

A critical analysis of the study of gender and technology in government

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Abstract. Research at the intersection of feminist organizational theory and techno-science scholarship notes the importance of gender in technology design, adoption, implementation, and use within organizations and how technology in the workplace shapes and is shaped by gender. While governments are committed to advancing gender equity in the workplace, feminist theory is rarely applied to the analysis of the use, adoption, and implementation of technology in government settings from the perspective of public managers and employees. In this paper, we argue that e-government research and practice can benefit from drawing from three streams of feminist research: 1) studying gender as a social construct, 2) researching gender bias in data, technology use, and design, and 3) assessing gendered representation in technology management. Drawing from feminist research, we offer six propositions and several research questions for advancing research on e-government and gender in public sector workplaces.

Keywords: Gender, e-government, feminist theory, representation

Key points for practitioners:

- Given the public sector's importance as a labor market for women, researchers should be more concerned with the gendered nature of digital technologies and their effects on gendered work tasks, roles, and processes in government.
- Gender biases in representation, technology design, and work culture shape government technology use, adoption, and implementation. E-government researchers and practitioners must investigate the consequences and implications for gender-equitable government outcomes in the digital era.
- Integrating research on gender in public administration and techno-science feminist theory into e-government research is critical to understanding the reciprocal relationships between gender, technology, and public sector work life.
- Taking a feminist, social-constructivist approach to the study of technology and government will advance research, theory and practice toward achieving more gender equitable government workplaces and public outcomes.

1. Introduction

Gender and feminist theory have long held that gender – characteristics on a continuum from masculine to feminine – shapes and is shaped by repeated social and cultural behavioral patterns, some of which are embedded in our organizational work-life (Butler, 1993). Gender is fluid and can, but does not necessarily, align with biological sex. Individuals are socialized into feminine and masculine cultures in ways that construct their gender identity and they engage in gendered processes and practices that define, pattern, and enforce the feminine and masculine (Acker, 1992). Gendered processes, practices,

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and culture indicate “concrete activities” (Acker, 1992, p. 391), such as conversations about masculine or feminine preferences, actions that underscore gendered stereotypes, and individual perceptions of what is masculine or feminine. These gendered processes make gender a fundamental social and cultural component of our interactions, behaviors, and cognitions.

Work organizations have traditionally valued, preferred, and rewarded masculine gendered processes, structures, norms, and tasks while feminine gendered ones have been undervalued and exploited. The hierarchy between masculine and feminine manifests in differential power and autonomy throughout organizational life (Acker, 1990). As digital technologies, such as software, social media, computers, laptops, and so on, are introduced into organizational life, they are not and cannot be exempted from these gendered processes. In fact, researchers note that particular digital tools and their use are perceived as more masculine or feminine, and those perceptions reinforce gendered workplace culture, divisions, power structures, and autonomy (Elsbach & Stigliani, 2019; Nygren, 2012). For instance, the integration of digital technologies in the workplace has created predominantly masculine professions (e.g., coding and software development) marginalizing women from spaces where digital technologies are designed, used, and implemented.

While there is a great deal of research on gendered organizations in general (Acker, 1990, 1992; Connell, 1987, 2006) and feminist studies of technology (Perez, 2019; Shade, 1998; van der Velden & Mortberg, 2012), these approaches have found little traction among scholars who study the design, adoption, implementation, and use of e-government tools within public organizations. E-government refers to digital tools used by government to deliver services, implement public policies, and alter administrative practices (Moon, 2002). Gender is a critical component of public sector culture and work-life as government promotes efforts to advance social justice and equitable public outcomes. Governments strive to be gender equitable employers, promote and protect women in the workplace, and reduce gender disparities in society – from the gender pay gap to political representation. Yet e-government research rarely applies a gender perspective when assessing the potential threats and benefits of digital technology adoption, use, and implementation in public organizations and how e-government tools affect the power and autonomy of public employees and managers.

Overlooking gendered perspectives is significant both for practice and theory. Given that public managers and employees are responsible for the way technology is implemented and used, e-government research would benefit from assessing gendered aspects of e-government from the perspective of organizational users and implementers (e.g., public employees and managers). Applying feminist theory to e-government research can advance knowledge on how gendered work culture influences decisions about which tasks become digitized and how technology reinforces gendered work tasks, authority, and power within a public organization. Why are digital tools more readily adopted and implemented in the military, policing, and infrastructure rather than education or human services? Could the gendered nature of agencies explain these patterns? And how do gendered technology adoption patterns shape organizational outcomes and public service delivery? Does the adoption of technology for automated work tasks differently impact women’s employment? Are public organizations applying algorithmic decision-making tools that exacerbate gender disparities in program delivery and public outcomes?

Through a scoping literature review, we explore feminist theoretical approaches in technology and organizational studies and identify and describe three gender research streams: (1) gender as a social construct; (2) gender bias in data, technology use, and design, and (3) gendered representation. Drawing from these research streams, we suggest that e-government research can benefit from feminist theory by 1) assessing e-government adoption and implementation as the result of gendered practices, structures, and processes; 2) engaging the study of gender bias in technology design, adoption, use and

implementation in public sector workplaces; and 3) assessing gendered representation within public organizations as a factor in government technology use and implementation. For each theme, we propose a set of research questions and empirical propositions for future research at the intersection of gender and e-government.

Our work makes three contributions to e-government scholarship. First, we argue that more research should focus on government employees as users and implementers of digital technology and how technologies reinforce and reshape gendered work-life in public organizations. Second, given the importance of gendered processes and culture in public sector workplaces, e-government research can benefit from integrating feminist theory, in particular by applying a constructivist perspective to assess the reinforcing relationships between gender and digital technology. Third, e-government research can benefit by drawing from gender and technology studies and the representation literature in public administration, both of which advocate for integrating women in technology design, decision making, and organizational leadership. These contributions aim to expand e-government scholarship in ways that ensure more gender equitable technology use, adoption, and implementation.

2. E-government and gender research: State of the art

In this article, we refer to e-government scholarship as research on the causes and consequences of digital technology design, adoption, implementation, and use in government organizations traditionally found in public administration, public policy and related fields. This research outlines the promises and possibilities that digital tools offer government employees and managers by way of increased efficiencies, transparency and openness, and community engagement (Bertot et al., 2010; Boulianne, 2009). As with any technological advancement, there is research on the challenges and potential dangers of e-government, including duplication and increased workload, privacy and security threats, and digital access and literacy challenges (Fusi & Feeney, 2016; Mossberger et al., 2003). Few studies, however, integrate gender and digital technology, although public administration scholarship notes that gender greatly affects government management and policy making (Hamidullah et al., 2015; Holman, 2014).

A few e-government studies investigate how gender issues are integrated into e-government development, such as assessments of achieving gender development goals and increasing women's access to technology in developing nations (Al-Rababah, & Abu-Shanab 2010; Blakemore & Dutton, 2003; Scott et al., 1999; Venkatesh et al., 2014). Some work notes governments' failure to implement best practices for promoting equitable gender outcomes in technology implementation (Martin & Goggin, 2016; Nesti, 2019). Other studies investigate differences in how men and women access, use, and perceive e-government tools (Akman et al., 2005; Blakemore & Dutton, 2003; Choi & Park, 2013). The evidence is mixed. Some studies find that women and men do not show different attitudes towards technologies (Hansen & Nørup, 2017; Venkatesh et al., 2017), while others find few significant differences. Saxena and Janssen (2017) find that men are more likely to engage with open data. Akman and colleagues (2005) find no differences in access to public websites but women access services related to education and culture more frequently than men, which might be explained by their role as primary caregivers. A review of e-government studies in the Middle East reports that women are less likely to participate in online activities for fear of harassment (Sevdik & Akman, 2002).

While gender is addressed in these studies, they have two fundamental limitations. First, gender is conflated with biological sex and researchers rarely engage feminist research and theory to identify the gendered nature of technology design, adoption, use, and implementation and explain why women and men differ in the way they use technology or why policy makers fail to integrate women's issues

into technology development. Second, these studies focus on citizens and residents as the end-users of digital tools, paying little attention to public managers and employees as users and implementers of technology and how technology may affect gendered public sector workplaces. A focus on gendered practices, culture, and technology in public sector workplaces would offer insights into the gendered nature of technological work in public organizations and reciprocal effects on technological, managerial, and societal outcomes.

3. A feminist approach to gender and technology

Scholars such as Karen Barad, Donna Haraway, Judy Wajcman, and Wendy Faulkner use feminist theory to understand how gender shapes and is shaped by technology design, development, adoption, and use. Feminist theory describes gender as a socio-cultural construct. Gender is an ongoing performance of becoming (Butler, 2004); it does not pre-exist nor is it static, rather it is performed through repeated activities and actions that embody gendered norms and values which are continually reworked. While feminists like Butler (1993; 2004) focus on gender performance through the human body, techno-science feminists such as Barad (2003) and Wajcman merge feminist theory with social constructivist science and technology studies (e.g. Latour and Bijker) to investigate the performance of gender among human bodies and technological artifacts. Individuals have a gender that is evolving and performing and is brought into technological design and use, such that the interaction of humans and machines constitutes a gendered performance (Suchman 2007) which inevitably creates gendered outcomes (Noble, 2018). For instance, technological tools might emphasize masculine cultural traits such as expertise and technical abilities as compared to feminine ones like collaboration and interaction (Acker, 1990; Elsbach & Stigliani, 2019).

Feminist techno-science scholars note that technology is most often associated with a masculine culture, which furthers the masculinity of technological design, processes, and workplace culture and often results in the exclusion of women (Adam, 2006). For example, artificial intelligence voice recognition systems more easily recognize deep masculine rather than higher pitched feminine voices (Palmiter Bajorek, 2019), machine learning algorithms use frameworks that emphasize a normative view of women and their bodies (Adam, 2006), and data collection assumptions about what gets counted and classification systems perpetuate the oppression of women by reproducing masculine structures (D'Ingazio & Klein, 2020). This masculine focus has led feminist techno-science scholars to identify mechanisms to degender technology. Van der Velden and Mörtberg (2012) note three approaches to degendering technology design including focusing on gender differences, gender equity, and deconstruction. Bath (2017) applies a feminist approach to design in computer science, concluding that degendering technology requires a participatory design approach that centers on democracy, co-production, asymmetrical power, and multiple voices. This feminist scholarship provides a starting point for understanding how gender, a socio-cultural construct, is reflected in design, adoption, and implementation choices related to e-government, and how gender is shaped by repeated use of gendered technologies.

We conducted a traditional scoping literature review of studies on gender and technology to identify relevant feminist theoretical frameworks and perspectives that can advance research on gender and e-government. A scoping literature enabled us to assess a vast, multidisciplinary, theoretical body of knowledge, rather than doing a systematic review which focuses on a single discipline or set of journals and seeks to produce summary statements of previous research findings rather than a critical analysis to advance new research (Jesson et al., 2011). A scoping literature review is appropriate to tackle an emerging topic – gender and e-government – for which it is necessary to connect theoretical

foundations and identify opportunities to inform future research. We identify three research streams: (1) gender as a social construct, which directly stems from the integration of gender studies, science and technology studies, and techno-feminist literature; (2) gender bias in technology design, including data and programming algorithms, an increasingly popular theme in technology studies across disciplines; and (3) gender representation research in science, technology, mathematics, and engineering (STEM), management, and public administration. In the next section, we present the three research streams and their potential contributions to the study of gender and e-government. In Section 4, we draw from these streams to outline research questions and develop propositions for advancing research on gender and e-government, with a particular focus on government employees.

3.1. Gender as a social construct

This first research stream takes a social constructivist standpoint to investigate how technology shapes and is shaped by the socio-organizational context in which it is embedded (Latour & Woolgar 1979). Feminist organizational theory recognizes the persistent dominance of male advantage in organizational processes and structures resulting in sex segregation, occupational inequality, power differentials, the gender wage gap, exploitation, and other gender biased outcomes (Acker, 1990, 2001; Connell, 1987). Gendered processes are continual and reinforcing in work organizations, thus technology “cannot be fully understood without reference to gender issues” that are embedded in organizational culture, routines, and roles (Elsbach & Stigliani, 2019, 195), while technological changes (which are also socially constructed, continual, and reinforcing – Latour & Woolgar, 1979) impact gendered processes (Nygren, 2012; Leach & Turner, 2015). These studies recognize gender as a social construct embedded in various aspects of the work environment and note there is a reciprocal, reinforcing relationship between gender and technology.

Feminist organizational studies analyze how the masculine and feminine manifest in gendered interpretations of work tasks, skills, roles, and routines (Acker, 1990). These interpretations often come from implicit biases automatically activated by the mere presence of masculine or feminine objects (Hewstone et al., 2002). For instance, certain types of technology use – graphics, emojis, emailing, and e-learning – are associated with the feminine while others – programming, gambling, and online banking – with the masculine (Elsbach & Stigliani, 2019; Selwyn, 2007). Roles can also be gendered with the inventor, programmer, or creator assumed to be male and the computer operator as female (Leach & Turner, 2015). These biases have deep historical, cultural, and social roots (Wajcman, 2006) and lead to a gendered culture and work environment surrounding the implementation and use of digital technologies, which themselves are socially constructed and reinforcing of organizational norms (D’Ignazio & Klein, 2020; Orlikowski 1992).

Hicks (2010) offers a detailed assessment of the gendering of computer science in the United Kingdom, where the feminization and masculinization of work tasks, computing, and programming determine the roles of men and women in the workplace, institutionalize discrimination, and result in gendered management hierarchies in favor of the masculine. Moreover, the institutionalization of a gendered culture in the workplace further reinforced perceptions about what types of computing were perceived as masculine or feminine. Elsbach and Stigliani (2019) note that new digital technologies are perceived as “complex” and “difficult to understand” and linked to a masculine culture where men are more suited to technology use. As a result, women show, on average, lower self-efficacy towards the use of technology and are excluded from spaces where technology design, adoption and use take place. Research on gender as a social construct shows clear patterns of technology employment, access, and utilization that are

related to socio-cultural views of particular tasks being more or less masculine and feminine and how these gendered views reinforce or alter employment markets, salaries, and organizational outcomes.

The gendered nature of digital technologies inevitably affects the understanding of gender in public organizations (Nygren, 2012; Leach & Turner, 2015). As e-government tools are implemented to routinize and automate work processes that are predominantly perceived as feminine – administrative assistance, social work, citizen-oriented services – gender, technology, and organizational practices will reciprocally influence one another. Nygren (2012) observes this reciprocal relationship. A public organization introduced a new digital tool to streamline feminine routinized frontline tasks. From the public managers' perspective, the introduction of the digital tool – a masculine object – was a way to improve organizational routines and upgrade the skills of frontline employees, most of whom were women. However, frontline employees had a different perspective: for them, the new tool required more basic skills and pushed them away from the more social and valuable parts of their job. When filtered through a feminine culture, the change was perceived as a deskilling process where daily tasks became more routinized and less engaging.

The relationship between gender and technology might also favor a feminine culture. Leach and Turner (2015) note women can adapt the use and implementation of digital tools in ways that create feminine spaces removed from masculine stereotypes. Analyzing a Canadian public organization, they observe that women frontline employees shifted their technologically heavy job from “one of pure technical expertise to one focused on social networking, promotion, and teaching basic computer skills” and “gradually [more] women began to assume these positions” (p. 4). New technologies can also enable telework offering more flexible schedules which reshape gendered workplace autonomy and power, in particular for women who are often disadvantaged due to family caretaking responsibilities, higher turnover rates, and an increased likelihood of taking leave (Hicks, 2010; Mortberg & Elovaara, 2010). In all these cases, social gendered practices differently shape technology use and implementation by men and women in ways that produce new meanings of masculine and feminine culture within work organizations and subsequently reshape gendered work tasks, job attractiveness, and labor distribution.

3.2. Gender bias in technology design and use

The second stream has been receiving great coverage in the popular press and policy as scholars raise concerns about gender biases in the design of emerging digital technologies and algorithms used to support decision making (Busuioc, 2020; Miron et al., 2020; Noble, 2018). There is a growing research investigating how gender (in addition to racial and ethnic) bias is incorporated in training data, algorithm design, and analytical outputs (D'Ignazio & Klein, 2020). This feminist techno-science scholarship, which draws on social constructivist science and technology studies (Latour & Woolgar, 1979) aims to understand the extent to which decisions, models, and outcomes produced by digital tools are gender biased because of the dominance of masculine culture in society which gets embedded into technology design.

Research has identified bias in the design of digital platforms, decisions about what data are collected and how, and analytical models used to assess data (Broussard, 2018; D'Ignazio & Klein, 2020; Noble, 2018; Zhao et al., 2017). It shows how the prevalence of masculine culture in society and technology workspaces results in gender biased data and programs designed with men as the default. For instance, studies find that current algorithm models reinforce gender and racial discrimination with regard to financial loans, test scores and school admissions, parole setting, and health monitoring (O'Neil, 2016) and further economic and social inequality (Eubanks, 2018). A recent example is Genderify, a privately

developed online software to identify the gender of potential clients through their name, email address, and social media profiles (Vincent, 2020). Genderify's algorithm is inherently gender biased, marking an individual identified as "Dr" as more likely a man than a woman. Data-driven systems that further gender, racial, and economic discrimination are commonly found in the public sector including 311, criminal risk prediction systems, and data tools used to design voting districts (e.g. gerrymandering). The use of third-party screening algorithms has been shown to unfairly discriminate in public housing applications (Kirchner, 2020) and medical decision making (Simonite, 2020).

The majority of the research on bias in technological design has been in the feminist technology studies and digital humanities but is emerging in public administration and e-government discourse (Bullock et al., 2020; Busuioc, 2020; Nagtegaal, 2020; Giest & Grimmelikhuijsen, 2020). In the public sector, concerns about gender bias in design and implementation raise issues about further discrimination and gender inequality, especially when algorithms are not transparent, open for public scrutiny, nor accountable. The abuse or overuse of artificial intelligence in public sector decision making could threaten or limit bureaucratic discretion (Criado et al., 2020), hurt service recipients (Young et al., 2019) and affect procedural justice (Nagtegaal, 2020). Busuioc (2020) notes that there are technical ways to limit gender bias such as, programming algorithms for parity in outcomes, limiting data that can bias decisions, or removing gender, other protected status variables, and correlated variables from the model. Others argue that 'neutral' data are the problem (Young et al., 2019). Legal measures that prohibit the use of protected status information amplify gender bias because they prevent programmers from explicitly consider gender as a possible source of bias so that they can program algorithms for outcome parity. Health data offer a good example. When government programs use supposedly gender-neutral data to predict health outcomes or public benefits, they end up predicting outcomes that hurt women because 'neutral' data are biased towards men's health needs (Eubanks, 2018).

While these technical solutions are useful, they do not fix the gender bias in technology design, nor do they modify the ways in which the data used to program algorithms are gender biased because of past practice. Drawing on examples from search engines, Noble (2018) describes how algorithms are biased because of lack of women in programming and developing spaces as well as profit motives and lack of incentives to promote fairness in big tech companies. Similarly, digital tools designed to make profits through advertising (e.g., social media tools) are structured to advance profit goals rather than public values, including fairness and equity (Feeney & Porumbescu, 2020). However, few studies focus on possible incentives to reduce gendered bias at a more systemic level.

3.3. Gender representation in technology management

The final research stream focuses on gender representation in technology spaces, how underrepresentation of women, especially in leadership positions, affects technology design, implementation, and success, and how it can be solved (Durbin et al., 2020; Kenny & Donnelly, 2020). The starting point is a large literature in science and technology studies on the need to increase women's representation in science, technology, engineering and mathematics (STEM) fields (D'Ignazio & Klein 2020; Kemelgor & Etkowitz 2001; Long & Fox, 1995). This research notes that women are underrepresented because of a combination of factors including stereotyping, biased systems that place boys in STEM fields and girls in the arts and humanities, a lack of access to informal networks for women, explicit gender discrimination and implicit bias, and structural and institutional barriers that make STEM careers less conducive to family and caregiving responsibilities.

Representation is important for a variety of reasons. First, gender diverse teams are better for decision making, and representation of different viewpoints helps addressing implicit biases and stereotypes in

the workplace. Diversity in gendered leadership styles also matters. There is concern that when women occupy traditionally masculine gendered leadership positions, they are socialized to reproduce masculine roles. With more women in leading technology positions, we find more awareness and attention given to the feminine gendered aspects of technology design, adoption, use, and implementation – including what services get digitized, what data are collected and shared, how female employees are protected in online environments, and so on (Busuioc, 2020; Ignazio & Klein, 2020; van der Voort et al., 2019). Second, representation is path-dependent. Organizations with fewer women are less likely to attract women or create environments where women are comfortable innovating and challenging the status quo (Connell, 2006). Women are more likely to enter into agencies and careers that are perceived as feminine or women friendly (Bae et al., 2017), where women are in leadership positions (Ricucci, 2002; Naff, 1995), and where women have achieved a critical mass to influence decision-making and leadership (Kanter, 1977). Given these well-known patterns of women's representation in the workplace and research on the positive outcomes of these patterns, it is increasingly important to assess how technology management and outcomes in government are related to gender representation.

Currently, women remain underrepresented in government technology positions. As of 2019, all 50 states in the US had a Chief Information Security Officer (CISO), but only 5 of them were women (Goldstein, 2019). NASCIO estimates the women's representation in government cybersecurity leadership and general employment at around 10 percent. Women also remain underrepresented throughout US government leadership, in particular at local government levels. In 2016, women accounted for only one fifth of mayors and 26% of department heads in US cities with populations of 25,000 to 250,000 (Feeney & Camarena, 2019). This gendered distribution of work in the public sector – a sector dominated by women (Mortberg & Elovaara, 2010) but predominantly led by men (Feeney & Camarena, 2019; Ricucci, 2002) – plays a critical role in shaping gendered technology adoption, implementation, and success. While gender diversity among CISO's is important for improving gendered outcomes of e-government, equal representation throughout government can mitigate gendered dynamics of power in decision making on technology adoption and use – from which tools are used and how to issues related to communication, harassment, privacy, and security. Adequate representation of women across all employment levels in government is particularly important with the emergence of new technologies, such as artificial intelligence, and new policy areas, such as cybersecurity and online harassment, where government decisions are more political than technical in nature (Busuioc, 2020; Stark et al., 2020).

When men are the default designers and fixers of technology in the workplace, there are long term implications for power and autonomy in the workplace and future application of technology (Mortberg & Elovaara, 2010). The lack of adequate representation reinforces masculine culture and power differentials, for instance valuing competition and technical expertise, while not valuing and giving space for feminine traits such as cooperation, collaboration, and more open communication dynamics (Elsbach & Stigliani, 2019; Faulkner, 2016). The preference for masculine over feminine is present in technology-related professions and workplaces and the fast spread of digital tools might further exacerbate gendered culture that is counterproductive for feminine traits. Researchers focused on the public sector also note the importance of gendered representation. Research on representative bureaucracy indicates that when women are represented in leadership and decision-making positions, they are more likely to actively (or passively) represent women's issues and take into consideration gendered perspectives (Liang et al., 2020; Naff, 1995; Ricucci, 2002; Ricucci et al., 2014). While arguments of gendered representation are commonly found in the general public administration literature, they are less commonly applied in the e-government literature.

4. Gender and e-government: A research agenda

In this section, we discuss the three research streams on technology and gender in relation to technology use, adoption, and implementation in the public sector workplace and suggest avenues for public administration scholars to advance a more multidisciplinary research agenda on gender, e-government and public employees and managers. For each sub-section, we outline research questions and propositions that highlight theoretical approaches to advance e-government gender research.

4.1. Gender as a social construct – Investigating the reciprocal relationship between gender, organizational practices, and government technology

A social constructivist perspective to gender and technology is rarely applied in e-government research. Most e-government research on gender takes a positivist approach, using gender as a predictor variable for measuring outcomes and outputs from organizational and individual actions. E-government researchers reduce gender to a binary construct and take a linear, predictive empirical approach which limits our understanding of how gender permeates technological perceptions, experiences, and engagement. A social constructivist approach combined with a techno-feminist lens would allow e-government scholars to shed light on why digital tools, especially sophisticated ones, are more readily adopted in masculine agencies such as military and policing, while agencies with a more feminine mission, such as education or human services, are lagging. It would also allow exploration into how the adoption of technology for automated work tasks impacts frontline employees, the majority of which are women, and how these new tools might exacerbate or create new gender disparities in the workplace.

Qualitative methodologies, such as discourse analysis and ethnographies, are commonly used to investigate gender as a social construction in feminist literature (Bishu & Heckler, 2020; Burnier, 2006; Faulkner, 2016; Bishu & Headley, 2020) and to assess the social construction of technology in science and technology studies (Bjiker et al., 1987; Orlikowski, 1992). These methods critically analyze narratives of feminine and masculine elements along with changes in practices, culture, and routines that are brought by new technologies (Acker, 1990, 1992). By interviewing public managers and employees at the frontline of technology use, researchers could explore how the use of interactive technologies differently affects feminine work tasks (e.g. responding to citizen complaints or website design) as compared to more masculine technology tasks (e.g. programing and software development). Guided by current work on public managers' perceptions of gendered roles (Bishu & Heckler, 2020), e-government research could focus on women Chief Technology and Information Officers to understand how they see their roles in a predominantly masculine environment and how they produce new meanings of gender and technology in masculine spaces. This would enable e-government research to assess how digital tools in government workplaces alter, challenge, or perpetuate gendered power, autonomy, and authority in ways that might marginalize a feminine culture and harm women, as well as how women might reframe gendered stereotypes on technology use and co-produce a gendered culture combining both masculine and feminine elements.

Proposition 1: Gender, as a social construct embedded in organizational and individual culture and behavior, is shaped by and shapes government technology design, adoption, use, and implementation in ways that affect gendered roles, tasks, and routines for public sector employees.

Proposition 2: Government decisions about technology design and adoption and the resources dedicated to different types of technologies will be related to the masculine and feminine nature of the technologies as well as the gendered nature of the public organization and its mission.

4.2. *Gender bias in design – Assessing gendered technologies and adoption, implementation, and use*

There is a growing awareness of how digital tools, platforms, and programming can be biased by design. While it is widely accepted that data can be biased and algorithms are only as good as their design and data put into them, public administration scholarship and practice lag in providing evidence of the severity of the threat or appropriate solutions for enhancing effective, data-driven decision making. Public administration scholars (Bannister & Connolly, 2020; Young et al., 2019; Bullock et al., Wang 2020) offer theoretical frameworks highlighting the role of humans in algorithm-led decisions, but few studies examine the factors influencing the integration of human and machine decision-making (Criado et al., 2020; Stevenson & Doleac, 2019) and none focus on women bureaucrats as users and implementers of gender-biased digital tools. E-government research is silent on how women bureaucrats might be more skeptical of decisions made by algorithms and more concerned with equity and privacy issues related to digital tools (Hamidullah et al., 2015; Stark et al., 2020). Will women be less likely to implement decisions suggested by machine-learning systems? How will street level bureaucrats use their discretion to mitigate biased gender outcomes produced by algorithms? Will the increasing use of data and algorithms for decision making alter the gendered composition of the public sector workforce?

While bias in algorithm design is important to understand technology use for decision-making in government, it is also true that most platforms used by governments are not designed by government nor well understood by the public servants charged with using them (Feeney & Porumbescu, 2020). Thus, we argue it is equally important to assess the more immediate ways in which gender bias in design impacts digital technology use and implementation for employees in public organizations. For example, the application of particular digital tools to organizational problems as well as managerial and front-line uptake and support for particular digital platforms are influenced by gendered values and preferences that are implicitly and explicitly embedded in technology design. Are the digital tools that replace bureaucrats selected to advance feminine style work processes such as collaboration and shared governance (e.g., collaborative digital platforms) or do they perpetuate masculine managerial styles and roles? Future e-government research should investigate which work tasks are selected (or not selected) for automation, the gendered nature of those tasks, and how digital tools reinforce or modify the interpretation, meaning, and production of feminine and masculine culture. Gendered stereotypes have various implications in the workplace and e-government research has yet to explore how the gendered nature of digital technologies shapes the narratives around new work tasks and processes.

Proposition 3: The use, implementation, and adoption of technology by government will be shaped by feminine and masculine values placed on different aspects of society which are implicitly and explicitly embedded into the design of digital tools used by government.

Proposition 4: Gendered aspects of technology design, such as data curation, algorithm design, and automated decision-making systems, will affect how public employees and managers experience technology use, adoption, and implementation in public sector workplaces and for public sector outcomes.

4.3. *Gender representation in technology management & leadership – Advancing feminine culture into technology workspaces*

Public administration scholarship is rife with research on the importance of representation and gender balance in leadership (Liang et al., 2020; Naff, 1995; Riccucci, 2002; Riccucci et al., 2014). Surprisingly, little of this work has been incorporated in e-government research. Possibly because e-government has

been a masculine gendered subfield, spending more time on masculine approaches of positivist empirical measurement, classifications and typologies, and technological advancements with less emphasis on gender, representation, and more feminine values such as social justice and equity. Future research should look at the ways in which representation in leadership and middle management matters for gendered outcomes of technology use in government. For example, how is gendered leadership related to the allocations of resources to different digital tools? How do technology adoption and use patterns reflect gendered approaches to management and governance? How does the gendered management of digital technologies affect organizational outcomes and service delivery? Researchers could draw from representative bureaucracy literature to investigate how women allocate technology resources, promote policies and public service, and enhance organizational technology practices that affect gendered outcomes. We know that women support different policies and hold different values (Hamidullah et al., 2015; Holman, 2014) and women tend to be more collaborative, manage downward, and promote participation (Eagly & Wood, 2016; Eagly & Johnson, 1990). These insights could help explain how women public managers adopt different stances towards technology and how technology is shaped by gender representation.

As noted by Mörtberg and Elovaara (2010), the public sector is an important labour market for women because of working conditions and stability, making it critical for public organizations to consider how gender representation shapes power, cooperation, collaboration, and communication dynamics. Are technology adoption and implementation exacerbating power differentials between men in leadership positions and women in frontline positions? Is technology changing the roles and responsibilities of female public employees or feminine work tasks? Research indicates that women are more likely to balance and incorporate both the masculine and feminine in technology use and implementation (Leach & Turner, 2015). Future research should investigate government adoption and implementation of technology based on gendered employment, leadership patterns, and mission.

Proposition 5: Gender representation and the introduction of new technologies in the workplace will shape and be shaped by resource allocation and structural changes in masculine and feminine job roles, tasks, responsibilities and outcomes for both the leadership and frontline employees.

Proposition 6: The adoption, use, and implementation of new technologies might conflict with gendered spaces and culture either marginalizing women in public organizations or requiring them to create new or adaptive gendered practices and technology uses.

5. Conclusions

Our six propositions offer a starting point for using feminist theory to advance the study of gender and adoption, implementation, and use of digital tools in public organizations. Our assessment is not without limitations. First, a scoping literature is an appropriate approach to identify theoretical approaches to advance gender and e-government research, but we recognize that there may be biases stemming from our perspectives and disciplinary backgrounds (Jesson et al., 2011). We tried to mitigate this issue by asking other experts in both gender and technology studies to critically review our work. Second, our analysis does not explore the role of the political context (e.g., Western vs non-Western countries, communist or democracy). While our assessment can be broadly applied, we note that the techno-feminist literature is predominantly Western in its approach and e-government research is dominated by US, European, and increasingly, Asian scholarship. Our assessment may be missing key frameworks for studying gender and government technology in other political contexts. For example, developing nations typically have

larger digital divide issues which make women's discrimination an explicit object of concern for policy makers. The discrimination and disparities in technology use in more developed nations are likely more subtle and implicit, requiring a nuanced assessment of bias that takes into account the reinforcing social construction of gender in the workplace. Additionally, we do not consider the intersection between gender and race, ethnicity, disability, and social or economic class, which is undoubtedly an important next step for e-government researchers.

Our work contributes to previous research on gender and technology in public organizations by advocating for a feminist approach to investigate the design, adoption, implementation, and use of technology in government settings from the perspective of public managers and employees. We note that gender shapes and is shaped by all stages of government technology use, from technology and algorithm design, representation in technology and managerial leadership, government data collection, analysis and technology adoption, to use and implementation. Because of its widespread implications, advancing a research agenda on gender and e-government requires an interdisciplinary approach, where researchers integrate the broad knowledge available on gender in public administration with techno-science feminist theory and methodologies. Bridging these gaps is critical to providing more robust research to ensure gender equitable government outcomes in the digital era.

Acknowledgments

We thank Dr. Sebawit Bishu, Dr. Leonor Camarena, Clara Siboni Lund, and Mathilde Albertsen Winsløw for their thoughtful, swift comments on an early draft of this manuscript. We are honored and grateful to have such amazing colleagues willing to lend their time and expertise to our work.

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