Gender and Human-Machine Communication: Where Are We?

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The time has come to take stock of the discussion on gender and human-machine communication (HMC) in terms of where we have come from and where we may go. Undoubtedly, much work has been done on specific aspects of the relation between gender and HMC, but we lack a coherent systematization of the efforts made so far. The purpose of this article is to do just that: to root the analysis of gender and HMC on a historical level, develop it in a comparative perspective with other forms of communication, and finally embed it in a sociological and political dimension. In other words, we seek to avoid the three fatal flaws Carey (2005) identified for internet studies and which were more recently taken up by Jones (2014). To do so it is important to keep in mind the three elements that we want to analyze—gender, communication, and technology—by putting them in resonance with each other while recognizing that all are subject to change over time.

Elsewhere, drawing on Jones (2014, p. 251), Fortunati (forthcoming) pointed out that in general the technologies of information and communication (ICTs) that have succeeded in the domain of communication have caused the progressive removal of human beings from in-person communication and depreciated the relationships between them. In other words, according to Fortunati, the shift from in-person to mediated communication in all its forms has outlined the progressive evacuation of individuals from the communicative scene. The physical separation of human beings from each other has weakened them, given the potential huge opening in the virtual space of social relationships that these technologies have implied. Specifically, bodily separation has devitalized people as workers and citizens, and in the end, it also has broken down human/machine binaries.

Drawing on this discourse, our main thesis here is that ICTs such as the telephone, mobile phone, computer, and robot were all first and primarily designed to support and advance male users and have given them more power in a domain—communication—in which there were virtually no significant remaining differences between women and men. The penetration of these technologies into the social body has required women to take a

long and tiring approach to them in the attempt to redesign and reshape these technologies according to their needs. In fact, women have played the most important role in the co-construction of these technologies, but this domestication process has involved phases of the social exclusion of women from information society and of a progressive comeback. Just how difficult this journey has been and continues to be for women is exemplified by gaps still existing today in many areas of the world in technology access, use, and competency. The construction of more advantages for men has had the effect of rebuilding their power differential in the family, power which had previously been decreased by the struggles of the various waves of feminism. This power inequity has been rebuilt starting from communication because this is the first ground of confrontation in the man–woman relationship. As we said above, women obviously did not willingly accept trends of technologically reconstructing their subordination to their husband/partner/father/brother and they have tried to appropriate these technologies by transforming them from power technologies into empowerment technologies (Fortunati, 2014). However, the fact remains that these technologies function as tools of immaterial domestic work. The power of men as a social group has been reassembled through these technologies to allow the direct penetration of capital into the immaterial spheres of the reproduction of individuals, which have been machinized and where direct value is now extracted, in addition to the value produced by women and incorporated into the labor force (Fortunati, forthcoming).

The structure of the article is organized as follows: in the next section, we will analyze the theme of gender, including how this notion has historically and politically been set up, and for what reasons. Then we will examine the meaning of gender for women as a social class and what it represents to them. Next, we will analyze the notion of gender in communication, reviewing historically and comparatively the forms of communication that have succeeded each other over time. We will start by considering gender in in-person communication, then we will progress to consider what happens to gender when it is mediated by the most important ICTs that preceded HMC: the telephone, mobile phone, and computer-mediated communication (CMC). In all of these sections, we will continue to outline the historical framework necessary to analyze the last section of the essay, which focuses on gender in HMC. In the conclusion, we will set up some final sociological and political reflections on the social meaning of these technologies for gender and specifically for women.

What is gender?

Let us start with a historical reconstruction of the notion of gender. The intellectual starting point was de Beauvoir's discourse in 1949 that anticipated many arguments of the sex-gender debate. She wrote, "One is not born, but rather becomes, a woman," (1973, p. 301) concluding that femininity is not an eternal essence but is the result of contingent forces. However, the term *gender* only began to be used as distinct from sex in the English debate of the 1970s. Its meaning was defined in terms of socially constructed femininity and masculinity, in opposition to sex which was defined as biological differences between men and women. The need to contest biological determinism arose from the fact that biology, considered a careful guardian of nature, was often invoked as an inevitable and sad destiny for women and a justification for women's oppression. This distinction between gender and

sex has been made necessary by the fact that much of what was considered *biological* in Western culture was the probable result of education, cultural conventions, social pressures, beliefs, and prejudice. We owe Ann Oakley (1972) for proposing the distinction between sex (a biological term), and gender (a social and psychological term). Although people may be categorized as male or female at the biological level, they are pressured by culture to be and become masculine or feminine through processes of socialization (Oakley, 1996).

Consequently, in this framework sex was seen as a fixed element, whereas gender was considered changeable, historically determined, and influenced by political and social factors (Rubin, 1975). Over time, this idea turned out not to be completely correct in the sense that as Fausto-Sterling pointed out (1993, 2005), sex is also subject to changes over history caused by the force of culture, although such changes are not as fast or awesome as the changes in gender. In fact, the idea of two biological sexes is now recognized as reductive given the rich spectral diversity in chromosomal, genetic/DNA-based, cellular, and hormone-linked possibilities observed by biologists in the intervening years. The concrete operationalization of this sex-gender conception, however, has never been easy. Not by chance, Butler (1990) expressed concerns about the practical distinction between biological sex and social gender. Stone (2007) argued, however, that recognizing both sex and gender as socially constructed does not make sex identical to gender. In the same vein, Nicholson (1994) contended that it is society, rooted in sexed bodies, that fixes the amount of femininity and masculinity of humans as being either male or female. Thus, the notion of sex-gender is far from being clear since it is difficult to draw the line between sex and gender. Moreover, there is no consensus about which social practices construct gender, what their social constructions consist of, and what it means to have a certain degree of femininity or masculinity (Mikkola, 2022). This lack of consensus is probably due to the fact that the term *society* is employed generally in this debate, without specifying *the who* in society, except for a generic male-masculine or patriarchal ruling power.

In this definitional debate about gender, some tech scholars have also intervened. For example, Rakow (1986) proposed that gender is

> both something we do and something we think with, both a set of social practices and a system of cultural technologies. The social practices—the 'doing' of gender— and the cultural meanings—'thinking the world'—. . . constitute us as women and men, organized into a particular configuration of social relation. (p. 21)

Putnam (1982) even suggested treating gender as an effect rather than a factor determining communication. Incorporating the performative lens, the vision of gender has been expanded to acknowledge the differences between women and the differences between men (Eckert & Wenger, 2005, p. 165) and its intersectionality with other variables such as age, ethnicity, and class. This definition has been further implemented by Kessler and McKenna (1978) who distinguished different features of gender: gender assignment (gender classification at birth), gender attribution (the assignment to a gender classification in social interactions), gender role (the behavior of an individual being male- or female-like) and gender identity (feeling male or female). Robert Stoller (1968) investigated the psychological effects of having lived with an erroneous gender assignment at birth. In the mid-1980s, gender began to be replaced by *sexual difference*, a less dualistic and broader expression.

Post-structural thinking contributed to the debate on gender by opening a discourse on the social constructivism of gender (Irigaray, 1984; Kristeva, 1984) and, drawing on Foucault (1979) and Butler (1990), proposing additional categories—such as transgender—and thereby arriving at a more *diffuse* gender categorization. In light of this debate, gender shifted from being binary (categorizing men as a group and women as a group) to articulating different forms of doing gender. The notion of a *gender continuum* was introduced, which made room for third genders, agender, two-spirit, and different dimensional models of gender (Søraa, 2017). This discussion is pivotal because gender is an important marker of identity that helps people to relate to one another, is characterized by cultural norms and practices, and is bound to power structures and relationships (Alesich & Rigby, 2017).

The debate on gender is, however, broader than that and it develops by introducing into the framework very important elements. Katherine Millett (1971), for example, argued that gender is socially constructed through socialization: in the classic example, a female becomes a woman by acquiring feminine traits and learning feminine behavior. Butler (1990) added that the ascription of gender is the outcome of a process of *girling* and *boying* beginning before birth and then strengthened by performativity practices. Consequently, the solution for creating more equal societies is unlearning social roles and social practices. Socialization also implicates social learning: Sharpe (1976) and Renzetti and Curran (1992) described how the different socialization of boys and girls at home and school affected how they learned to become men and women. Socialization and social learning recur in many feminist analyses, along with education (e.g., Kimmel, 2000), social roles, and practices that are all seen as the outcome of behaviors that shape women's subordination to an unspecified male power. A relevant limitation of this debate is that it does not clarify what should be considered appropriate for each gender. These approaches show how current socialization, social learning, social roles, and social practices produce gender stereotypes, but they refrain from indicating what constitutes *good* socialization, social learning, social roles, and social practices. In the same way, they do not specify what a *non-stereotypical* woman or man would be.

Other scholars have tried to identify concrete reasons for the social practices that produce stereotypical men and women. For example, Chodorow (1978, 1995) argued men and women develop different personalities that begin in early infancy as responses to the fact that mothers tend to identify more with daughters than with sons; therefore, to remedy the formation of gender stereotypes, fathers and mothers should be equally involved in parenting. Another argument (although less fully elaborated and less influential than the previous one), was advanced by MacKinnon (1989), for whom the notion of gender should be rooted in a theory of sexuality, which identifies the power relation between men and women as a crucial factor from which the sexual dominance of masculinity and the sexual submissiveness of femininity derives.

Two major contributions to the gender debate were offered by S. James (1953) and Lees (1993). In 1953, S. James wrote the essay "A Woman's Place," in which she described the life conditions of women in post-war Los Angeles. This essay for the first time implicated domestic labor as the main reason for women's status weakness and the first link in the chain of their oppression and exploitation. In the same vein, Lees argued that the construction of masculinity and femininity is based on the relations of power that shape domestic roles to the disadvantage of girls and women. After its initial impulse, the gender debate

has developed a range of analytics and arguments: gendered social series (Young, 1997), resemblance nominalism (Stoljar, 1995), gender realism and particularity (Spelman, 1988), normativity (Butler, 1990), gender uniessentialism (Witt, 2011), and gender as positionality (Alcoff, 2006). It is not surprising that this theoretical development has imploded: when the feminist movement began to ebb, the political analysis and theory of course suffered.

However, in this debate on gender, one of the most important themes has been the identification of women as a social group, collective, category, or class, although the treatment of this theme has become thorny. Instead of stimulating reflection on women's social stratification, the recognition of differences in nationality, ethnicity, class, sexual orientation, and social position ended up sowing doubts about whether it was possible to build a truly inclusive feminist movement. Very often in these analyses and their given theoretical approaches, women are seen as passive social subjects, devoid of any agency. However, the theme of the domestic work which forms the basis of the power relationships that women undergo has remained on the table, offering the possibility to contextualize, frame, and give meaning to the other processes analyzed: socialization, education, social learning, social roles, and practices.

What is gender for women?

Among the folds of the theoretical discourse on gender, it is possible to deduce what gender has been and has become for the broad category woman. Feminism was born by revealing and imposing gender as a politically, economically, and sociologically substantive variable. Gender became a political node, in which gender identity was negotiated, reshaped, and reformulated, since the perception of belonging to the gender socially associated with one's biological sex, which is often operationalized with the binary categories male or female and which is the first component of sexual identity, was leaving a large margin of dissatisfaction among people. At the mass level, gender identity seems to increasingly outdistance the canons fixed socially as desirable, but undoubtedly the lack of clarity and proactiveness that has characterized the debate on gender, as we have seen above, weighs heavily in this situation. Gender identity has become a true terrain of political struggle against the biopower (Foucault, 1979), or the body of practices and regulations tuned by modern nation-states for achieving the subjugations of bodies and the control of populations.

Equally strong are the struggles that have invested the second component of sexual identity, role identity, with which a person expresses their belonging to a certain biological gender with respect to the outside world. The gender division of social roles has been contested, expressing a more healthily fluid aspect. Today a man can express talents traditionally considered feminine such as cooking, sewing or designing clothes, and taking care of the body, and a woman can play roles traditionally perceived as masculine such as astronaut. But these experimentations in terms of personal expressiveness, which can be seen as innovative and satisfying, actually obscure struggle on the gender division of domestic work between partners. Although less intense now than in the past, reluctance persists on the part of men as a social group to contribute an equal amount of domestic and care work. The role most contested by women is that of housewife, or roles of mother and partner which are rooted in domestic labor. This is the primary role from which all the other social roles for women derive. The primeval weakness of being unwaged workers in the house

determines the weakness of position at the social level from which women suffer. Women's gender roles open issues of political strategies to compose new conditions of life for women, but this is not the place to deepen this discourse appropriately.

Here it is sufficient to stress that gender has become a terrain of confrontation about power and control of women's labor and social roles as well as a place of insubordination and political initiatives by women and their strategical allies: LGBTQ+ communities. One of these initiatives was the birth in the 1980s of women's studies or gender studies, which had the merit to make feminism a recognized part of academic knowledge production and sharing (Fortunati, 2018). We should not forget that the 1980s was the period in which an undeclared war against feminism was fought largely in the media, where many articles claimed that feminists had gone too far with their political program and had created a lot of discontent among women. Also in response to that, women's studies became a major academic discipline, but perhaps with the inevitable effect of institutionalizing the feminist discourse.

Gender and communication: Where are we?

The second element implicated in our discourse is communication. This is the primary terrain in which elaboration and presentation of the self, socialization and social relationships (including work relationships), and life organization take place and inevitably cultural, social, economic, and political changes reshape communication. These changes are particularly important for women, because, as Rakow (1986) states "it is in communication that this gender system is accomplished. Gender" . . . "takes place as interaction and social practice, all of which are communication processes. That is, communication creates genders who create communication" (p. 23).

The most important point here is that the debate on gender and communication, just because of the difficulty of operationalizing the sex-gender notion, risks remaining stuck within an approach focusing on male and female differences regarding opinions, attitudes, and behaviors in communication practices. Therefore, there is the need to generate an analytical framework capable of addressing these concerns. In this framework, which is diachronic and synchronic at the same time, the analysis of the relation between gender and communication opens the question of women's agency and subjectivity in the social changes that have reshaped this relation in the shift from in-person communication to telephone (mobile and fixed) communication, to CMC and HMC. The theoretical framework of reference for this analysis is informed by the long tradition of feminist Marxism (Cox & Federici, 1975; Dalla Costa & James, 1972; Fortunati, 1981), which will help us to outline the historical and social meaning of the relation between gender, communication, and technology, the three elements introduced above. This theoretical framework counts on many established contributions from other traditions, which have shed light on many features and meanings of contemporary communication regarding men and women.

In the domestic sphere, the diffusion of ICTs has had the specific implication of strengthening the gendered and racialized division of labor in the home. While it has conjured against the rooting of the process of individual reproduction in the materiality of life, it has worked as a privatizing mechanism that has decreased the need to leave the house or talk to or make love with another human being (see the surrogate sexuality provided by

sex robots, Atanasoski & Vora, 2020) and has legitimized the development of relationships of domination and dehumanization (Schiller & McMahon, 2019; Woods, 2018). Moreover, the process of separation of one individual from the other, which we talked about before, is also a specific attack against women and the domestic sphere, because the machinization of individuals at the communication level has further decreased the value of the reproduction of the labor force, which historically is the outcome of women's work process. On the one hand, men and women come to be more easily controlled (Andrejevic, 2007; Zuboff, 2019), but above all on the other hand they have become an additional source of surplus value production (Jarrett, 2015); in fact, the labor force no longer works only in the production sphere, but also, and increasingly more, in the sphere of domestic reproduction (although women continue to be the backbone of this sphere), creating an enormous amount of value (Fuchs, 2017).

This process was particularly crucial for women and the issue of gender because it developed in a particular, historical moment in which in the domestic sphere, after the various waves of feminism, women had reshaped gender power relationships within the family to be more in their favor. Specifically, they reinforced their mastery and control over in-person communication (where, as we will see later, a lack of differences between men and women have been documented), appropriated communication in the public sphere (after thousands of years of exclusion), and redefined intergenerational power relationships within the family in favor of the youngest (Fortunati, 1998). Paradoxically, this power women attained at the communicative level has been reduced by the diffusion of digital technologies in the domestic sphere. Unfortunately, the process described so far did not meet a solid defense from women, who chose not only to favor the so-called white goods such as domestic appliances, which could bring about a more equal division of labor within the household and thus liberate them immediately from a certain amount of material fatigue, but also to neglect the so-called brown goods, such as electronic and digital devices, which were perceived by women as more connected to the entertainment dimension. This strategy on the part of women, labeled by Gray (1992) as calculated ignorance, was revealed to be dangerous in the long term, given the unequal power relationships within the family. Women's competence in the use of domestic appliances ended up being perceived socially as a sign of a lack of power, while men's competence in the use of ICTs strengthened their power. In this process, there has been a crucial shift that held particular importance regarding the gender issue: the introduction of the computer into the domestic sphere. Specifically, through the computer, women's comparative strength in the domain of communication was downsized (e.g., Herring & Martinson, 2004), since this artifact was designed (even more than the telephone and the mobile) primarily by men and for men (especially those who were affluent, Western, White, young people; see Wyche et al., 2016). Women as a group have not been early adopters of digital technologies, although research shows that women tend to be more open than men to the technology if it is easy to use (Vankatesh & Morris, 2000). Consequently, women have required more time to domesticate and appropriate these devices. Among digital technologies, the computer has been a specific case in which the appropriation by women was particularly difficult, because, as Wajcman (2010, p. 146) pointed out, there was a widespread sensation among women that the computer/internet was not serving them well. We will learn more about this topic in the section dedicated to CMC. To conclude this discourse, the most relevant gender difference that crosses all these fields of communication

is this: despite shouldering alongside men an attack by these technologies on their identities as workers and citizens, women also bore an assault on their identity *as women*, rendering them more vulnerable than men.

Gender Differences and Gender Diversities in In-Person Communication

In-person communication is a social process in which individuals create meanings by talking, viewing, and listening to and with one another. By doing so, each interlocutor makes sense of the attributes and traits of the other interlocutor in relation to the self (Goffman, 1959). The visibility of others and their performances enables communicators to take stock of others' appearances and behavior as an essential part of this process. Communication is thus intrinsic to social relationships and ultimately to how society forms (Mead, 1967).

Historically, the physical presence of the interlocutors created a context in which they perceived themselves as self-located in the same spatial environment and felt that they could interact with that environment. The body of research on in-person communication (Cummings et al., 2021) allows us to figure out how different components of a person's sense of presence such as perceived self-location, sense of co-presence, and judgments of social realism play a big role in this mode of communication (Heeter, 1992). Moreover, the notion of embodied cognition, which stipulates that the body and brain are intertwined, with cognition being influenced by the physical sensations and actions of the body (Varela et al., 1992), points out how in-person communication embodies the maximum potential for harmonic performance. In a similar vein, presence is also a complex psychological construct with several potential dimensions. Despite its common reduction to *being there*, presence has been defined and typologized repeatedly over the past three decades (Heeter, 1992; K. M. Lee, 2004; Lombard & Ditton, 1997; Slater, 2009; Slater & Wilbur, 1997). One of the most commonly accepted explications conceptualizes presence based on a three-factor typology: physical presence (experiencing actual physical objects), social presence (experiencing actual social actors), and self-presence (experiencing one's actual self) (K. M. Lee, 2004). However, these aspects of presence are themselves often further treated multidimensionally within the broader literature. For instance, physical presence (sometimes referred to as spatial presence) has been regarded as a two-dimensional construct consisting of self-location (perceiving oneself as inhabiting a spatial environment) and perceived action possibilities (the sense that one can interact with that environment; Wirth et al., 2007).

Systematic literature reviews on social presence have found that it can be construed as the sense of *being there with a real person* (Oh et al., 2018), yet consists of the separate feelings of copresence, psychological involvement, and a behavioral engagement factor (Biocca et al., 2003). One key component of social presence is copresence (Biocca et al., 2003; Oh et al., 2018), which refers to the psychological connection and proximity experienced with another person and the perception of potential interaction (Nowak, 2001). As a consequence, as Richardson (2015) pointed out, individuals only experience their full humanity, and we would add their full sociality when confronted with other humans.

Several other elements, however, should be considered pivotal to understanding the social foundations of in-person communication and to capturing the changes that the mediation of technology has introduced in the relation between gender and communication.

Let us at least consider the presentation of the self, the role of the human body, sociality, and labor. The presentation of self and the materialization of the human body facilitate social categorization (gender, age, ethnicity, and so on), supporting the stereotyping and discrimination processes that are the costs generated by automatic, category-based information (Eyssel & Hegel, 2012). Furthermore, the presentation of the material self depends, within certain limits, on criteria of visibility, authenticity, and reciprocal control. A relevant extension of the human body is the voice, which during in-person communication allows us to generate social categorization and regulate social behaviors. All bodily cues serve to reduce communication uncertainty by aiding in the formation of impressions, refining the understanding of the interlocutors, and predicting their mental and physical status (Infante et al., 1997). Collectively, they help communicators manage their conversations and build interpersonal relationships.

Historically, communication, like many other domains, is shaped by the social structure and its class stratification, which is founded on the attribution of more social, political, and economic power to men who have the task of mediating the power of capital toward women, children, and older people. Factors such as the power difference between men and women, the weight of social construction of gendered identities, and the strength of gendered socialization processes, as well as the associated stereotypes, norms, expectations, and performances, have all contributed to generating a different relation with communication on the part of men and women as social groups. However, after the first and second waves of feminism, these differences in in-person communication were attenuated until their virtual disappearance. Returning to the observation we made at the beginning, several meta-analyses exploring many dimensions and variables of communication have documented very small or non-existent sex differences in communication behavior.

The first of these meta-analyses was carried out by Dindia and Allen (1992) who found that there were only small differences in men's and women's self-disclosure. The second meta-analysis, which was conducted by Canary and Hause (1993), again found minimal communication differences between men and women in their persuasibility and aggression, verbal ability, self-disclosure, helping behavior, small group performance, leadership behaviors, and evaluation of others; further, these small differences were moderated by a series of factors other than sex. They also found that there were no statistically significant sex differences regarding interruptions, five dimensions of interaction (relational control, source of information, time orientation, evolution of information, and reducing equivocality), and marital conflict behaviors. Canary and Hause (1993) also remonstrated the unfortunate reliance on sex role stereotypes at the research level with the implication that sex role stereotypes and sex polarization were perpetuated through communication science. Moreover, they identified as conceptual shortcomings the lack of a valid measure of gender and a dearth of theory on how sex/gender and communication are related (p. 130). Much of this research offered results directly counter to popular stereotypes of men's and women's communication tendencies. D. James and Drakich (1993) clarified that men talked more than women in mixed-sex interactions and in formal and public situations, whereas women tended to talk more in private and informal situations and same-sex interactions. More recently, Leaper and Ayres (2007) found again that men were more talkative and used more assertive speech whereas women used more affiliative speech. Even women's presumed biological advantage for language ability appeared trivial when empirically observed and

evidenced a decrease over time (Gleason & Ely, 2002). The same happened for verbal ability, on which Hyde and Linn (1988) produced a meta-analysis reporting a minuscule difference between the sexes. Even when such differences were statistically significant, their effect sizes were minimal to the point of social insignificance. Further, they became more consistent when moderator variables such as interactive context, measurement quality, and publication characteristics were taken into account. A careful examination of the huge body of literature that has tried to capture all these gender differences in communication brings scholars to converge toward recognizing that there are very few differences between men and women at the communication level (e.g., Goldsmith & Fulfs, 1999).

These studies that have obtained this important outcome have some limitations. First, the majority of these essentially investigates sex differences (i.e., differences between the behaviors of men and women) rather than gender differences (i.e., the prevalence of behaviors and characteristics that different cultures associate with masculinity and femininity). Second, they only describe these differences without trying to interpret them. Even the lack of differences between men and women has been insufficiently interrogated and probed for sense and meaning. By contrast, drawing on Canary and Hause (1993), we could ask if this communication gap has practically disappeared or has migrated and opened in other dimensions of daily life. Probably, both of these answers are true on some level and each owes to the fact that women's (and in part also men's) agency on a practical level has been weakening the sexual division of labor which forms the basis of the entire structure of society. Sex is no longer that wall, capable of dividing men and women in a radical and frontal way, at least in the communication domain. Therefore, we argue that the demolition of this wall has implicated for capital the need to erect, as mentioned in the introduction, other walls—walls built up by the new strategy of dividing each individual from the other and also rearticulating at a higher level the division of communication work on the line of gender. These new walls have been reintroduced by means of digital technology.

However, before analyzing what happened with the various technological artifacts, it is worth concluding this discourse on gender and in-person communication. The elements we analyzed so far such as the presentation of the self, the role of the human body, sociality, and labor, are pivotal not only to understanding the social foundations of in-person communication, but also to capturing the changes that the mediation of technology has introduced in the relation between gender and communication. From a communicative point of view, the human body can be considered a complex platform that conveys several languages, among which is nonverbal language. The voice can communicate emotions in varying timbre, tone, and rhythm, regardless of the verbal content, and according to Ricci Bitti (1987, pp. 102–114), offers the advantage that its emotional modalities are less controllable than facial expressions. People rely on bodily cues to form impressions and make judgments of interlocutors (Berger & Calabrese, 1975). Sociality itself needs exist in and through communication (how, for example, would it be possible to accompany a child into society without teaching them communication skills?) and, at the same time, it promotes communication, since to be effective and to last over time it must be embedded in social activities, like going with our friends to a restaurant or the cinema (Fortunati et al., 2013). We need to go out and move into public spaces to do things with others to nourish the communicative process. Mobility also comes into play, even if once we have reached our interlocutor, the setting of conversations is generally sedentary: we talk with others mainly

while we are sitting. We can also converse when walking but it is a rarer context for in-person communication. The "immobility" that accompanies communication will grow more extreme under the influence of communication devices. Finally, labor is interconnected with communication not only because people cannot work if they do not pass-through communication, but also because communication is labor in the domestic sphere. Reproductive labor is constituted by different tasks, such as affect, love, sex, psychological support, knowledge sharing, entertainment, and information, which are all conveyed in and through communication. Thus, this labor, which still involves women much more than men, is the spine of value production in the domestic sphere (e.g., Fortunati, 1981; Hochschild, 1983). Care labor, rooted in communication, is also grounded in cooperation and organization since to build and maintain concrete forms of sociability we need to work in coordination with others. In light of these specifications, it is clear that sociability is a process that applies an intensified logic: individuals feel more reassured and are more reassuring if they can practice any of the sociability forms together with another person, through communication. In fact, Mou and Xu (2017) found that in communication with a chatbot, people expressed a higher level of neuroticism and lower levels of openness, agreeableness, extroversion, consciousness, and self-disclosure compared to communication with another human being.

The scenario we have described so far and which is typical of in-person communication has been profoundly affected by the diffusion of digital technology, which is both a source and a consequence of gender relations, and in which "social relations (including gender relations) are materialized" (Wajcman, 2010, p. 147; L. A. Suchman, 2009). In the next two sections, we will investigate how gender has been reshaped by the fixed telephone and the mobile phone and in turn how these technologies have been reshaped by gender.

Gendering Fixed Telephone Communication

The third element of our analysis, technology, is a relevant source of change in itself and also because it mediates communication. Especially digital technologies—the mobile phone, computer, and robot—change over time both because of the advancements in science and technology that produce innovations in their affordances, forms, features, functions, services, and applications, as well as because of their continue reinvention by "produsers" (Bruns, 2007). The changes produced in the technological domain are relevant not only to communication but also to gender since both gender and technology are products of a moving relational process, which emerges from mutual shaping (Wajcman, 2010). Thus, when we look at the intersection of these three elements—gender, communication, and technology—the historical moment comes to matter particularly, given their structural dynamicity.

The telephone was the first tool used to inaugurate the processes of physically separating individuals from one another and challenging women's empowerment. Of course, it was presented to people the other way around: as a device that could shorten the distance between individuals far away from each other. The two aspects are both true, but the second was so exciting that it quietly overshadowed the first, which is perhaps the most relevant. The reason that the first aspect was considered unimportant may have been that in-person communication was by far the most widespread form of communication. After all, if we

consider that on average people made very few phone calls a day and that on average those lasted only a few minutes, telephone communication represented in the eyes of people a good opportunity to overcome geographical distances that were otherwise insurmountable without much effect on the status quo. Even the fact that in order to communicate by telephone people had to pay did not elicit the proper reaction as one would expect, although it was the first time that at the mass level communication began to cost. An important feature that has not been sufficiently emphasized in the debate is that the fixed telephone was introduced into the households as a family device, submitted to collective use. The contract was signed by the head of the house who could check the number and length of calls made by each family member because the bill was addressed to the account holder. The fact that access to the telephone retraced the hierarchy of gender relationships has heavily affected women's access and use of this tool within the family and also at a social level (e.g., women received a large number of abusive calls).

In this physical separation between individuals, the telephone retained a vital element that served as a bridge between the world of the living and that of the artifice. This element was the voice, which lies precisely on the boundary between the materiality of the human body and the artificiality of the twisted pair. The voice blurs the boundaries of the body, rendering them uncertain because it expands a few meters away from the body. Of all the cues typical of in-person communication, only the voice remains in telephone communication. However, the voice is a primary element since it conveys a series of social cues of the interlocutors, and, among them, the gender cue, which usually is the primary information that communicators seek to obtain (Turkle, 1995). Our brains, as Nass remarked in an interview (Stober, 2008), are so tuned to speech that they react to a voice as to a person and, thanks to the voice of the interlocutor, people forget their absence.

However, the extrapolation of only a part of the human body—the voice—makes the human body a secondary entity of the telephone interlocutor. Telephone first, and then all the other ICTs, have increased the separation of the human body from the communicating individual with the consequence that communication was also separated into its parts. From a unitary process, communication became increasingly more partial and a specific alienation in the communication sphere emerged, which was also accompanied by the profound joy of being able to go beyond spatial constraints and talk to distant people. The telephone was the first device to shape a form of communication in which emotions and nonverbal signals were hindered, if not prevented. This separation has meant that the mind was more likely than the body to become the central, true protagonist in the mediated communication process. As Manovich (2001) has argued, the main feature of new media is not the individuals' presence through media, but their absence through media, that is, their anti-presence. The tele-absence of the individual in mediated communication confines the body to a secondary role and to what could be described as a discriminated or suppressed condition. The new reality is that the affordances, needs, and desires of the human body are largely ignored. We need to understand more in detail what really happens with and to bodies in communication processes. For example, the physical and emotional infrastructures of communication processes have become separated from the words and thoughts that are conveyed inside the process. Furthermore, emotions have a different fate from the human body. Considering the emotions in their essence of inner energy, as Illuz (2007) defined them, somehow they adapt themselves to mediated communication with the consequence

that individuals experience and live emotions in a manner that is not automatically worse (Vincent & Fortunati, 2009). On the contrary, in telephone communication it is the physical infrastructure of the body that is ignored in its potency and peculiarities and, because it is less adaptable, is destined to be more inert. As we already mentioned, in-person communication also requires a certain steadiness, but with the telephone, users are obliged to be even steadier: to sit down in a chair with limited possibilities of motion. Telephone communication became a great training ground for ignoring one's own body and that of the interlocutor. A progressive dematerialization of the communicative process in which the bodies are removed silently takes place.

The debate related to telephone communication goes back to the 1980s and 1990s of the last century especially and involved a relatively small number of scholars engaged in studying its role in social change and social life. The themes addressed by the studies on gender and in-person communication were very partially ferried into the scholarship on telephone communication, which expressed a more sociological approach. The 1980s, especially, were a period in which, following the ebb of feminism, families and social structures were reshaped under a hierarchy reflecting resurgent male dominance. Rakow (1992, 2004) traced a profile of the social meaning of the telephone both for overall society (the telephone has always been seen as an agent of modernization, based on Veblen's analysis of the role of technologies in society) and specifically for women. This debate (e.g., Claisse & Rowe, 1993; Dimmick et al, 1994; Moyal, 1992) was strongly influenced by Max Weber's (1978) distinction between instrumental and intrinsic value: the first was seen as characterizing men's telephone communication, considered functional, and the second, as characterizing women's telephone communication, considered expressive. This stereotyped distinction has contributed to confusion in this field of studies because in reality women's use of the telephone is just as functional as men's: only the functions are different (Fortunati, 1995).

The primary point to be considered here is that women simultaneously transformed the telephone into a work tool of domestic labor and appropriated the telephone to empower themselves by overcoming their isolation and separation from each other (Fischer, 1988). The telephone was transformed by women into a technology of sociability (Fischer, 1988) and psychological support, serving to strengthen the immaterial sphere of housework. At the same time, it gave those who were isolated in their urbanized houses or dispersed in rural areas the possibility to reconstruct their network of family and friendship ties, especially those with women family members, relatives, and friends. This network with strong ties was the social structure on which women based the cultivation of their personal as well as their social and political identity. Women's networks were profoundly different from those of men and would reappear as such in mobile communication (Friebel & Seabright, 2011). However, what media and social discourse labeled as "chatting" was in reality the elaboration of a collective analysis by women on their role within the family and society, their housework, their intimate relationships, and their future. Ann Moyal (1992), analyzing the gendered use of the telephone in Australia, depicted a fascinating fresco of how the counter-power of women's network deployed all its strength for them. She stressed that the feminine information flows were equally important "to national well-being and progress as the more visible and highly rated masculine business information flow" (p. 67). Concerning the United States, Fischer argued that although this device was designed to meet men's needs, women reinvented both the user and the uses inscribed within this technological

artifact. The affinity of women toward the telephone, also detected by Fischer, should in reality be understood as the pleasure felt by women in reshaping this tool according to their needs. Of course, Fischer (1988) was right in stating that the gendering of the telephone "may have simultaneously reinforced gender differences and also amplified women's abilities to attain both their normatively prescribed and personally preferred ends" (p. 212) in an empowering process for women. Two recurring issues in the general debate on telephone and gender were: (1) that this tool was considered capable of freeing women's time from unnecessary travels and reducing their loneliness, isolation, insecurity, and personal anxiety; and (2) the lens through which to observe the mechanisms of gender power was the issue of who answered the telephone. Rakow (2004) reported that the leader of the Association for Protection of Telephone Subscribers suggested reserving this task to "the servant" or the woman of the house. The fact that women were expected to answer the phone testifies that at that time in industrialized countries telephone technologies, in general, were seen as mere instruments, not as signs of social prestige. If in the house answering the telephone was seen as a woman's task, in the factory, it was the task of an employee, often a secretary, but not of a manager. This situation will occur again with the mobile phone: its early adopters, who were usually affluent persons (Fortunati, 1995), entrusted the task of dealing with screen intrusions to the personal secretary. This situation will also reappear with the computer and the informatization of the productive system (Fortunati, 1998). The ICTs will become a prestige commodity only in parallel with the increasing economic power of large companies such as Microsoft, Google, Facebook, Apple, and Twitter.

Finally, in the debate on the relation between the telephone and gender, the point was also who talked more on the telephone. There was evidence that women distinguished themselves as talkers. Rakow (2004) argued that being responsible for maintaining family and social relationships and home-business transactions meant women had to use this device more than men. News of this evidence, however, was met with disapproval or derision by the popular press and by the managers of the telephone companies themselves, who, not seeing housework as proper work, condemned themselves to not understand the market (Fischer, 1988, p. 217). Since domestic labor also was not recognized socially as true work by the various members of the family (although this had been one of the feminist objectives of the struggles of the 1970s), when the telephone bill arrived, women were often pushed to feel guilty for having used it so much (Fortunati, 1995).

Gendering Mobile Communication

The mobile phone continued the processes of challenging women's empowerment and promoting physical separation between individuals; both of these were inaugurated by the fixed telephone, but the second was further exacerbated through what has been called phubbing (or phone snubbing, e.g., Vanden Abeele, 2020). The conversation with and the attention toward the person(s) physically present takes a backseat when a phone call arrives. This marks visibly in the public space the devaluation of relational engagement with the embodied co-present interlocutor (Gergen talked of absent presence, 2002). At the same time, the mobile phone collapsed the distance between technologies and the human body since the device lies over the human body. The loss of distance blurred the perception not only of

the alterity between the human body and this wearable technology but also of the physical separation between individuals.

Researchers looked at the new telephone on the move differently compared to the telephone, although even here the sociological approach continued to prevail. The second half of the 1990s is a period in which strong forces of increased individualization (Wellman, 2001) made the family less standardized (Fortunati, 1998) and women's conditions of life more empowered. Topics such as the derision toward women because they were too talkative on the phone, or the guilt felt by women for those reproaches receded. However, the theme of women's appropriation of the technological artifact remained on the table and, in particular, the theme of the feminine affinity for a device conveying the voice (Livholts & Bryant, 2013). To understand the novelties that have accompanied this device, the first years of its diffusion should be considered with great attention, because at the end of the last century people decided to completely reshape the mobile phone. First proposed to households as a supplementary telephone to accompany family members on the move and carrying the same conditions of the fixed telephone (contracted and billed to the heads of household, typically men), the mobile phone became within a few years a personal and a personalized device that accompanied individuals both when they were stationary and on the move. Men were initially more likely than women to access and use the mobile phone (Ono & Zavodny, 2005), but this gap very quickly narrowed or closed in many countries (Rainie et al., 2000; World Internet Project, 2010). Starting as a tool subjected to collective use within the family, whose costs were drawn from the family budget (to which men breadwinners typically contributed more) and whose use was controlled by men, women and youth transformed the mobile into a personal and personalized device on whose use and payment they could have control. This reshaping of the mobile phone gave women new freedom and thus new power regarding their communication practices. Since then, the evolution of the domestication by women of a tool designed at the beginning for men has involved various steps, as reconstructed by Pei and Chib (2020), who proposed the notion of mGender to describe a technology women used to negotiate their gender status.

The mobile phone continued to maintain the voice, a treasured aspect of the telephone experience, but, in addition to the dimension of orality, it also developed writing modalities (thanks to youth who, through SMS, found a way to use the mobile phone without paying) and in more recent times, also visual. The extreme flexibility of this tool is well expressed by its ability to return to its users an increasing number of the social cues of their interlocutors and themselves (e.g., the self). The mobile phone is the device that has made living "as if" the interlocutors were with them irresistible for the users (Turkle, 2011).

The use of the mobile phone by women has been quite accelerated by their massive intervention on the material body of the mobile phone, which was originally designed with men in mind (Shade, 2007). Women's pressure on mobile phone manufacturers has pushed them to embark on a long journey with fashion and design to adapt this device to women's tastes and sensitivities to aesthetics (e.g., Fortunati, 2013; Zhang & Juhlin, 2020). In Western countries women also exerted influence on the services, functions, and applications of the mobile phone, gendering this device in feminine terms (Fortunati, 2005; Shade, 2007). The pivotal use of the mobile phone by women has continued to identify it primarily as a work tool. Household management, organization, caring, emotional support and expression,

microcoordination (Ling, 2004), and remote mothering or grandmothering, have passed through the mobile phone both in industrialized countries (Fortunati & Taipale, 2012; Frizzo-Barker & Chow-White, 2012; L. F. Rakow & Navarro, 1993; Sawchuk & Crow, 2012) and also in developing countries (Stark, 2020; Tacchi et al., 2012). However, the mobile phone has also been a means of undoing gender, strengthening women's control of communication, reinforcing their personal autonomy and freedom, including at the political level (Stark, 2020), and making mobile housework and care visible in public space (Hjorth & Lim, 2012). The halo of invisibility that surrounds the immaterial sphere of care work has been shaken by the mobile phone because its use helped to make the expression of intimacy, affection, and so on conspicuous and observable in public places. However, as in the case of the telephone, it is difficult to find a definitive answer to the question of whether the mobile phone has contributed more to decreasing or to expanding women's work, as well as whether it has contributed more to women's empowerment or disempowerment (Stark, 2020). Probably, an answer to these questions will be emergent when much more research has been conducted in developing countries that cannot of course be considered as a monolithic whole. Zainudeen et al. (2010) found, for example, that a larger gender divide in direct access to phones existed at the bottom of the pyramid (the lowest socioeconomic classification) in countries such as Pakistan and India, less in Sri Lanka, and none at all in the Philippines and Thailand.

A growing body of research has found sex differences (operationalized in these studies as comparisons between male and female participants) in the use of mobile telephony in many national and/or cultural contexts, but these studies are not systematic and suffer the same three flaws outlined by Carey (2005) and reported in the introduction: they are not sufficiently historical, lack comparative perspective, and are not sufficiently embedded in politics, economics, religion, and culture. But above all this body of research has continued to not address the problematization of the categories of sex and gender. Regarding the mobile phone, the pivotal, political point here is that women continued to erase their differences from men in access and use of this tool that was emergent at the beginning of its appropriation and to empower themselves through ownership and control of this tool. However, women were unable to contest the main process of the general separation of the individuals. The more women's similarity with and closeness to men progressed, the more digital technologies worked in the direction of spacing out each individual from the other, moving the walls to a higher level.

The debate on the mobile phone has also highlighted several evolutions of this device such as the shift from an oral communication tool to a multifunctional device, the access to the internet through mobile phones, and finally its transformation into a kind of social robot. Notably, Sugiyama (2013) defined the mobile phone as a quasi-robot and Vincent (2013) as a personalized robot along with its user.

Gendering CMC

The physical separation of individuals from each other, which has reached yet a higher level with the diffusion of CMC, again proceeded differently for women who were subjected to a double attack: they, like anyone, were separated by the computer from each other, but they were in many cases also separated by the computer itself. This process has been also

supported by the fact that even though women contributed heavily to the development of computers—not least of all at the programming level—(e.g., Light, 1999, p. 455), women's omission from the history of computer science has perpetuated "misconceptions of women as uninterested or incapable in the field" and contributed to the lack of female role models who used computers (D. M. Marx & Roman, 2002). Hyper-masculine fraternity cultures of computer design have generated a gendering of computing "against which feminist technologists and designers have worked to carve out spaces and create more equitable products" (Lingel & Crawford, 2020, p. 3). The computer/internet was apparently configured as an "everybody" tool, but by applying I-methodology in which designers assumed they were representative of users, they incorporated in the device barriers against specific groups of users such as women, older people, and the differently able (Oudshoorn et al., 2004). The gendered, anti-woman culture has played heavily in the diffusion of CMC and has been amplified also with the diffusion of the computer because its ownership and use replicated the same scheme as the fixed telephone. In the early days, the computer was usually bought by men heads of the house, who also paid for its use and maintenance. In principle, it could be used by all family members, but in practice the computer/internet access and consumption patterns have mirrored the same power structure of the family and the society, becoming a collective, yet hierarchical device. Rendering women's appropriation of the computer/internet even more difficult were other factors: acquiring and maintaining a computer required financial resources and its use demanded many prerequisite skills and literacies which were time-consuming (extra time was not a resource women generally had at their disposal). As Dunne (1998) pointed out, the genders experienced different forms of resonance with computers.

Another important element that played to the detriment of women is that in this mode of communication, at least at first, the human body disappeared completely from the interlocutor's vision. This happened even more severely than in telephone communication because the voice was also evacuated from much of CMC in its initial form, excepting some chatrooms and videos. The absence of the body meant that in CMC all of the social and nonverbal cues were blocked, making it more difficult to manage proper communication and, for example, to identify interlocutors correctly, even at the level of gender (Savicki & Kelley, 2000; Savicki et al., 1999). The computer environment was built at the beginning as a written and silent world in which women, who have always been "more sensitive than men to social cues in general, as many studies have shown, and to nonverbal cues in particular" (Henley, 1973–1974, p. 2), have been deprived of the use of this specific ability, acquired through socialization and learning. If we think that the nonverbal message greatly overwhelms the verbal one, since it carries 4.3 times the weight in a popular estimate (e.g., Birdwhistell, 1970; Mehrabian, 1981) then we have an idea of the disadvantage that this technological artifact has presented for women.

In the first phase, although there was widespread hype that gender was invisible on the internet, computer/internet users were not discouraged from attributing gender based on the limited cues at their disposal. Gender features of text-based communication have been explored by several scholars (e.g., Mulac et al., 2001; Newman et al., 2008). Herring and Martinson (2004) reported that women more frequently made justifications, utilized hedges, expressed emotions, and made use of supportive language, while men more frequently made use of assertive language, asked rhetorical questions, made sexual references,

and challenged others. Over time, people began to use CMC in all phases of their social relationship management: forming new personal relationships (Maddon & Lenhart, 2006), maintaining existing relationships (Johnson et al., 2008), and ending relationships (Gershon, 2008; Weisskirch & Delevi, 2012). However, the disappearance of the body has led to design practices that do not focus sufficiently on incorporating users—and in particular users' identities—in the design process. The lack of the human body in the communication process also affects the presentation of the self, which becomes something with which one can play by representing oneself through nicknames and later through avatars. Yee and Bailenson (2007) documented the alteration of self-representations happening in virtual environments and the consequent changes in behavior and perception that this entails: the so-called Proteus effect. This phenomenon of altering behavior based on the characteristics of one's avatar was investigated further by Sherrick et al. (2014) who analyzed the role of stereotypical beliefs in gender-based activation of this effect. It has been argued that the lack of social presence (e.g., Short et al., 1976) or social cues (e.g., Kiesler et al., 1984) has created an impoverished social environment, although not in the long-term (e.g., Walther, 1996) and this has played particularly against women who are more socially vulnerable in environments little under their control. Other research has looked also at how the CMC channels affect the impression formation of the other, which in this mode of communication passes exclusively through cues such as participants' names, their *linguistic style* and typographical marks, and other textual features (capital and lowercase letters, ellipsis, exclamation marks, typing errors, and emoticons) (e.g., Jacobson, 1999). Moreover, in desk–computer communication, the body is obliged to become even steadier than in telephone communication and to perform only micro-gestures on keyboards and with the mouse. This is not friendly toward the body because well-being is connected to movement and this also has played particularly against women, given that the domestic and care labor that disproportionately falls to them entails moving within the household.

A further element of difficulty for women came from the fact that the internet is a public arena and historically women had been excluded more from public communication to center their life and work especially within the four walls of the house. This contributes to the explanation for why, at the beginning of internet history, women's presence in online discussion and communication forums was dramatically lower than men's. Gender differences in access and use of the computer/internet persisted for almost 2 decades although, over time, different types of gendered consumption emerged in several contexts. Allen (1995) for example reported that women employees perceived email to be easier to use, more efficient, and more effective than men and that they used the computer system for word processing more than their men colleagues. Some years later, Mo et al. (2009) found more pronounced gender differences in communication in single-sex online health support groups and less evident differences in communication patterns in mixed-sex online health support groups. Rainie et al. (2000) found that more American women than men sent an email to maintain ties with family and friends. Other researchers (e.g., Boneva et al., 2001; Colley et al., 2004; Fox et al., 2007; C. Lee, 2003) found that in the US and the UK women's emails and instant messaging were more social in nature, while men's messages were more information-based. Obviously, the educational field has also been the subject of much empirical research. Herring (2003), for example, found that in online mixed-gender discussions, women students showed a more supportive attitude, while men students used

a quite assertive, less polite, and sometimes aggressive language style that pushed women to participate less in these discussions. Miller and Durnell (2004) documented that some gender-related patterns in language use and interaction styles previously identified by Herring (men's domination in mixed-sex interaction, women's preference to use a pseudonym and to employ greater personal and emotional forms) and Tannen (1994) (women's supposed preference for supportive language patterns, men's for authoritative) emerged also in educational CMC. Valenziano (2007) found that women more than men tended to use self-disclosure, express personal opinions, use "I" statements, communicate by apologies, justifications, questions, and support others; by contrast, men more than women tended to argue, use assertiveness, self-promotion, presuppositions, theoretical questions, are authoritative, and challenge and use more humor and sarcasm. She also found that women faculty received more emails from students and tended to answer them sooner than their men colleagues and that there was a high amount of lying and misinterpretation in online communication. Prinsen et al. (2007) reviewed gender differences in computer-supported collaborative learning (CSCL) and found that while male dominance played a role in many CMC environments, this was less pronounced in CSCL because the participation of all the students was explicitly promoted especially in inclusive settings. Koch et al. (2008) documented that women faced more difficulty in building the skills necessary to use the computer since they tend to attribute their failure to their inability, while men were more likely to blame faulty technical equipment. Over time, web services became more user-friendly and required less service-side knowledge and this also had implications for gender differences in CMC. For example, Argamon et al. (2007) found that among bloggers, men used more words connected to politics and business, whereas women used words more linked to interpersonal conversation or relationships. Chan et al. (2013) reported that women engineering postgraduate students engaged more in online communication while men students focused on becoming controllers of information flows; moreover, gender differences emerged in belief gains concerning social aspects, but not in the dimensions of epistemological beliefs. Kimbrough et al. (2013) showed that women, compared to men, preferred and more frequently used text messaging, social media, and online video calls; that is, they used the internet for social interaction and relationship maintenance, whereas men preferred and more frequently used the internet for reading the news, getting financial information, making new relationships, and finding job leads. Bode (2017) found that, differently from what happens in in-person political activity which sees less engagement by women, few gender differences emerged in social media. The most relevant difference was that women were more likely than men to engage in less visible political behaviors. Herring and Demarest (2017) documented that the notion that connected women, audio/video, and positivity, was sociability, while that which connected men, text, and neutrality/negativity, was distancing. Ochnick and Dembińska (2018), studying a sample of 452 Polish students, found that men were more likely than women to become internet-addicted and that their internet use was positively correlated with self-esteem; for women, the correlation was negative. Vella et al. (2019), exploring sociability in online games, found that women players reported misogynistic targeting and stereotype threats (to the extent that they often masked their gender identity) with the consequence that this negatively affected their ability to use voice technology and create social relationships.

Unfortunately, these studies on sex differences are ahistorical and are not brought back to the foundational categories of the social sciences. Furthermore, they do not problematize the notions of sex and gender (related, most measured only whether participants selected male or female) with the consequence that gender stereotypes continue to be perpetuated even in scientific research. Recently, Cryan et al. (2020) demonstrated that gender stereotypes persist in various contexts of computer-mediated and media communication, from biographical pages of notable people, recommendation letters, and Wikipedia entries to fiction novels and movie dialogue. They also pointed out that this issue is magnified by the use of machine learning tools in language processing since these often incorporate gender biases. Gender stereotypes (which certainly persist) are traditionally captured by a gender word inventory, which dates back to 1974. Instead of continuing to use this pre-compiled word lexicon, they propose end-to-end classification approaches because today these are significantly more robust and accurate in detecting gender biases in language. This proposal starts from the premise that, although women and men may process information and problem-solve differently (Czerwiński et al., 2002), in the design of end-user computer programming the human-centric issue has not been considered and this has been at the expense of women (Beckwith & Burnett, 2004; Huff, 2002).

In addition to these stereotypes, the results of research carried out in the first decade of internet diffusion also risk functioning as stereotypes, because they continue to be cited as findings beyond time. On the contrary, the gender gap has been reduced; for example, ITU reported that in 2017 in the Americas, where not by chance gender parity in tertiary education is greater and the percentage of women using the internet is higher than that of men. Moreover, since 2013 the gender gap has narrowed in most regions. By contrast, in Africa, women's percentage of internet use was 25% lower than that of men and even wider in the case of Least Developed Countries (LDCs), where "only one out of seven women is using the internet compared with one out of five men" (ITU, 2017, p. 4). Everywhere, however, there is evidence that the internet continues to be used by men and women for different purposes (e.g., Mäkinen, 2020).

To conclude this part, it is worth noticing that the way in which this debate has developed has obscured the real socioeconomic and political meaning of women's (and also men's) engagement in this field: the fact that men and women, increasingly more separated from each other, are contributing through CMC an enormous, even if different, amount of immaterial and unwaged labor.

What is gender in human-machine communication?

We have reached the last part of our discourse, which is dedicated to HMC and is the main purpose of our analysis. This section reviews how the processes described so far are further radicalized and articulated by this new typology of communication. Here, the analysis concerns not only the relation that women establish with machines and its social consequences but also the attribution of gender to machines. For convenience, we divide this section into two parts: one focused on the gendering of human-machine communication (HMC) and the other on the gender of machines.

Women and Human-Machine Communication

If in CMC the individual is divided from the others by a machine that mediates the communication between them and that at the same time approaches and distances them, in HMC each individual is separated from the others more radically. The human *other* disappears from the communication context since individuals talk to a machine that responds to them. This has serious consequences on the one hand for communication productivity because machines can only transfer their own value (K. Marx, 1964), whereas individuals are able to create and incorporate more value reciprocally. On the other hand, for humans since their disappearance means that they are posited as superfluous with respect to communication labor and that they are subjected to a deep devaluation; as we said, they experience their full humanity and sociality when confronted with other humans. If every individual comes to be devalued by HMC, women are doubly devalued, one as individuals and the other as the traditional performers of domestic, care, and reproductive labor, one of whose tasks has been to teach new generations how to communicate and manage the communication thread in family and parental relationships.

In the shift from CMC to HMC many elements of the communication scene change because in the new context technologies are conceived as communicative "subjects" (Guzman & Lewis, 2020, p. 71). Let us review the most relevant structural changes, before trying to understand women's relationship with this typology of communication. For example, with voice-based assistants (VBAs, such as Alexa) and social robots (such as Nao) the presentation of self by the human interlocutor—a fundamental feature of the dynamics of human–human interaction—loses its traditional sense. Humans do not spontaneously present themselves to the robot; the problem is how to incorporate in the robot all the information regarding its interlocutors that would make it capable of recognizing them. The materiality of the human body is only partially implicated in human–robot interaction (HRI), whereas here it is the body of the machine which acquires great importance. In virtual assistants, the voice comes back from the mediated voice of telephone and mobile communication as well as from the automatic voice recorded in the answering machine that has trained millions of users to acquire the habit and the discipline to talk to a machine. In human–robot communication, human communication transforms from a relatively spontaneous to a forced process within the automated paths of conversation that the robot can perform. Furthermore, the high degree of authenticity in in-person communication to which individuals are accustomed leaves room for a form of communication with robots based on their capacity to simulate a conversation and this devalues and disadvantages humans' sense-making of the communication itself.

According to J. Reeves (2016), AI automates communication and related social processes more than it facilitates them (Gehl & Bakardjieva, 2017). Furthermore, the emotional exchange in HMC has a very small range: robots can potentially recognize users' emotions from their voices and react appropriately, but they are unable to feel and convey emotions to their users. While warmth is one of the main elements exchanged in social relationships, for robots this aspect becomes difficult to manage, and thus the quality of the social relationship they can offer suffers. Consequently, sociality devoid of emotions can only be stereotyped and automated. When compared with our understanding of what

social interaction and the *social* are, the outcome of HRI seems a rudimental form of sociality, which fundamentally restricts the degrees of freedom of flesh-and-blood interlocutors. Furthermore, it is unclear what will be the consequences of HMC on the maintenance of our ability to interact with human beings (Cranny-Francis, 2016). J. Weber (2005, p. 215) asked if we are really convinced that the deficiencies of our social life in terms of care and company can be adequately repaired by means of the basic sociality that social robots can offer to women, children, and people who are older or living with various degrees of illness, ability, and so on.

Faced with these fundamental characteristics of HMC, what has research on the relationship between women and this type of communication offered so far? The first issue that was explored was whether women hold more positive attitudes than men toward robots. Taipale and Fortunati (2018), for example, drawing on a representative sample of Europeans (N = 26,751), showed that among those who said they had a fairly or very positive view of robots, men were slightly more numerous than women. This slightly less positive view by women can be understood properly if we take into account that women have often expressed less interest in scientific discoveries and technological development. This attitude derives from women's awareness that science and technology historically have been largely managed by male scholars and professionals who have built this field of knowledge in their own image and likeness. We argue that women could never be early adopters of these kinds of technology because science and technology systematically fail to be inclusive of them. Nomura (2017) found in her research that women participants, compared to men participants, were less likely to have a positive view of robots (although she highlighted that gender differences can interact with moderation factors). Showkat and Grimm (2018) found that the sex differences such as tinkering (i.e., men are more likely to tinker than women) already identified in information processing style, emerged also in human–robot interaction. Other studies (e.g., Obaid et al., 2016; Rea et al., 2015; Reich-Stiebert & Eyssel, 2017) did not find significant differences in the attitudes men and women expressed toward robots.

This debate on gender in human–robot communication that we tried to reconstruct briefly counts on a substantial corpus of experiments carried out by engineers, computer scientists, and psychologists on convenience samples comprised of few participants (very often students). Given these characteristics, the gender-linked differences that are observed are not generalizable and are often only descriptive. Also, the research questions are typically those that can be submitted to an experimentation process and thus are very much circumscribed and the stimuli are in many cases pictures or videos, and more rarely live social robots. Unfortunately, L. Suchman's (2019) suggestion to explore the mundane practices of the use of social robots, which enable us to ask the big questions, is very difficult to follow because social robots are still at the prototyping level and users have a very limited direct experience of them.

The debate on gender and HMC has received a great contribution from three sources of inspiration. The first is the Stanford website http://genderedinnovations.stanford.edu/case-studies/genderingsocialrobots.html, which addresses especially the theme of gender stereotypes encouraging users, through a number of strategies, to rethink gender norms and inviting designers to design robots that promote women's empowerment. The second source is the European-funded research project GEECCO on gender and feminist aspects

in Robotics. Pillinger (2019) offered an interesting analysis of the main feminist contributions to robotics, discussing many good points raised by feminist philosophers, theorists, sociologists, and so on. The third is the European-funded research project ETICA (Ethical Issues of Emerging Information and Communication Technologies) on gender issues in information and communication technologies (ICTs). Oleksy et al. (2012) analyzed more than 100 publications by focusing on the power mechanisms that characterize the production and use of ICTs, the forms of discrimination and exclusion of women from ICT business, and the representation of gender in ICT studies.

The literature developed on gender and HMC so far has focused not only on gender attitudes and behaviors toward robots, chatbots, and virtual assistants but also on the sex—or better, the gender—of machines to which we will dedicate the next section. Both of these approaches are interesting and deserve further development in order to understand their implications for increasing women's empowerment.

Gender of Machines

Robertson (2010) observed that generally robots are gendered in the absence of the visibility of physical genitals (which for humans often catalyze gender attribution processes). However, as Jung et al. (2016) documented, minimal visual gender cues on the robot's interface are sufficient for people to assign gender to robots. They also found that if a gender cue was not provided, there was a general tendency to perceive robots as male; if a cue is provided, the robot with a *male* cue is perceived as more masculine and the robot with a *female* cue is perceived as more feminine. Especially provocative among robots are those anthropomorphic models that pose the issue of their sexual identity, because the more humanlike a robot is, the more gendered it ends up becoming. Several scholars have addressed this point. For example, Bray (2012) and Søraa (2017) pointed out that attributing gender to a robot is in a certain sense inevitable: first, because one way for humans to express gender is through technology and second, because if people want to talk to robots, they need to refer to them by name (and usually a name raises expectations about robot's gender) and if they want to talk about robots, they need to use pronouns (and often these are gendered). Lie and Sørensen (1996) asked whether we are able to reshape our imagination to accommodate the changes happening in technology and/or in gender and Alesich and Rigby (2017) invited us to think about what the production of gendered robots might implicate for human gender. Crowell et al. (2009) reminded us that not only the anthropomorphization but also the embodiment of robots pose the problem of their sexual identity. Interestingly enough, they found that male-embodied robots and female-disembodied robots were perceived as more reliable than the opposite and that embodied robots, in general, were perceived as more friendly.

The real problem here is that robot sex is affected by the cultural order of gender, which is in force in most societies. As we said above, Alesich and Rigby (2017) have raised the question of the binary vision (male and female) that shapes many discussions in robotics, with, at maximum, the addition of genderless, which is the assumed category of machines. The range of sex and gender among humans is much more numerous and fluid than this, and the relation between sex and gender more complex and unsettled. Furthermore, there is the specialized production of sex robots to consider: this topic has been investigated by

some scientists (e.g., Dehnert, 2022; Masterson, in this volume), but it has also received many criticisms by feminists such as Richardson who, along with Brilling, launched the Campaign Against Sex Robots.

The research on sex differences in HRI has drawn from CASA (the Computers as Social Actors) paradigm (e.g., B. Reeves & Nass, 1996). Several scholars, such as Eyssel and Hegel (2012) extended this approach to robotics. In HRI, robots' appearance, voice, and demeanor provide the social cues that guide social perception (Powers & Kiesler, 2006) and the categorization processes. According to Nass et al.'s (1997) experiments, the voice was the main cue to trigger gender stereotyping of machines; other peripheral signs and symbols employed to gender robots were usually hair length or lip color (pink versus gray). Nass et al. (1997) documented that evaluations supplied by an acoustically male computer were taken more seriously than those provided by an acoustically female computer, as if the voice would represent the mirror of the power stratification at the social level. This result was later confirmed by Powers and Kiesler (2006). But because the gender (and identity) of women as a social class changes over time, these changes are also reflected in the voice chosen. Nass and Yen (2010) reported that BMW had to recall one of their cars because German men drivers did not want to take directions from an acoustically female voice because it "was a woman." But after a few years, in the European Union, the majority of the GPS navigators exhibited female voices.

The gendered voice and appearance of a robot are often matched with the stereo-typed gender of its occupational role. Tay et al. (2014) found that the participants in their study expressed more positive responses when gender-occupational role stereotypes and personality-occupational role stereotypes matched, showing that people reacted to robots according to social models. However, they also found that stereotyped personality could be more prominent than stereotyped gender in interactions with social robots, insofar as the former reduced the impact of the latter on users' responses. Bryant et al. (2020) documented that "perceived occupational competency is a better predictor for human trust than robot gender or participant gender" (p. 13). The *matching* hypothesis suggests that when the robot's appearance matches stereotypical occupational roles this can affect users' willingness to comply with the robot (e.g., Carpenter et al., 2009; Goetz et al., 2003; Kuchen-brandt et al., 2014; Nass & Moon, 2000; Reich-Stiebert & Eyssel, 2017). This match however can nourish gender/occupation stereotypes and reinforce gender divides in human society. Powers et al. (2005) suggest that if we want to violate occupational stereotypes in the design of a robot (e.g., a female mechanic's helper robot), we probably have to expect that the process of communication would be more redundant in order to clarify their discourse. Another cluster of studies tried to challenge gender stereotypes (e.g., Eyssel & Hegel, 2012; Rea et al., 2015; Wang & Young, 2014). For example, Eyssel and Hegel (2012) proposed that designers, in order to change stereotypes and prejudices, should "develop gender-neutral or counter-stereotypical machines to counteract the stability of personal and cultural stereotypes" (p. 2224). In the same vein, Wang and Young argued that designers should pursue a gender-inclusive design. Another strategy proposed to deconstruct gender stereotypes in robot appearance is personalization, as discussed by Tam and Khosla (2016). Rea et al. (2015) found that gender stereotypes turned out to be less pronounced than expected and, thus, they hypothesized that gender stereotypes may not manifest strongly in human–robot interaction.

Less research has been done crossing humans' gender and robots' gender and findings are not consistent. Otterbacher and Talias (2017) demonstrated that the cross-gender effect is more salient for men participants than for women; in other words, men are more sensitive to the female-cue robot than women are to the male-cue robot. This result confirms previous research by Schermerhorn et al. (2008) who showed that men are more likely than women to treat a robot as a social agent rather than simply a machine. Eyssel et al. (2012), on the contrary, have found a preference for a same-gender robot, based on voice-gender cues. Carpenter et al. (2009) documented that gendered robots will be more effective in some circumstances and genderless robots in other circumstances may work better. Siegel et al. (2009), investigating robots' persuasiveness in the communication process based on the dimensions of trust, credibility, and engagement, found that participants rated the robot of the other sex as more credible, trustworthy, and engaging and that the effect regarding trust and engagement was much stronger between male subjects and the female robot. Schermerhorn et al. (2008) found that there are evident differences in how men and women conceptualize robots, react to, and coexist with them; men tend to think of the robot as more human-like, show some "social facilitation" in respect to an arithmetic task, and express more socially responding on a survey administered by a robot. Women, on the contrary, perceived the robot as more machine-like, produced less socially desirable responses to that survey, and did not feel facilitated by the robot in the arithmetic task. Kuchenbrandt et al. (2014) demonstrated that participants performing a typically female task with a robot made significantly more errors than in a typically male task. Moreover, participants interacting with a robot in the context of a typically female work domain were less prone to accept help from the robot compared to participants interacting with the robot involved in a typically male task. Another unexpected result was that, within the context of a stereotypically female task, the male and the female robots were perceived as equally competent, while within the context of a stereotypically male task, the female robot was perceived as less competent than the male robot. These results in part contradict previous findings that had documented that people prefer a proper match of gender robots and task features. Robertson (2010) argued that this corpus of research has neglected to take into account gender quality in itself.

In This Issue

From the review of the current studies on the gendering of HMC it is evident how we are still in the first phase of empirical exploration, inspired only in a limited sense by big questions. This special issue is not an exception; however, the collection of articles that are included here are all the—same interesting and stimulating. This special issue opens with the article "Gender Ambiguity in Voice-Based Assistants: Gender Perception and Influences of Context" by Sandra Mooshammer and Katrin Eztrodt. A number of researchers and critics have suggested the development and use of ambiguous or androgynous voices as a potential means of combatting the sexist treatment of VBAs and avoiding the application of human gender stereotypes or even challenging them. However, there is scant empirical information about how people perceive and respond to voices that are acoustically neither male nor female. One obvious but important question is whether such voices are actually perceived by people as ambiguous or are nonetheless "heard" in light of the historic human gender binary of man or woman. Mooshammer and Eztrodt address this significant gap

through an experiment examining how German-speaking participants (n = 343) perceived the genders of VBAs designed to sound male, female, or ambiguous. Although participants generally perceived the ambiguous voice as such, roughly four in five still assigned the voice a rating that was skewed somewhat male or female rather than truly neutral. A second important question in the debate about gender-neutral, ambiguous, or androgynous VBA voices is whether people actually form different stereotypes of them and react to them differently than acoustically male or female VBAs. On this second question, the ambiguous voice was situated between the male and female voices on perceived instrumentality (a masculine stereotype) and expressiveness (a feminine stereotype), which "strengthens previous reflections on the emergence of novel heuristics regarding artificial agents (e.g., Etzrodt & Engesser, 2021; Gambino et al., 2020; Guzman, 2020)" (p. 64). Continuing with a provocative and valuable interpretation of the finding that respondent gender was not influential to perceptions of VBA gender, Mooshammer and Eztrodt find additional support for the operation of a VBA-specific gender heuristic in

> the lack of impact of the theoretically indicated over-exclusion of the ambiguous voice from the participants' own gender. If the VBA was not perceived as a gendered person, but as a gendered 'personified thing' (Etzrodt & Engesser, 2021) or 'social thing' (Guzman, 2015), the VBA is already part of an outgroup, independent of its gender." (p. 65).

The question of whether VBAs are gendered along human lines or are perceived in distinct, agent-specific ways is a theme that continues in the second article, "Do People Perceive Alexa as Gendered? A Cross-Cultural Study of People's Perceptions, Expectations, and Desires of Alexa." Along with our co-authors Chad Edwards, Anna Maria Manganelli, and Federico de Luca, we present the results of a cross-national online survey of US and Italian university students regarding their conceptualizations of the VBA Alexa. A good deal has been written about the default female gendering of many VBAs and we sought to investigate, from a novel angle, whether the gender of Alexa was a salient aspect of participants' common associations, expectations, and desires concerning the virtual assistant. We analyzed free associations in the form of the first three words that came to respondents' minds when thinking of Alexa. In these conceptualizations, explicit references to gender or embodiment were exceedingly rare. Instead, Alexa was associated with the distinct category of being that respondents often termed "virtual assistant" or "digital helper" and was connected with themes of technology innovation and positive qualities. Although there were some differences in respondents' perceptions linked to their country or gender, the similarities across national samples were much more typical and striking. Holistically, the results support the idea that Alexa is understood as mainly belonging to the world of the digital, which overlaps only in part with the analog roles, functions, and ontological positions fulfilled by human beings (Fortunati et al., 2022). Thus, taken with the results of Mooshammer and Etzrodt's experiment, we find additional evidence for the emergence of VBA-specific identities (Eztrodt & Engesser, 2021) or robot-specific identities that may be emerging as people become more familiar with machine communicators and build the cognitive and interpretive schemas to understand both their similarities and differences from humans and other social actors (Edwards, 2018).

The ambiguity and hybridity we are witnessing in people's perceptions and conceptualizations of VBAs are on full display at another level, the sociocultural, and with embodied robots in the third article in this special issue. In "Designing a Loving Robot: A Social Construction Analysis of a Sex Robot Creator's Vision," Annette Masterson offers a critical discourse analysis of the marketing and publicity of RealDoll's Harmony model. As Dehnert (2022) in Volume 4 of this journal argued, sex robots present rich terrain for HMC researchers to explore issues of intimacy, love, desire, and sexuality among humans and machines (p. 131). To demonstrate how mediated discourse on sex robots contributes to the mutual shaping of their meaning at the sociocultural and political levels of Social Construction of Technology Theory (SCOT), Masterson considers how RealDoll visionary and creator, CEO Matt McMullen, constructs his view of the product and explains its purpose for existence to publics and media audiences. Masterson contends that McMullen's discourse is used deliberately to destigmatize relationships with sex robots and promote his company as a force benefitting all social groups. Specifically, Masterson demonstrates across 38 publicity interviews "a tendency to emphasize the companionship of sex robots while envisioning a future where integration is normalized, and a sentient robot is possible" (p. 99). A significant finding is how McMullen's discourse fluctuates between identifying Harmony as a mechanical tool versus a being or companion that replaces or approaches humanness. The shifting ontological solidarities and identifications promoted by McMullen are highly strategic. For questions concerning dehumanization effects or deteriorating relations among other humans, Harmony is positioned as a *mere machine* or compared to earlier technologies like the mobile phone. For questions concerning the future or limits of companionship, Harmony is situated as traveling a path toward potential rights, independence, and sentience. In other words, while technologies remain in the stage of interpretive flexibility, creators and marketers may use ambiguity strategically to suit the interests of developers and financial stakeholders to the detriment of the integrity of the larger discourses on the meaning of these technologies in sociocultural and political terms.

Whereas the first two articles in this special issue on Gender and HMC show at the micro level how individuals or users perceive machine communicators as a hybrid with or distinct from human social roles, Masterson offers the great contribution of articulating a role of ambiguity at the macro level in the social construction of these technologies.

From the beginning of the development of *intelligent* and *social* software and machines, there has been ambiguity, uncertainty, and conflict about whether and how to gender them. In the fourth article, Victoria Kratel poses the question "boy or girl?" to organize a fascinating and necessary historical account of "The evolution of gendered software: Products, scientific reasoning, criticism, and tools." Kratel details significant developments in the 70-year saga of gendering software which begins with Alan Turing's famous imitation test (a lesser-known version of which entailed the challenge of determining whether one's interlocution partner was a computer or woman), and traces through Weizenbaum's ELIZA, to the more recent theoretical developments of CASA and the Media Equation (Reeves & Nass, 1996). As Kratel explains, a complicating factor regarding the gendering of software (including the VBAs which are the focus of the first two articles), is that they are not biological systems that allow the assignment of gender in a manner linked with the physical qualities of human or animal bodies, but are gendered through the use of sociocultural features. Particularly, Kratel calls attention to three decisive features in the process of

gendering software: (1) product name, (2) voice (like the acoustical register investigated by Mooshammer and Etzrodt, this volume), and (3) personality traits. Each of these aspects of software design does gender by, on the one hand, invoking the cultural meanings of gender in ways that shape people's interpretations and reactions toward the software and, on the other hand, reflecting and reinforcing historical gender stereotypes as well as the gender prejudices of historically male software designers. The process of gendering software is a crucial consideration, according to Kratel, because of the status inequalities that persist between genders; in other words, "making use of socially shaped comprehensions of what being female or male means in a world which is still permeated with gender inequalities cannot be understood to be without consequence" (p. 116).

Indeed, the social shaping of what it means to hold or represent certain identities is central to the contribution made by Caitlyn Jarvis and Margaret Quinlin in the final article of this special issue: "IVF So White, So Medical: Digital Normativity and Algorithm Bias in Infertility on Instagram." Among other insights, the context in which Jarvis and Quinlin situate their research (machine- or algorithmically-identified and promoted "daily top 9" Instagram posts on infertility hashtags) and the approach they take (inductive analysis of the social construction of normative experience) serves as an important reminder that gender is always intersectional with other social identities and is inextricably entangled with other large discourses of power, control, and privilege. In the case of IVF narratives, Jarvis and Quinlin demonstrate that Instagram's algorithmic practices may contribute to constructing a portrait of the idealized IVF experience as primarily a medicalized journey of cis-White women with wealth. The communicative importance of machines extends beyond meaning-making (Guzman & Lewis, 2020), according to the authors, because:

> machines emerge as a locus of rhetorical practice as they manifest 'visceral responses entangled with material culture to enliven discourse' (p. 14). While technology does not hold feelings or beliefs, it can still manifest 'rhetorical energies' that shape the dissemination of health information and medicinal communication. (p. 136)

Discussion and Conclusive Remarks

We hope that the long journey we have undertaken from in-person to machine-mediated human communication trying to express a feminist point of view has allowed us to lay the foundations for addressing the gender issue in HMC with the necessary depth. Exploring gender means asking a big question that requires, rather than a big answer, keeping analyses significantly at the theoretical level. With gender, we are in the heart of women's core political analysis, and investigating gender in HMC we are in the innovative core of women's political analysis. Drawing from this, we believe that it is time to set a research agenda of the study of gender and HMC that is more founded on a theoretical analysis of the current condition of women and that is more equipped to address the big questions that remain yet open.

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