tightly interconnected with socialization. The linkage between communication and sociality is unavoidable in the practices of everyday life. Take work, for example, or primary socialization processes: How would it be possible to manage, organize, and carry out work without communicating or accompanying children into society without teaching them communication skills? Moreover, communication is not only needed to elicit sociability, but sociability also promotes communication. As Fortunati and Taipale (2012) argued, "since communication is an action with a low output of energy, to be effective and to last over time it has to be embedded in social relations and activities,

which imply a higher energy requirement” (p. 34). What Gambino and Liu show us is the important effect of the circularity of communicative behaviors from one context to another one. For example, they explain how the communication mode with which people approach a machine may reverberate on their interpersonal communication practices, potentially to the detriment of those involved.

The authors also suggest there may be reduced opportunities for observational learning (Social Learning Theory) in the context of digital HMC because it often involves private use. This may, among other things, “lead to a developmental calculus (i.e., the ratio of experiential and observational learning) that relies more heavily on experiential learning” (p. 115). There are massive possible consequences of the proliferation of socialization practices that rest on people’s direct experience with machine interlocutors and these include altered behavioral norms and interaction scripts. As Berger (2005) wrote about computer-mediated communication, “the interaction procedures and conventions associated with the use of these technologies may subtly insinuate themselves over time into the conduct of nonmediated social interaction, thus altering the fundamental nature of face-to-face communication” (p. 435). The concern for potential interactions between people’s conduct in HMC and their conduct in human social interaction demands greater theoretical and empirical attention. Second, in the case of the goal structure undergirding message production, Gambino and Liu consider differences in the objectives for communication people may bring to their interactions with machines in comparison to other humans, differences arising from context-linked aspects of the (perceived) nature of humans and machines and their capabilities, roles, and functions. For example, face concerns and social judgment fears may figure less prominently in the goals driving message production in digital HMC than human communication. This article by Gambino and Liu is a must-read, not only for its erudite recommendations for advancing HMC theory but for the exemplary exercise of tracing out in two concrete examples those aspects of context that necessitate theoretical reconfiguration.

In the sixth article, “Sex With Robots and Human-Machine Sexualities: Encounters Between Human-Machine Communication and Sexuality Studies,” Marco Dehnert examines the topic of sex robots as fertile ground for theorizing from an HMC perspective. Like Gambino and Liu, Dehnert foregrounds *context* as key to theory-building. Further developing a critical approach to HMC (see Dehnert, 2021; Dehnert & Leach, 2021; Fortunati & Edwards, 2020), Dehnert draws HMC and sexuality studies (SeS) into conversation with each other to consider the meanings of intimacy, love, and sexuality among humans and machines. As in the case of ethics and moral philosophy (Gunkel), the machine is also a radical communicative other in the context of sexuality. By intersecting HMC and SeS frameworks, Dehnert pursues a fluid, more-than-human, and ecological conceptualization of communicative sexuotechnical assemblages. There are provocative implications, as Dehnert argues, for both theory and practice in HMC. In terms of theory, these approaches allow for more nuanced perspectives of sex robots that avoid both utopian and dystopian visions of them. In terms of design, Dehnert argues that we must problematize the meaning and representation of sex, gender, age, ability, power relations, and anthropomorphism as they are modeled in sex robots, which must always and only be understood in the context of larger systems of meaning (on this point, see also “Social robots as the bride? Understanding the construction of gender in a Japanese social robot product” by Jindong Liu, 2021).

This paper suggests the need to reflect on the topic of sex robots from a wider perspective. Dehnert has the merit to distill this theme to a concentrated technical analysis, searching along the way for suggestions and perspectives in the literature of sexuality studies. Beyond the conclusions he arrives at, it remains to be understood why human sexuality has been so readily subjected first to the forces of digitalization and then to those of automation. Sexuality is a crucial task, which on the one hand, constitutes part of the unpaid domestic work within the process of the reproduction of the workforce and, on the other hand, encompasses sex work, which may be paid more or less but with the attendant cost of a strong, social stigma. By digitizing sex (making it virtual and disembodied) and now automating sex (making it nonhuman and asocial), what do these forces of mechanization aim to achieve? No doubt, the purpose is to extract more value, as stated above, because part of domestic sexuality work has been transferred online (monetized and compensated) where it is now consumed especially by men, but also by cultivating an ever-larger separation between one individual and another, creating stronger dividing walls between human beings. After the advent of the feminist movement and its various waves, sexuality has become a great field of resistance and struggle on the part of women and LGBTQ communities who have challenged and loosened the coupling between sexuality and the reproduction of children (e.g., Arrow et al., 2021). The regulation of relations between men and women has also been transformed. It is on the wave of these developments that so-called online porn has developed, largely in response to the struggles of women who, for example, no longer enact sexuality in the domestic space to respond only to male needs as they were once historically and socially shaped to do. The specific consequences of the introduction of digital porn and now of sex robots for the quality, value, and meaning of individuals' sexuality must be foremost concerns. The point is that for the capital system not only does sexuality become an additional terrain in which to make money at the expense of consumers but it also becomes a formidable terrain of control and command over people's sexuality through machines. According to Dubé and Anctil (2021, p. 1206) "the private sector is racing to develop new erotic products to occupy an untapped sextech market that is estimated to be worth \$30–120 billion." It is within this broad contextual understanding of commercialized digitization and automation processes that we must further interrogate what value of sexuality is lost, gained, or transformed for individuals.

With the next article, we conclude the trilogy of articles whose topics align with the domestic sphere. In particular, we come to discuss how a specific type of care work in society has been picked up by machines. Austin Beattie and Andrew High, in the sixth article, "I Get by With a Little Help From My Bots: Implications of Machine Agents in the Context of Social Support," present an implication-rich synthetic literature review of HMC research relevant to seeking emotional support from bots. Beattie and High ground their project in the historic and rising contemporary developments in chatbots designed to provide therapy, emotional assistance, and supportive interactions. Based on their organized review of research on seeking and processing support in HMC, Beattie and High articulate conflicting and testable perspectives touching the heart of an important issue for both researchers and users of such technologies: When one partner is a bot, are the processes and outcomes of social support richer (*improvement perspective*) or poorer (*impairment perspective*)? Resonant with the theme of *context* threading through this volume, Beattie and High suggest that as a starting point for further inquiry, researchers should attend to "the characteristics

and qualities of contexts in which machines may impair or improve supportive outcomes, as well as how factors such as technological efficacy, the severity of the stressor, how stigmatizing a stressor is perceived to be, or a bot's degree of humanness influence the process of support represent several clear starting points for further inquiry" (p. 162).

This synthetic literature review invites us to reflect on what has happened and is currently happening to care work in society. Why do people feel compelled to or choose to turn to machines for emotional support? Once again, the answer to this question is to be found at least in part in restructured gender and labor relations, since care and support work of this nature has historically been associated with women and the domestic sphere. On the one hand, women face the impossibility of being the sole performers of family care due to the overall rhythms of their work, which often form a non-stop continuum between housework and waged work; in this sense, care work and that demanded by the market have become irreconcilable because of practical demands on time and energy. On the other hand, they may face the desire to put an end to an unpaid job falling mostly to them within families as a reaffirmation of their right to social appreciation and the economic regulation of domestic work. People of advanced age have been the first to experience the consequences of the impossibility for families (and especially women) to perform the entirety of care for their members. In the redistribution of domestic work within couples that took place after feminism, men took on only a part (varying from country to country) of this work. At the same time, governments of many Western countries (including the US during the Trump administration) have made substantial cuts to their social welfare systems (The Lancet Commissions, 2021), reducing or eliminating adequate funding for nursing homes, in-home eldercare, and paid family leave to care for older family members, as well as social services for children such as nurseries, kindergartens, after-school activities, cafeterias, and dedicated public transportation. The potentially dehumanizing aspect of this social and economic organization is that it both strips people of the time and resources needed to take care of each other, while simultaneously throwing more care work back onto the shoulders of individuals. Technologies can help in caring (because a robot or a bot is likely better than having no one), but automated care may also risk a relevant deterioration of the quality of care work. In their article, Beattie and High foreground this important possibility and offer paths for investigating when, why, and how the use of bots may improve or impair care.

Examining Industry: HMC Applications and Theory in Education and the Factory

The last two articles in this volume deal with specific and future-facing social contexts involving the use of AI and robotic technologies: education and the factory. AI and robotics arrive in societies which Bolin (2022) describes as

late, modern life in the technologically advanced parts of the world can be described as having entered a deepened form of informational capitalism, based on the datafication of social domains and colonizing parts of our lifeworlds that have previously been outside of the market (Bolin, 2018; Couldry & Mejias, 2019; Snircek, 2017). (p. 23)

Neo-capitalism affects all societal domains and these final articles examine two important sectors—education and the factory—which are undergoing particularly rapid and dramatic automation processes at this moment. Let us start with education, which belongs to the sphere of social reproduction and is the place where knowledge is shared with young generations to prepare and train them for their future work and professions, and to socialize them for public life. Over the past few decades, this sector has been colonized by processes such as computerization and datafication (van Dijck et al., 2018) and because of the COVID-19 pandemic, it has been forced to transform its main tasks—teaching and learning—from in-person to online or hybrid activities. Education stands out as especially affected by the recent wave of neo-capitalism because the opportunities for platform companies to capture new market shares have rapidly multiplied. Looking at the school sector, the OECD (2021) writes:

Last year, 1.5 billion students in 188 countries were locked out of their school. Some of them were able to find their way around closed school doors, through alternative learning opportunities, well supported by their parents and teachers. However, many remained shut out when their school shut down, particularly those from the most marginalized groups, who did not have access to digital learning resources or lacked the support or motivation to learn on their own. The learning losses that follow from school closures could throw long shadows over the economic well-being of individuals and nations. The crisis has exposed the many inadequacies and inequities in our school systems. (p. 3)

Even at the higher education level, which is presumed less vulnerable than primary and secondary schools because university students are expected to be self-directed and independent in their studies, this pandemic has shown that aside from questions about the efficiency of online teaching and learning, the move from teachers' autonomy to automated data analytics (van Dijck et al., 2018) has been tumultuous. At the same time, COVID-19 has shown that it was cost-saving to offload the expenses for rooms, energy, IT support, Wi-Fi, and equipment onto teachers and students, to the extent that some worry there is a risk that "lecturers and researchers will become freelancers or subcontractors in the trade of knowledge" (Bolin, 2022, p. 31).

It is in the light of this framework that the eighth article, "Embracing AI-Based Education: Perceived Social Presence of Human Teachers and Expectations About Machine Teachers in Online Education," by Jihyun Kim, Kelly Merrill Jr., Kun Xu, and Deanna Sellnow should be read. In particular, this article reports the results of an online survey exploring whether and how students' prior experiences with human-taught online courses were linked to their expectations of AI teaching assistants in the future. The results indicated that the social presence (psychological involvement) of the human teacher was associated with more positive attitudes toward an AI teaching assistant and higher intentions to adopt the technology if given the opportunity. Kim et al. explore the meaning and implications of the link between experiences with humans and expectancies of machine partners. "It is not clear yet when a machine teacher or AI-based education will be readily available in higher education" (p. 178) they note, but their findings reinforce and reflect the reality that when

machine partners fulfill roles traditionally performed by human beings, there will be cognitive, affective, and behavioral carryover that colors reactions toward them.

The other social context analyzed by the ninth and final article is factories, which are places with a long history of powerful impacts by machinic development. This article is entitled “Exoskeletons and the Future of Work: Envisioning Power and Control in a Workforce Without Limits” and is written by Gavin Kirkwood, Nan Wilkenfeld, and Norah Dunbar. Kirkwood et al. offer a valuable contribution to theorizing and gaming out the implications of wearable robotics, which present a site for investigating the literal, embodied combination of human and machine in the workplace. Specifically, their purpose is to “discuss the potential of industrial exoskeleton technologies to shape human-machine and human-human power relationships across a variety of industries and theorize how power dynamics might change in these settings” (p. 188). Using Dunbar’s interpersonally-oriented dyadic power theory (DPT) (Dunbar, 2004; Dunbar et al., 2016), Kirkwood et al. artfully trace how power, interpersonal dynamics, and autonomy may be disrupted in the face of emergent technologies. They demonstrate the applicability of DPT to the context of exoskeletons in workplace HMC and offer revised theoretical propositions adapted to the unique contextual features which arise. Issues of authority (who ought to have control) and resources (including their implications for diversity, equity, and inclusion) are of utmost importance in human-machine configurations, and there is much to cross-apply from their negotiation in interpersonal communication. At the same time, the differences to these processes introduced by HMC necessitate theoretical extension and refinement. To that end, Kirkwood et al. offer a series of revised propositions intended to forward an expanded theory useful for studying the integration of exoskeletons in workforces.

Exoskeletons are an interesting topic to investigate and reflect upon since they are the contemporary emblem of an important move that is happening in the factory. As in the domestic sphere and in the sphere of social reproduction, machines have come increasingly close to the human body (e.g., mobile phones, laptops, Google Glass, Oculus, Google watch, and so on) and even penetrate it (e.g., the pacemaker). In factories, also, machines increasingly approach the human body of workers. The consequence is that workers today have shifted from being machine appendages to becoming an integral part of the machines themselves. Exoskeletons are one of the typologies of robotic machines present in today’s factories. Traditional factory robots have helped pave the way for collaborative robots or cobots, which, unlike most of the industrial robots adopted up to 2008, which were designed to operate autonomously or with limited guidance and were protected by barriers, are designed to physically interact with humans in a workspace. Collaborative robots, however, along with the cluster of technologies and processes such as soft automation, digitalization, AI, big data, social media, and 3D printers (Evans, 2017), which are redesigning the factory world today, are far from being truly collaborative. Instead, they mainly contribute to dictating the pace of work. Delfanti (2021) for example, has focused on the effects of this technological and organizational regime on Amazon workers, analyzing their struggles across the world. He reports that in their protests against the work rhythms imposed by the machines “to increase their productivity, standardize tasks, facilitate worker turnover, and ultimately gain control over the workforce” (p. 40), their slogan was “We are not robots!”

The article by Kirkwood et al. on exoskeletons is an important addition to the study carried out by Andrew Prahll “Fight for Flight: The Narratives of Human Versus Machine

Following “Two Aviation Tragedies” to investigate the critical issues of the recent developments in aviation automation and to the studies published in Volume 2 of this journal by Piercy and Gist-Mackey (2021) on workers’ anxiety in respect to the diffusion of automation in the pharmacy context and by Prahl and Van Swol (2021) on the behavioral and psychological effects of replacing humans with robots in the financial sector. We hope this accumulating body of work will encourage other contributions on industrial or commercial sectors.

Conclusion

At this phase in the development of HMC as a field of study, there remains the need for more research on actual practices of use that illuminate meaning-making between humans and machines in naturalistic environments (Fortunati & Edwards, 2020, 2021). At the same time, there is the practical reality that many of the technologies and interaction practices of interest in HMC are undergoing rapid development and change, are still at the prototyping level (Fortunati et al., 2021), or rest on speculative probabilistic futures for communication technologies. Thus, we are faced with dual and sometimes conflicting demands to ground research and theory in the real and unfolding lifeworld of human-machine communication, and to also claim a seat at the table during the earliest phases in design, testing, implementation, law and policy, and ethics to *intervene* for social good. Such interventions must be performed, in each case, before it becomes too late to make a difference in the emerging practical realities of HMC. Taking up this second role requires serious consideration of what we want from HMC, honest assessment of whether we are moving in productive or unproductive directions in society, and strong advocacy for those designs and practices which safeguard the dignity, inclusivity, and well-being of humanity and other earth communities. After all, the main trajectory of social theory passes through the level of description, which enables explanation, which allows prediction (Albridge, 1999), which finally empowers *action*.¹

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