September 2023

Working Paper

The gendered division of household labor and emerging technologies:
THE PROMISE OF ARTIFICIAL INTELLIGENCE AND AUTONOMOUS VEHICLES

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Regulation and Markets
at BROOKINGS

**The Gendered Division of Household Labor and Emerging Technologies:
The Promise of Artificial Intelligence and Autonomous Vehicles**

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September 2023

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Abstract

For decades, women have disproportionately managed household labor, including domestic tasks, child-rearing, elder care, etc. As women's labor force participation has increased, and subsequently the number of dual-working families has grown, men have taken on a greater share of household labor and families increased reliance on support systems (e.g., childcare centers, paid home cleaners, etc.). While this has helped somewhat, gendered disparities in household labor persist (even when women earn equal salaries to their male counterparts) largely due to the 'stickiness' of gender role expectations. Artificial intelligence (AI) and autonomous vehicle technologies (AVs) are quickly emerging and having an impact on household labor tasks; this may have a positive impact on alleviating the gendered gap in household labor. We present an overview of existing research and introduce a framework for considering how these technologies might impact the gendered division of labor in the domestic sphere. In particular, we emphasize the promise of these technologies in reducing the mental load of managing household tasks. We also note that second-order effects, i.e., consequences for household members other than those directly using the technologies themselves, may play a role in alleviating the gender gap. We conclude by highlighting a few policy considerations and suggesting areas for future research.

Introduction

For decades in the United States, women have disproportionately managed the domestic domain spending more time on household tasks and caregiving than their male partners (Barraso, 2021; Brenan, 2020; Hsu, 2023; Pew Research Center, 2023a). This gendered division of domestic labor rests on long-standing societal assumptions that associate women with the home and men with paid work outside the home. As women's labor force participation has steadily increased, men have taken on a greater share of household tasks and caregiving than in previous decades (Brenan, 2020). Parallel support structures, like day care centers and paid home cleaners, have also become more readily available to assist dual-working families. Yet, despite these improvements, research examining time-use trends finds persistent inequalities between women and men in the domain of unpaid domestic work. Most recently, a 2023 Pew Research report confirms that even when women are the primary breadwinners in dual-career households, they still spend more time on housework and caregiving compared to their male partners (Pew Research Center, 2023a).

The creation of household technologies – such as the washing machine and the microwave – alleviated some of the time spent on domestic labor (Greenwood, 2019), and more recent innovations in the platform space (e.g., Uber Eats and InstaCart) facilitate the outsourcing of additional household tasks. Indeed, technological advancements offer the promise to solve some of society's most persistent problems, begging the question of whether and how future advancements may continue to ease the time burden of domestic tasks. Consistent with recent trends in the development of artificial intelligence (AI) and autonomous vehicles (AVs), a burgeoning stream of literature addresses how these technologies impact organizational routines and processes. However, relatively less discussion centers on ways in which AI and AVs may

impact household and familial routines and processes. In this paper, we consider the potential of AI and AVs to disrupt the domestic domain in ways that may finally narrow the persistent gender gap in the household division of labor. We suggest that AI and AVs may offer unique promise compared to previous household technologies in terms of alleviating the *mental burden* of domestic labor – that is, the anticipating, planning, deciding, and overseeing that managing a household requires, and that so often falls to women (Daminger, 2019; Dean et al., 2021; McKeown, 2021). Further, we demonstrate that AI and AVs offer additional promise through what we refer to as second-order effects – consequences for household members other than those directly using the technologies themselves that serve to reduce the overall load for the female partner.

In the following section, we provide a summary of the problem at the heart of this paper – the unequal burden of domestic labor on women. We offer an overview of existing concepts, drivers, and research on the persistent gendered division of labor in the United States. We then present brief introductions to artificial intelligence (AI) and autonomous vehicles (AVs), focusing especially on those technologies and applications that impact household labor. Next, we explore the limited existing research that has analyzed AI and AVs in the context of the gendered division of domestic labor and then introduce our own contributions to this discussion – investigating whether and how AI and AVs offer unique promise for alleviating the burden of domestic labor that falls disproportionately to women. We conclude by presenting thoughts for policymaking and future research.

The Unequal Burden of Domestic Labor: The persistent gender gap in the US

An extensive sociological literature examines the context of unpaid domestic work within households in the United States. Research on time-use and survey data details types of domestic labor tasks, who completes the tasks, how much time it takes, and if/how these trends vary over time or based on other familial or geographic factors. The negotiation of household tasks and care-giving work within heterosexual couples is a core focus of this literature, with much of this work demonstrating the persistent gender gap in the division of domestic labor between men and women (Carlson et al., 2022; Daminger, 2019).

Conceptual Definitions and Boundaries

The tasks associated with managing a household and family are plentiful – including (but not limited to) food preparation, cooking, cleaning, laundry, caring for children, and generally maintaining a 'livable' home. In this paper, we define domestic labor as the unpaid work that needs to be completed within a household, and typically is categorized into three types: (1) routine house work tasks (e.g., cooking, cleaning, laundry, grocery shopping), (2) episodic house work that are less routine (e.g., yardwork, small repairs), and (3) care work (e.g., taking care of children or elderly relatives) (Dean et al., 2021; Lee & Waite, 2005). The division of domestic labor, then, refers to the distribution of different roles and responsibilities within the household between partners in managing housework and care work.

Domestic labor has physical, emotional, and cognitive components. Physical labor consists of the 'doing' of cooking, cleaning, paying bills, shopping, dressing children, packing school lunches, etc. These tasks are the most commonly addressed form of domestic labor in research on the gendered division of domestic labor (Daminger, 2019), given that the

predominant frame for such research is time-use (i.e., how much time is spent on certain household and caregiving tasks). This allows for comparisons between the time that women spend on domestic labor as compared to their male partners. Beyond the physical 'doing' of tasks, existing literature also calls attention to emotional and cognitive components that capture the "mental load" of domestic work (Daminger, 2019; Dean et al., 2021). While scholars differ on the extent to which they see cognitive and emotional labor as conceptually distinct, the recognition that domestic work includes things like managing feelings, anticipating needs, making decisions, and overseeing logistics (Daminger, 2019; Hochschild, 1983, 2003) is particularly important for the present inquiry because of research indicating that women are far more likely to take on this mental load of managing a household than men (e.g., Ciciolla & Luthar, 2019; Daminger, 2019; McKeown, 2021; Offer, 2014).

Before moving forward, it is important to define the scope of our article. For our analysis, we focus on married or co-habitating couples with male and female partners. While surely a variety of other familial/household arrangements exist today, most literature addressing the gendered division of household labor focuses on partnered heterosexual couples. Where relevant, we comment on whether/how trends apply to partnered households with or without children, as well as to alternative familial structures (i.e., multi-adult households, same-sex couples, etc.). Finally, although the gendered division of labor persists globally, we focus here on dynamics and trends within the United States.

Drivers of the Persistent Gendered Division of Labor

The division of labor within families has long been a focus of sociological inquiry, with particular attention paid to gendered patterns within heterosexual married or partnered couples.

In a historical sense, women were assigned domestic work such as cleaning, cooking, and childcare, while men were assigned tasks related to physical labor and providing for the household (Davies & Frink, 2014). In a post-industrial revolution society, opportunities to work outside the home increased, which channeled men away from the household farm or artisanship and into the paid labor force where they could provide for their family through financial means. In effect, this solidified what we now know as the separate domains of "work" and "home" – women remained home to manage the household, while men went off to participate in paid work outside of the home where the focus was on market productivity and earnings for their family (Boris, 1994; Davies & Frink, 2014; Sellers, 1991). In many societies, this traditional division between unpaid and paid labor persists today. Even as women's participation in the paid labor force has increased steadily over the past 50 years, cultural norms still largely project the expectations that the household and family are primarily the domain of the female partner and the paid workforce is the domain of the male partner (O'Connor, 2019; Pew Research Center, 2023a; Thomason, 2022; Wong, 2017). These gendered patterns persist due to a number of intertwined dynamics as explained below.

First, traditional gender roles which associate women with household work and familial care, and men with paid employment, have proven 'sticky' and difficult to unwind. One critical juncture that underscores the entrenched roles is the recognition of the "second shift" - a concept popularized in the 1980s by sociologist Arlie Hochschild as women entered the paid workforce in greater numbers. Even as more women participated in paid employment during the day (the 'first shift'), they were still expected to be the ones completing household tasks and caring for children once they came home (the 'second shift') (Hochschild & Machung, 1989). A further illustration relates to women's growing economic influence within families. Recent statistics

suggest that the share of married women earning equal to or more than their spouses has more than tripled in the past 50 years, yet such economic contributions to the family have yet to balance the gendered division of labor in the home (Pew Research Center, 2023a). Even breadwinning women who outearn their spouses continue to carry the burden of household tasks and caregiving in dual-earning couples – women spend more time on household activities and childcare while men spend more time on paid work and leisure (Pew Research Center, 2023a) demonstrating just how deep-rooted traditional gender roles are within families.

Workplace norms also continue to reinforce a gendered division of labor through expectations of what it means to be an ideal worker. A wealth of management scholarship emphasizes the persistence of *ideal worker norms*, in which work is structured around an expectation that a person is fully devoted to their work during the daytime hours, with minimal (if any) constraints from the home domain while engaged in paid work (Davies & Frink, 2014; Thomason, 2022). Such expectations are built on an assumption of the traditional family structure where one partner (likely the man) works outside the home performing paid labor, while the other partner (likely the woman) stays at home to manage the household and family. Even though only about thirty percent of American families fit this traditional familial structure (Pew Research Center, 2015, 2023b), the vast majority of organizational life is still structured around such expectations. While growing trends toward flexible arrangements, family-friendly policies, and hybrid work are a step toward recognizing that current structures are outdated, ideal worker expectations remain pervasive in the informal and formal operation of day-to-day work (Padavic et al., 2020; Reid, 2015).

Finally, despite greater participation in the paid labor force, women are still more likely to work part-time and take breaks from the workforce to support familial and household needs,

thus reducing their overall earning power in the paid labor force. In an economic sense, research confirms that top earners "win" in intra-family economic decisions, and those top earners are still more likely to be men – when a familial unit needs one partner to engage in more of the household and caregiving labor, the partner who is making more money in the paid workforce is much less likely to be the one to pare back or manage the second shift (Livingston, 2014). So, even with women's increased economic contributions to their families, men still are more likely to be top earners in families and thus have their careers take priority, leaving women to manage the unpaid domestic domain. This not only reinforces the gendered division of labor within partnered couples, it also further entrenches the unequal economic realities facing working women.

In sum, despite women's entrance into the paid labor force and the rise in dual-earning couples, the gendered division of labor continues to persist due to entrenched traditional gender roles within households and workplaces and the economic realities of paid employment within male/female partnerships.

Time-Use Trends in Men's and Women's Participation in Unpaid Domestic Labor

Much of the research documenting the division of labor in households is based on data gathered through the time-use surveys conducted by organizations such as the Bureau of Labor Statistics (BLS) and the Organisation for Economic Co-Operation and Development (OECD). Time-use surveys capture the amount of time individuals spend doing various activities, including various categories of unpaid domestic labor – chores, grocery shopping, house cleaning, laundry, child-care, elder care, etc. – to compare within households who spends more time doing what. Yearly

comparisons of the time-use data confirm that women continue to shoulder a disproportionate burden of unpaid work within households compared to their male partners.

Recent time-use data finds that American women spend about 4.5 hours per day on unpaid work, as compared to 2.75 hours per day that American men spend (OECD, 2023). The 2022 BLS American Time-Use survey similarly confirms that women are doing about one and a half times as much as men when it comes to household activities and caregiving and that a gap exists even when women work full-time and even when they are the primary breadwinners in their dual-income households (BLS, 2023; Pew Research Center, 2023a).

Importantly though, time-use data also confirms that men's involvement in the domestic domain has improved over the past several decades – trends demonstrate that the time men spend on housework has doubled since the 1960s to the present day (Pew Research Center, 2013). The time men spend on childcare has also steadily increased, particularly as cultural expectations have shifted to expect fathers to be more involved in caregiving than they were in previous decades (Ladge et al., 2015). Nonetheless, even with these improvements over time, women still spend more time on unpaid labor in the home than men, and the COVID-19 pandemic only exacerbated this time gap (Dunatchik et al., 2021; Pew Research Center, 2023a).

Time-use data provides an important foundation for understanding trends in the household division of labor, but scholars have recently emphasized the limitations of solely relying on time as a proxy for understanding the (un)equal division of labor in families (e.g., Daminger, 2019; Dean et al., 2021). Daminger (2019) argues that time-use surveys fail to fully capture the cognitive dimensions of household labor in part because it is difficult for individuals to even fully report time spent on things like the "anticipation work" of thinking about what to cook for dinner or the "monitoring work" of ensuring the babysitter is confirmed to come the

next day (Daminger, 2019, p. 628). Recent articles in the popular press similarly describe the

mental load of managing a household as one of the most stubborn, and invisible, components of

the unequal division of domestic labor (Ashfar, 2023; Hogenboom, 2021; Owens 2018).

Research confirms that there are costs to this stubborn dynamic – the continued

disproportionate burden of unpaid domestic labor has deleterious consequences for women's

career advancement, marital satisfaction, and well-being (Bass, 2015; Ciciolla & Luthar, 2019;

Offer & Schneider, 2011). On the other hand, contributors to the narrowing of the gap over time,

albeit small, can be attributed to the rise of dual-income households, increased awareness and

advocacy for gender equality, and the accessibility of labor-saving devices and technology.

Given the proliferation of emerging technologies, we consider whether and how AI and AVs can

provide unique contributions to alleviating the persistent burden of domestic labor that falls on

women.

Overview of Emerging Technologies: Artificial Intelligence and Autonomous Vehicles

One cannot scan a business, technology, or pop culture website today without being bombarded

with articles and posts sharing stories and debates about the usage and potential implications

(both good and bad) of artificial intelligence (AI) and autonomous vehicle technologies (AVs).

Especially since the burgeoning usage of large language models (e.g., ChatGPT[1]), assertions of

AI's impact have become ubiquitous. AVs in their various forms are also becoming increasingly

prevalent in both commercial and personal realms.

Along with other emerging technologies such as robots, virtual and augmented reality,

drones, sensors, voice and facial recognition, communication technologies, and others, AI and

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[1]*OpenAI.* (2023). ChatGPT Overview. https://openai.com/chatgpt.

AVs are changing how we and those around us work. Books and articles abound on the "future of work" and how AI and automation will impact jobs, workplaces, and the political and social context in which all of these reside (Mottola & Coatney, 2021; Susskind, 2020; West, 2018). Within workforces, AI is driving the development of new job categories and accelerating the adoption of workforce ecosystems that encompass employees, contingent workers, partner organizations, and technologies, all aimed at meeting strategic goals (Kiron et al., 2023; Altman et al., 2023). AI, AVs, and associated technologies are impacting business, non-profit, government, military, and educational enterprises. While applications in these contexts are receiving the majority of the attention from academics, businesses, and policymakers, these technologies also have substantial potential to affect the household domain – our focus in this paper.

In this section, we discuss how we define the household environment, and then provide brief overviews of AI and AVs as emerging technologies in this arena. We concentrate predominantly on aspects that are, or may soon be, associated with reducing the burden of domestic labor in the household environment, and emphasize how these technologies may impact the imbalance of labor affecting women.

Defining the Household Environment

In this paper when we refer to "the household environment" or "the domestic sphere," we mean not only the physical environment in which individuals and family units live but also the *relationships among household members*. Often research and writing on technology usage in the home tends to focus on how technologies affect individual household members (such as how an appliance may improve time usage for the person preparing meals) (e.g., Berger, 2019; Marikyan

et al., 2019; Van Der Lippe et al., 2004). Yet today, especially as we explore the impact of digital

systems, it makes more sense to expand this scope and include technologies that affect not only

one person but also those that affect the relationships among individuals. For example,

collaborative cloud-based scheduling systems impact not only a single family member's

productivity but also how that family member relates to others. It also potentially affects how

other family members accomplish their scheduling as these members all coordinate with each

other. The same is true for communication technologies such as messaging systems, which

impact how family members send and receive information (e.g., sending not only text data but

also audio, videos, etc. for richer communications). Thus, we adopt a very broad definition of the

household environment, which includes not only physical locations (e.g., houses) but also virtual

spaces (e.g., messaging threads, shared calendars, collaborative documents, etc.) that provide

contexts for interactions between and among household members.

Artificial Intelligence: Topics with Potential to Affect Household Labor

For decades, scholars across disciplines have proposed and debated definitions of AI. As the

technologies constituting AI have evolved, so too have the perspectives of the diverse scholars

researching the development and applications of AI. In his often-cited foundational paper, Turing

(1950) proposed the Turing Test to determine a machine's ability to exhibit intelligent behavior.

More recently, Kissinger, et al. (2021) presented the simple explanation that AI encompasses

"machines that can perform tasks that require human-level intelligence" (p. 15), which includes

algorithmic management and various sub-fields of AI, some that are particularly relevant for

improving efficiency in the domestic sphere. For example, the sub-field of machine learning

(ML) centers on algorithms enabling computers to use data (usually very large amounts of data)

to learn and make predictions and decisions. ML is the mechanism behind computers adapting over time as they gain experience (Alpaydin, 2021), which facilitates, for instance, continuously improving personalization for systems that provide customized consumer services such as online clothes shopping (e.g., Stitch Fix)[2] and home meal box delivery (e.g., Hello Fresh).[3]

With the emergence of large language models (LLMs), general-purpose models trained on enormous text datasets, the subfield of generative AI has become increasingly accessible and popular in the home (as well as in workplaces and schools). Generative AI produces human-resembling text content in response to text prompts (Zhang, et al., 2023). The dramatic decrease in the cost and availability of computing power has moved this type of AI into mainstream usage accessible not only to university and government-funded labs but also to consumers. School-age children are using generative AI systems such as OpenAI's ChatGPT to help with homework, teenagers are using it to write (not always accurate) essays, parents are using it to find recipes and after-school activities, and older people are using it to plan trips and learn new subjects. We recently heard of a father who used ChatGPT to determine what to do on a rainy day with his nine-year-old son, and colleagues described using it to plan sightseeing on an overseas trip. Almost every day we hear of new applications providing innovative use cases, some of which may affect the household environment and the tasks associated with managing it.

AI-related technologies and applications include automation, human performance augmentation, surveillance, intelligent telemedicine, and others (Davenport & Miller, 2022), all of which either have or potentially will affect domestic labor. Applications developed for military and industrial usage are making their way into homes. Roomba, the robot vacuum

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[2] *Picked by our Sylists, just for you.* (2023) StitchFix. Retrieved September 14, 2023, from https://stitchfix.com
[3] *Take the stress out of mealtime.* (2023) Hello Fresh. Retrieved September 14, 2023, from https://www.hellofresh.com.

cleaner introduced in 2002 by iRobot, uses technologies designed for discovery and search and rescue adapted for home cleaning. New versions have added personalization and control. As of 2021, iRobot had sold 40 million home robots.[4] Domestic environments are idiosyncratic, often complex, and difficult to navigate, thus advances in visual navigation technologies, especially for indoors, are essential for robotics for home usage (e.g., Zhu et al., 2017). Often, AI is integrated with mechanical robots to accomplish complex physical tasks. One of the largest and most complex hurdles is dexterous manipulation as robots need to be able to "grasp, move, and transform objects" (Billard & Kragic, 2019, p. 1). This technology presents some of the most challenging problems affecting the extent to which robots can live and work with humans in domestic environments.

Embodied AI addresses challenges including interactive questioning, following instructions, and manipulation (Srivastava et al., 2022), which are important for domestic applications. Household tasks are wide-ranging and difficult. Humans bring capabilities to accomplish these tasks, and also the flexibility to adapt to complexities. Researchers developing embodied AI systems build simulators modeling behaviors that technologies need to accomplish. One team developed a system benchmarking 100 household activities that are "… realistic, diverse, and complex. They are often performed by humans in their homes (e.g., cleaning, packing or preparing food)…" (Srivastava et al., 2022, p. 2). Through benchmarks and datasets, researchers are refining AI tools for domestic contexts. In some cases, these tools are slated to be open-source and free, enabling broad accessibility and collaboration (Srivastava, 2022).

Not only is AI being harnessed for work on its own, but often more interestingly and effectively for human-AI collaboration to improve performance in both physical and cognitive

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[4] *History.* (2023) iRobot Corporation. Retrieved September 14, 2023, from https://about.irobot.com/History.

domains (Malone, 2018). Virtual assistants have been helping businesspeople manage calendars and communication flows (e.g., optimizing email inboxes) for some time (West, 2018). Researchers have introduced the concept of Hybrid Intelligence (HI) defined as combining human and machine intelligence, focusing on augmentation versus replacement, and achieving goals that neither side could accomplish alone (Akata, et al., 2020). In the household, HI applications will likely prove useful when pure technological solutions may either be difficult or ultimately impossible to implement.

Autonomous Vehicles: Topics with Potential to Affect Household Labor

Along with AI, autonomous vehicles (AVs) and the technologies associated with them (e.g., sensors, actuators, navigation) represent some of the fastest-growing and most-watched advances today. Researchers, science fiction writers, TV producers, movie directors, and others have been predicting a future with driverless vehicles for decades (e.g., *The Jetsons*, *Knight Rider*, *Terminator*); the vision is now becoming much closer to reality in the 2020s.

AVs are emerging as technologically-based systems that will change the transportation of individuals, pets, meals, household goods, commercial products, and anything else currently moved by automobiles, trucks, trains, ships, and planes (McGrath, 2020; Winston & Karpilow, 2020). In the commercial space, AVs offer transportation solutions for both B2B transactions (e.g., moving goods between businesses) and B2C applications (e.g., providing automated land or air (drone) vehicles delivering packages). For households, AVs offer the promise of transportation solutions that may be short distance (e.g., transporting family members locally or running neighborhood errands) (Khayati et al., 2021) or long distance via land, air, or sea, providing efficiency and safety. AVs may be able to bring outside individuals to the family to

help with domestic labor, for example, bringing a caregiver or nanny to the household. For example, as of August 2023, Waymo LLC (formerly Google's Self-Driving Car Project), is trialing a driverless taxi service in San Francisco allowing riders to hail fully autonomous vehicles.[5]

Like AI, the topic of AVs encompasses a wide range of applications. In 2014, to help clarify these advances, SAE International[6] (2021) introduced what are commonly called the *SAE Levels of Driving Automation*, codified in: "SAE J3016™ Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles." This document, most recently updated in April 2021, presents six levels of driving automation used in autonomous vehicle capabilities discussions. The lowest level (Level 0) has no driving automation; the highest level (Level 5) has full driving automation. There are "three primary actors in driving: the (human) user, the driving automation system, and other vehicle systems and components" (SAE International, 2021) that the levels account for in their classification system. Using these levels and distinctions, researchers can develop nuanced views on what might be available when, and which types of automation might be most appropriate for different applications. For domestic applications, these classifications may help determine which levels (no automation, assisted, or fully automated) will be most appropriate for distinct applications and different variables such as age levels and abilities.

Mobility automation already exists in various forms, especially at lower SAE levels, though complete instantiations of automated mobility are unlikely to come to fruition anytime soon and will vary dramatically by geography and climate (Leonard et al., 2020). These

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[5] Waymo One: The Waymo Team. (2023, August 11). Waymo's next chapter in San Francisco [weblog post]. Retrieved from https://waymo-blog.blogspot.com/2023/08/waymos-next-chapter-in-san-francisco.html 3

[6] This organization was originally called the Society of Automotive Engineers and was formed in 1916.

advances are connected with developments in communication technologies, electric vehicles, and evolving business and service models to support new systems. Most of these emerging technologies and business approaches are being developed in response to enterprise needs, but many will also affect household environments as they are adapted to operate in domestic domains. For example, technologies for self-driving delivery vehicles can work for consumer applications such as home deliveries of goods or services, or for transporting family members in driverless vehicles. As AV technology continues to develop, parallel conversations about the impacts of these technologies on society are growing. Topics of particular interest include the impact of AVs on cities (Faisal et al., 2019), safety (Koopman & Wagner, 2017), and inequality due to cost impacts (Stacy & Meixell, 2018).

MIT's Work of the Future 2020 report (Leonard et al., 2020) presents four scenarios of possible mobility futures: 1) driver-assist personal cars, 2) automated taxi fleets, 3) automated shuttles and buses, and 4) long-haul truck platoons. Researchers developed these scenarios as they examined the employment effects of automated driving technologies, but they are also useful to explore in the context of domestic labor. For example, automated taxi fleets can provide transportation between homes and markets, sporting venues, or activity centers on an on-call basis. Similarly, automated shuttles and buses with proscribed routes provide more efficient transportation options. Other scholars present additional typologies that encompass vehicles beyond driverless cars such as all manner of freight and cargo transportation including light-duty automated transport vehicles and delivery droids (Jones et al., 2023). Automated delivery vehicles fall into this category, which is of particular interest related to the household environment because they reduce the resources required to deliver goods directly to homes.

AV-related discussions often encompass considerations for physical infrastructure like roads and bridges that may need to be modified or adapted to accommodate AVs. In addition, information infrastructures, such as communication systems, databases, and standards, need to be addressed (Leonard et al., 2020). While this is true on a large, community-wide scale, it is also true on a micro-scale for homes. At the moment, simply coordinating calendars among family members is itself a challenge. As households add additional technologies, such as AVs for family transportation, household management challenges will continue to increase and require new organizing and coordinating systems.

Internally and Externally Deployed Household-Affecting Technologies

Addressing the potential impacts of AI and AVs on domestic labor certainly involves examining technologies used within the home or by household members; yet, we also call attention to the impacts of technologies that are used by individuals or organizations outside of the household. Especially in today's digital, networked age, such *internally* and *externally* deployed technologies will affect household labor.

We define *internal* household-impacting technologies as those that members of a household acquire and use. They could use them within the house, or while they are outside the house, but household members procure and use the technologies themselves. For example, one or more family members might acquire an Amazon Echo smart speaker device enabled with the Alexa system[7] and use it within a home. The smart speaker works by accessing cloud-based technologies that do not reside within the home but since the technology is used by a household

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[7] *Amazon Echo & Alexa Devices.* (2023) Amazon.com, Inc. Retrieved September 14, 2023, from https://www.amazon.com/smart-home-devices/b?ie=UTF8&node=9818047011.

member we define it to be an internal technology. The same holds for smart appliances, generative AI tools, AVs owned or leased by family members, and other products or services acquired (or engaged) by household members. Household members use these technology-based goods and services to improve their daily lives for applications such as household chores, educating children, entertainment, transportation, health and fitness, etc.

We define *external* household-impacting technologies as those used by individuals or organizations outside the household environment that have an impact on one or more household members. These technologies are not owned (leased) or engaged by household members, but in some way affect household labor. An example of an external household-impacting technology could be an AI-powered meal delivery service (e.g., Hello Fresh), which works to improve its AI capabilities such that it continues to more accurately recommend meal options to match a household's preferences. Similarly, Stitch Fix is a U.S.-based AI-powered service that delivers clothing to subscribers based on subscribers' stated preferences and prior purchasing behaviors. Household members subscribe to the service that uses AI, but the actual AI deployment is not done by the household member. Thus, we consider this example to be an *external* technology.

Table 1 provides examples of technologies in each category. Table 2 highlights variations between the categories.

Table 1. Examples of internal and external AI and AV technologies affecting households

Internal technologies	External technologies
Personal-use autonomous vehicles (e.g., driverless cars)	Automated driverless taxi or bus fleets; driverless delivery vehicles
Smart appliances (e.g., robotic vacuums)	Robotic grocery shoppers (droids) & cashier-less stores; robotic restaurant waitstaff
Smart speakers (e.g., Amazon Echo)	E-commerce warehouse automation (e.g., picking)
ChatGPT-like generative AI applications	Home meal delivery services
AI-powered video gaming devices	Medical advising services

Table 2. Differences between internal and external household-impacting technologies

	Cost of ownership/usage of tech systems	Responsibility for maintenance	Locus of learning	Extent of shared usage
Internal household-impacting technologies	Household	Household	Household	Minimal
External household-impacting technologies	Enterprise	Enterprise	Enterprise	Extensive

The Potential of AI and AVs in Alleviating the Gendered Burden of Domestic Labor

While research on AI, AVs, and other emerging technologies abounds, work on the impacts of such technologies in the household domain remains limited. Existing and emerging research considers the impacts of automation and artificial intelligence in business and industry contexts, as well as the political, societal, and cultural implications of such technologies (e.g., Kissinger et al., 2021). With the booming of generative AI (e.g., ChatGPT) and related technologies, a discourse on the impacts in the educational domain is also gaining steam (e.g. Heaven, 2023).

Yet, research linking emerging technologies with an exploration of the world of unpaid domestic work and the persistent gender imbalance related to domestic work is quite scarce. One notable exception is recent research by Hertog et al. (2023) analyzing the likelihood of particular household-related tasks being automated and considering how this might change time spent on domestic labor. The authors discuss the potential effects of automation in the domestic domain on the gendered division of labor, asserting that:

> "Domestic automation will affect individuals unevenly. For example, women spend more time on domestic work than men do. Consequently, automation of domestic tasks, especially tasks that are dominated by women, will benefit women more than men and could reduce gender inequality in time spent on household production" (Hertog et al., 2023, p. 3).

To our knowledge, this paper is one of the first to gather empirical data on this intersection of these topics. Other work that centers on the potential effects of automation on women in the workplace may have corollary impacts on the household domain – for example, a short article by Baboolall et al. (2019) finds that women may benefit more than men in the realm of paid labor because they often work in occupations or roles that require skills that are less likely to be automated. However, there are also conflicting findings regarding whether men's or women's work will be more greatly impacted by automation (Casey & Nzau, 2019).

While this existing research provides a useful foundation, our understanding of how AI and AVs may impact the gendered division of household labor is still limited. To this end, we build on this foundation by calling attention to two important conceptual assertions. The first is that AI and AVs may be uniquely positioned to alleviate the mental burden of domestic labor. The second is that these technologies affect not only the person using them, but also other individuals related to, or associated with, that person. This leads to second-order effects that might be beneficial in reducing the unequal division of household labor.

AI and AV Capabilities and the "Mental Load" of Domestic Labor

Since existing literature focuses quite extensively on the time burden of domestic labor, it is not

surprising that much of the research on technology and the household domain centers on a time-

saving focus. Even the earliest household appliances, such as the washing machine and the stove,

were framed as time-saving devices, writes Greenwood (2019):

> "At the start of the Second Industrial Revolution, women's magazines were filled with articles extolling the virtues of these appliances, the new domestic servants. For example, in 1920, an article in the *Ladies' Home Journal* entitled 'Making Housekeeping Automatic' claimed that appliances could save a four-person family 18.5 hours a week in housework." (p. 50).

Such a time-saving lens aligns well with the primary conceptual concentration of existing

research on the physical *doing* of domestic labor and the reliance on time-use survey data.

Indeed, modern-day realities also illustrate how critical time-saving is in supporting dual-career

families in the domestic domain – for example, outsourcing domestic tasks by ordering takeout

dinners, hiring an in-home cleaning service, or utilizing laundry deliveries.

Emerging technologies like AI and AVs will certainly offer time-saving benefits and

assist with the accomplishment of household work in more sophisticated ways. We propose that

an area of unique promise from AI and AVs is their ability to assist with the cognitive and

emotional management of domestic labor –this is the *mental load* that continues to plague

working women in particular (Ciciolla & Luthar, 2019; Daminger 2019) and yet has received

relatively less attention in existing research on the gendered division of domestic labor. In fact,

scholars suggest that existing research on the household division of labor likely underestimates

the burden on women because it fails to account for the mental load and emotional work

involved in household management (Daminger, 2019; Dean et al., 2021; Reich-Stiebert et al.,

2023). Therefore, focusing on the intersection between the managing component of domestic

labor and the potential for emerging technologies to impact (lessen) it is a ripe area for inquiry.

We present a framework integrating technological capabilities with the *doing* and

managing components of domestic labor. Table 3 offers a summary of these intersections, which

we cover below.

Table 3. Integrating AI and AVs with *Doing* and *Managing* of Domestic Labor

		DOMESTIC LABOR			
		"Doing"	*"Managing"*		
			ANTICIPATING	**PLANNING**	**DECIDING**	**OVERSEEING**
EMERGING TECHNOLOGIES	Artificial Intelligence	Robots • Household chores	Generative AI • Exploring alternative scenarios and approaches	Virtual assistants • Scheduling • Predicting • Combining • Communicating	Generative AI • Presenting options • Providing analysis • Creating plans	Virtual Assistants • Evaluating outcomes Robots • Sensors and surveillance
	Autonomous Vehicles	Personal autonomous vehicles Automated shuttles and buses	Pubic and personal vehicles • Planning for pickups and drop-offs	Public and personal vehicles • Timing becomes less dependent on family availability when humans don't need to drive	Delivery Vehicles • Trade-offs become fewer when not constrained by household drivers	Infrastructure and systems • Remote monitoring and reporting provides real time feedback

As indicated in Table 3, emerging technologies certainly have capabilities that can assist

with the ***doing*** of domestic labor – for example, robots can help with chores such as vacuuming,

and autonomous vehicles (even with low levels of assistance) can help with driving. Yet, the

unique promise of AI and AVs that has greater potential to alleviate the unequal burden placed

on women is their ability to assist with the ***managing*** components of domestic labor. Even if

utilizing a grocery delivery platform or robotic vacuum saves time in completing such tasks, one

partner still must be the manager and overseer who anticipates, organizes, and delegates such

household tasks. Research suggests that managing the household is much more likely to be

handled by the female partner, and doing so requires significant cognitive and emotional labor

(e.g., Daminger, 2019; Dean et al., 2021; McKeown, 2021). Building from this research, we

consider four types of managing involved in domestic labor where AI and Avs have the potential

to assist – *anticipating*, *planning*, *deciding*, and *overseeing*.

   Anticipating. First, we focus on *anticipating* needs within the household and family as

part of the mental load of managing the domestic domain. Daminger (2019) describes

anticipation as a component of cognitive labor that involves "[recognizing] an upcoming need,

problem, or opportunity" (p. 618). This can include routine anticipation like noticing that the

milk is about to run out or recognizing the need to schedule an appointment for an elderly family

member. It can also include anticipating more complex problems, such as recognizing a

mounting financial concern related to meeting upcoming childcare or educational costs. Scholars

also note that anticipation involves emotional labor – the very nature of thinking about and

recognizing family needs requires anticipating the emotional needs of others while

simultaneously managing one's own emotions (Dean et al., 2021; Hochschild & Machung,

1989).

   With the anticipation of household and familial needs, AI and AV technologies offer

unique capabilities, some of which we are already seeing in use today. For example,

recommendation engines on e-commerce platforms like Amazon make suggestions of household

items that a family may be ready to re-order. As the algorithms within these systems become

more sophisticated, they will be even more able to assist with anticipating what household

supplies a family may need. Likewise, some healthcare provider platforms (e.g., Epic Systems)

already suggest screening procedures or vaccines that are coming due. It is not hard to imagine

such capabilities also anticipating necessary car maintenance, sign-ups for children's seasonal

activities, and other familial scheduling that may be seamlessly integrated into a household

calendar. As Grose (2019) details, women often find themselves doing more of this anticipatory

work than their male partners – describing it as

> "a constant thrumming, low-level anxiety over the health and well-being of your
> children, and women tend to do more of the worry work than men do. It's an endless list
> of organizational tasks that runs through your head like ticker tape: We're out of milk
> when do we need to apply for preschool is the baby outgrowing her onesies." (para. 3)

Thus, the promise of more sophisticated and reliable assistance with anticipation also lies in the

potential for reducing some of the embedded emotional labor that such anticipation requires.

    Planning. Managing in the household domain also involves *planning* – attending to

familial schedules, activities, doctor appointments, shopping lists, vacations, and the like. While

anticipation is focused on upcoming needs, planning work is really about "ensuring that the

household runs smoothly and every family member gets where they need to be when they need

to be there" (Daminger, 2019, p. 611). Planning can also include longer-term considerations,

such as college financial planning or the negotiation of which partner's career takes priority

during child-rearing years. Research suggests women devote more mental energy to such long-

term planning (Bass, 2015; Wong, 2017).

    Similar to anticipation tasks, AI and AVs can offer unique capabilities in the planning

domain. Returning to the example of healthcare platforms, improved AI capabilities will enable

such systems to integrate more seamlessly with other systems that assist with planning; in

addition to noticing that it is time to schedule a medical appointment, perhaps the system can

accomplish the scheduling at a time that works, and also integrate with the payment processing

system once the appointment is completed. Planning will also be enabled by AVs – at the

extreme end, AVs will provide more readily available transportation that does not require a

driver to be available; but even with lower levels of autonomy and assistance, AVs may allow

drivers to accomplish tasks with assistance that they otherwise would not be ready to tackle –

like a new driver being able to transport themselves to more difficult places than they would

have been able to do alone if they were driving unassisted. These examples highlight the

integration of time-saving task completion, with an alleviation of the cognitive labor required to

effectively carry out the planning of domestic and household tasks.

Making Decisions. In the household domain, *making decisions* requires a significant

amount of mental and emotional capacity, as well. Daminger (2019) aptly writes: "No meal is

made, no dentist appointment scheduled, and no daycare center selected without some amount of

foresight, planning, and *deciding*[emphasis added]" (p. 610); this highlights the process involved

in the management of a household from anticipation through execution of the decisions. A parent

notices that summer camp sign-ups open next week (anticipation), which in turn requires

figuring out what other commitments the family has during the summer months (planning), so

eventually the parent can decide what camps and during which weeks to sign up for (deciding).

Similar processes occur in managing more complex domestic decisions, such as buying a new

home or assisting an aging family member with eldercare; at each stage, cognitive and emotional

resources are expended to make these decisions.

Decision support is an area where AI can offer useful assistance. Generative AI systems

can already produce concise documents outlining the pros and cons of decisions and their trade-

offs. For example, the authors recently asked ChatGPT to help decide whether we should go to a

concert at a local stadium or an outdoor venue – the system immediately returned a list of

considerations to address before making the decision. While this is a relatively straightforward

example, it highlights how AI systems provide immediate guidance on everyday decisions that

otherwise require mental effort. Additionally, deciding what to cook for dinner or which daycare

to use for young children can be facilitated by increasingly sophisticated learning in automated systems that understand familial preferences and their relation to decision options. Certainly, complex familial decisions require more collaboration and human involvement – for example, if a family member wants to share with other family members the details of a meeting with an estate attorney, AI-powered communication technology can automatically transcribe and analyze meeting content very quickly to inform others who were unable to attend. AVs may also help alleviate some of the stress associated with decision-making if they add capacity to household transportation. For example, parents often need to make trade-offs related to which events they will attend, which they will leave early to go pick up another child (or other family member), or which a child may need to miss. If AVs can assist with some transportation needs, parents could more easily determine how to split their time to focus on the most meaningful interactions beyond driving tasks.

     Overseeing. Finally, we consider *overseeing* as a component of managing that requires additional mental and emotional work. Daminger (2019) discusses this as a form of monitoring that "entails following up to ensure the decision is carried out and satisfactorily addresses the anticipated need" (p. 619). In research by Robertson et al. (2019), they discuss how mothers engage in "managerial thinking" which involves "thinking globally about the family system" a type of labor that not only requires cognitive work but also a degree of emotional labor ensuring that everything is going smoothly for all involved. This could include anything from overseeing a child completing homework to ensuring an elderly relative is receiving (and taking) their correct medications either at home or in their new assisted living facility. AI-enabled surveillance and monitoring systems continue to increase in capabilities and decrease in cost, offering a direct mechanism to assist with overseeing. In a recent example shared with the

authors, a homeowner who had to be at work for a long day hired a dog walker to come to her house to take the dog for a walk; she used a pet camera system ("Furbo")[8] that recorded and saved short videos whenever it sensed a human was near the dog's environment. This allowed the owner to review the videos remotely and see how the walker interacted with the dog to determine that she had made a good choice in hiring her. Such an example relies on emerging technologies including AI, sensors, video processing, etc. to provide peace of mind to a family member. Similarly, a recent article in the Wall Street Journal titled *The AI Nanny in your Baby's Future* suggests increasingly sophisticated AI will be able to read bedtime stories to children, engage babies in back-and-forth communication tailored to their developmental needs, and "even deduce why a baby is crying"(Susskind, 2023). While such suggestions still garner mixed reactions from adults today, the article suggests the same potential cognitive and emotional benefits as we do here – "Like innovations of the past generation, these [AI] tools will leverage technology to engage children and save parents time and stress" (para. 3) Ultimately, this is where the unique benefit of these technologies lies – at the intersection of time-saving *and* reducing the emotional and cognitive labor that domestic labor entails.

Second-Order Effects of Emerging Technologies on the Household Environment

In addition to the potential for unique contributions in the domain of household *managing*, an additional promise of these technologies comes from recognizing potential second-order effects – that is, broadening our view of the household environment to consider the impacts of AI and AV technologies beyond those related solely to direct users of the technology. We found that most analyses of new technology adoption, whether focused on industrial or consumer settings,

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[8] *Furbo keeps your pets safe & happy even when you are away.* (2023) Furbo. Retrieved September 14, 2023, from https://furbo.com/us.

usually take the technology's direct user as the focal point. This is logical and justifiable because the main effects of new technology usage usually accrue to the user. However, as we study household and family units, we see that technologies that benefit one member may also have indirect benefits for other members. Second-order effects represent consequences for household members other than those directly using the technologies – an area where AI and AVs may be uniquely positioned to reduce the gendered burden of domestic labor

Earlier in this paper we mentioned a father who used generative AI to determine what to do on a rainy day with his nine-year-old son. This father is the husband of one of our colleagues – a full-time working mother. After a few iterations, the father and son decided to take ChatGPT's advice and bake cookies; however, they ran into problems when they realized they lacked some of the required ingredients and when they noticed their cookies were not finishing baking in the recommended time. In both cases, they went back to ChatGPT and asked what to do based on the evolving situation, and the tool provided helpful and ultimately successful suggestions (like, what ingredients to substitute for the missing ones, and how to rectify the slow baking times). What did not happen in this example is just as important as what did: the father did *not* call our colleague (his wife) asking for advice on what to do on a rainy day, how to locate the missing ingredients, or how to rectify the underbaked cookies. The main effect here was that the AI technology helped the father and son; the second-order effect was helping the mother complete her workday uninterrupted because the AI-powered tool assisted her household members. Surely there could be other avenues for seeking such help (e.g., Google search engine) and there are some households where the father is the better baker than the mother, but this example aptly illustrates the concept and benefits of second-order effects with the use of emerging technologies in household environments.

One can envision other examples where a teenager may be home and able to order food delivered or take a ride somewhere, all either pre-arranged or on-demand and not requiring interactions with a parent. While this is possible today, with the addition of AI systems providing suggestions, monitoring, guidance, payments, guardrails, etc., we expect this to increase in prevalence. The increasing use of AVs both by external service providers and internal family members, will enable these scenarios to become increasingly more common. Thus, as scholars continue to pursue research on the impact of emerging technologies on the household environment, we emphasize the importance of not only studying the main effect of a technology's impact on users but also the indirect effects of the impact a technology may have on other household members.

Policy Implications and Future Research

New Policy Implications

AI and AV technologies are rapidly changing with new advancements and innovative applications emerging at increasingly accelerating rates. Generative AI represents the fastest technology launch in history: ChatGPT set a record in January 2023 as it reached 100 million monthly active users, which earned it the title of the fastest-growing user application.[9] With this rate of adoption and advancement, policymakers face vast challenges to stay ahead of (or at least catch up with) addressing the risks and concerns associated with these technologies. In this section, we highlight a few topics relevant to policymakers as they embark on revising existing regulations and creating new ones.

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[9] Garfinkle, A. (2023, February 2). ChatGPT on track to surpass 100 million users faster than TikTok or Instagram: UBS. *yahoo!finance.* Retrieved from https://news.yahoo.com/chatgpt-on-track-to-surpass-100-million-users-faster-than-tiktok-or-instagram-ubs-214423357.html

Because AI and AV technologies and their applications are developed, deployed, and used across local, national, and global domains, policymakers and legislators at regional, state, federal, and international levels must collectively consider new implications of these technologies. From local governments to international standard-setting and regulatory bodies, policymakers are faced with learning about a quickly changing landscape with far-reaching consequences. Related to AI and Avs, especially for the domestic sphere, we envision the need for more refined policymaking in areas such as privacy, safety, labor laws, social safety net concerns, and others.

For privacy, the heart of the matter revolves around the collection, sharing, and usage of data (Bhargava et al., 2020). As data grows as the key component of both AI and AV systems, privacy laws need to keep pace to protect individuals and organizations. Protecting the data users (especially consumers) provide to systems is an obvious area of concern. Importantly, though, the data gathered and used by these systems includes not only that which individuals provide intentionally, but also information that systems access, acquire, process, and share via observation and surveillance such as through behavioral data analysis (e.g., how often an individual checks their bank account balance). In many cases, users are unaware of the extent (or value) of data organizations accumulate simply by monitoring usage. In social media and other platform businesses, transparency and data privacy practices and policies are evolving rapidly. This is only the start of a much greater need for organizations and policymakers at all levels to address privacy and data management concerns, particularly as technologies are deployed more extensively in the household domain. For example, as family members drop broadcast cable TV and turn instead to digital streaming services for entertainment, media platforms are

comprehensively able to gather data on what they are watching, for how long, from where, and

so on, creating opportunities for privacy concerns.[10]

Safety is an obvious critical risk area with AI and AV technologies. The most apparent

concerns with AVs are collisions including dangers for passengers and pedestrians as well as

risks to property, animals, and anything else that might be involved in an AV crash. These

concerns must be addressed at a policy level (Winston & Karpilow, 2020) in addition to all the

technological work underway to minimize and ultimately prevent them entirely. While safety

concerns are often highlighted in research regarding how emerging technologies might impact

workers and enterprises, as more and more individuals use these technologies in household

environments (e.g., AVs transporting family members), risks become increasingly salient for

consumers as well. Some AVs may be used as individually owned personal vehicles while others

might be deployed in public transportation networks; they all need to be regulated to account for

new circumstances where drivers are not part of the systems.

Beyond AVs, AI also introduces questions of individual safety: physically, mentally, and

emotionally. AI-powered machines may cause bodily harm to individuals in applications when

machines are operating autonomously or when they collaborate with humans. Though AI

systems are improving at record-breaking speeds, they still often construct and provide answers

that are misleading, unethical, or simply wrong. We can imagine situations for all these cases

where the usage of these answers may raise safety concerns. AI systems may also provide

solutions to problems that could be emotionally harmful, such as triggering trauma-related

responses. In all these cases, it is not yet clear where the blame should fall and what the

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[10] See Auxier et al. (2019) for an overview of privacy topics related to consumers.

appropriate recourse should be. Thus, it is also not yet obvious what regulations should be enacted to cover these situations.

Labor laws have connections with AI and AVs in the domestic sphere starting with the workplace. The definition of who (or what) is an employee versus a contractor is already complex, highly variable by geography, and has notable impacts on business model implementations (e.g., Uber lawsuits in California[11]). As emerging technologies make it even easier to find and engage with talent worldwide, we expect work arrangements to continue to evolve and include not only more traditional permanent full-time but also short-term contracts and other types of relationships within workforce ecosystems that raise new policy concerns (Altman et al., 2023). With AI serving as a scheduler and monitor of work in many cases (e.g., with food delivery services), and sometimes as a participant in workforces (e.g., with customer service chatbots), how employees and contractors can be engaged, monitored, and evaluated is an evolving policy topic with notable implications for how household members might choose to engage in the workforce. For example, as flexible roles become increasingly more ubiquitous, and increasingly include leveraging high education and skill levels to provide appropriately rich monetary returns, more women with school-age children may choose to participate in paid work. How these women are treated as workers, including for example which types of benefits they receive (or do not receive), what development opportunities they have, and how they are monetarily compensated, are all impacted by wage and labor laws. Policies classifying workers need to be updated to reflect today's reality of increased variability in worker engagements rather

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[11] Thomson Reuters. (2023, March 14). *Uber, Lyft shares surge after court decision to treat drivers as contractors*. Reuters. https://www.reuters.com/legal/uber-lyft-shares-cheer-court-decision-treat-drivers-contractors-2023-03-14/

than relying on old models simply distinguishing between employees and independent

contractors.[12]

Training, including for skills related to software, robotics, testing, etc., will continue to

grow in importance and thus require updated regulations since today's laws often prevent

organizations from investing in workers who are not considered employees (e.g., independent

contractors). Increased access to training on new collaborative, AI-powered systems might help

individuals more quickly adopt these tools. With today's policies, most temporary or contingent

workers do not (and cannot) have access to this training through workplaces. Thus, individuals

who participate in the workforce as contractors may be at a disadvantage in terms of learning

new skills.

Social safety net concerns emerge as technologies enable more forms of work

arrangements that may not include medical, retirement, and other family-related benefits.

Depending on geographic location, and especially in the US, most social benefits are linked to

employment relationships (usually requiring close to full-time employment). As AI and AVs

become more ubiquitous and affect women's moves into (and out of) the workforce, social

responsibility policy concerns will continue to emerge and evolve. Laws ensuring vulnerable

populations such as the young, elderly, disabled, and others have fair and equitable access to new

technologies are critical and must be refined to account for AI, AVs, and other emerging

technologies. Other areas of policy interest related to AI and AVs in the domestic sphere may

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[12]Commonwealth of Massachusetts. (n.d.). *Independent Contractors*. Mass.gov. https://www.mass.gov/info-details/independent-contractors-0

include taxes, capital investment considerations, and basic research laws and incentives associated with funding for new technology development and deployment across domains.

Future Research

While there is substantial research underway focused on emerging technologies such as AI and AVs, and excellent ongoing research on domestic labor and gender imbalance, scholars are paying little attention to the intersection between emerging technologies and how they might impact the gender imbalance in household labor. Even less emphasis is being placed on the topics we discuss in this paper: 1) addressing the mental load associated with managing the household environment, and 2) improving outcomes through second-order or indirect effects beyond impacts on direct users of technologies. We encourage researchers to pay increasing attention to these areas with future research that also pushes the intersection of these topics. Additionally, we can envision a few other extensions of this work including for other types of households, extending the research globally, and moving beyond conceptual discussions to theory building through quantitative and qualitative research.

Alternative household configurations – As we noted, the scope of our analysis centers on married or cohabitating heterosexual couples. We recognize there are many other forms of family and household units such as households with single people, partnered households with or without children, multi-generational households, and alternative familial structures (e.g., multi-adult households, same-sex couples, etc.), and all of these are being impacted by AI and AVs. Thus, we encourage future researchers to address how emerging technologies may impact these households and how they may affect imbalances that exist in household labor.

Extending the research globally - While our analysis has centered on U.S.-based examples, we recognize that topics covered in this paper represent global phenomena in terms of the gendered division of household labor and the rapid development and deployment of AI and AV technologies. By way of a specific example, Xpeng Robotics, an affiliate of Chinese electric carmaker Xpeng, raised $100M in mid-2022 to commercialize household robotics over the coming two years (Kharpal, 2022). Japan has long held a leading role in domestic automation (fuzzy logic rice cookers and automated toilets were introduced in the early 1980s) (Santo, 2018; Sealy et al., 2018). The smart home market in Japan is expected to reach over US$16B by 2027.[13] Asian AI-focused start-ups have recently raised US$25B in funding while European AI start-ups have raised US$8B (U.S. start-ups raised $38B) (Kissinger, et al., 2021). Funding will ebb and flow over the coming years, the speed of deployment is likely to vary across the globe, and different countries and regions may find some technologies more relevant than others, yet our expectation remains that technological evolution and impacts will remain global in scope. While the gendered distribution of labor also varies by geography, we expect the impacts of these technologies to span borders in terms of impacting gender roles within household contexts. Future researchers may find great opportunities to explore these phenomena on a global basis. Similarly, policymakers worldwide will need to consider the impact of these changes on local, regional, federal, and international laws and regulations, especially as many of the relevant systems reach across traditional geographic boundaries.

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[13] Statista. (2022, December). *Smart Home - Japan: Statista market forecast.*
https://www.statista.com/outlook/dmo/smart-home/japan

Theory building through quantitative and qualitative research - This article is conceptual in nature and presents new frameworks and contributions based on a review and integration of the literature and new insights derived from our analysis. Since we are studying nascent phenomena, this is an entirely appropriate approach at this point. However, we believe it would be productive and worthwhile to move this conversation further through theory-building with quantitative and qualitative research. We envision empirical studies incorporating surveys and building data sets. We can imagine qualitative studies leveraging semi-structured interviews, archival data, and observations. In sum, we believe that the topic areas presented here hold rich opportunities for new research streams to explore.

Concluding Comments

While the more common approach for management scholars is to investigate the role of emerging technologies in terms of their impact on businesses and other enterprises, AI and AV technologies are evolving to encompass capabilities that are becoming increasingly relevant for tasks well beyond the realm of business, non-profit, and government applications. Whether it is generative AI helping students with their homework or AVs delivering goods to the household, these technologies are affecting mainstream activities as well as more far-reaching elements of human lives. They are changing how we approach domestic labor and thus affecting what has been a persistent gender imbalance in the division of labor. By assisting household members with management tasks associated with running their lives and affecting not only technology users but also other family members, we expect these technologies to hold great promise in improving the gendered division of labor in households.

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