Service Robots, Customers, and Service Employees:

What Can We Learn from the Academic Literature and Where are the Gaps?

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Abstract

Purpose – Robots are predicted to have a profound impact on the service sector. The emergence of robots has attracted increasing interest from business scholars and practitioners alike. In this article, we undertake a systematic review of the business literature about the impact of service robots on customers and employees with the objective of guiding future research.

Design/methodology/approach – We analyzed the literature on service robots as they relate to customers and employees in business journals listed in the Financial Times top 50 journals plus all journals covered in the cross-disciplinary SERVSIG literature alerts.

Findings – The analysis of the identified studies yielded multiple observations about the impact of service robots on customers (e.g., overarching frameworks on acceptance and usage of service robots; characteristics of service robots and anthropomorphism; and potential for enhanced and deteriorated service experiences) and service employees (e.g., employee benefits such as reduced routine work, enhanced productivity and job satisfaction; potential negative consequences such as loss of autonomy and a range of negative psychological outcomes; opportunities for human-robot collaboration; job insecurity; and robot-related upskilling and development requirements). We also conclude that current research on service robots is fragmented, is largely conceptual in nature, and focused on the initial adoption stage. We feel that more research is needed to build an overarching theory. In addition, more empirical research is needed, especially on the long(er)-term usage service robots on actual behaviors, the well-being, and potential downsides and (ethical) risks for customers and service employees.

Research limitations – Our review focused on the business and service literature. Future work may want to include additional literature streams, including those in computer science, engineering, and information systems.

Originality/value – This article is the first to synthesize the business and service literature on the impact of service robots on customers and employees.

Keywords service robots, artificial intelligence, AI, literature analysis, customers, service employees

Article type Literature review

Introduction

"The Budapest café where robots serve (and occasionally spill) coffee" (Patricolo, 2019), "Service robots lend a hand at China's banks and railway stations" (Harashima, 2019), and "Will robots take your job?" (O'Brien, 2019) are a few of the increasing news headlines about the emergence of service robots. These headlines highlight that advances in robotics and artificial intelligence (AI) are gaining broad attention. Furthermore, the expected impact of robots on our economies is staggering. For example, experts estimate that around half of today's work activities could be automated by 2055 (McKinsey Global Institute, 2017), and that adoption rates of robotic technologies are accelerating across all industries, leading to an estimated displacement of about 175 million jobs by 2022 (World Economic Forum, 2018). Robotics and AI offer a wide range of potential benefits to organizations and can include cost reduction, productivity gains, enhanced reliability, scalability, improved compliance and security (Wirtz and Zeithaml, 2018), revenue growth, improved customer retention, and even improved creativity of managers (Kumar *et al.,* 2019).

The term "robot" originated from the Czech word *robota* and means forced labor and "has evolved in meaning from dumb machines that perform menial, repetitive tasks to the highly intelligent anthropomorphic robots of popular culture" (Lanfranco *et al.,* 2004, p. 14). Wirtz *et al.* (2018, p. 909) define service robots as "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to an organization's customers." Additionally, Jörling *et al.* (2019, p. 405) emphasize the customized nature of robotic service delivery, referring to service robots as a technology "providing customized services by performing physical as well as nonphysical tasks with a high degree of autonomy." Wirtz and colleagues (2018) further argue that, in terms of design, these service robots can (i) have a virtual or physical presentation (e.g., Alexa vs. Pepper robots), (ii) have a humanoid or non-humanoid appearance (e.g., Sophia vs.

Roomba robots), and (iii) perform cognitive-analytical tasks and emotional-social tasks (e.g., reception robots vs. image analysis software assistant for medical diagnosis). In the frontline service setting, service robots can also be viewed as social robots when they interact and co-create value with their customers at the service encounter (Čaić *et al.*, 2019; Wirtz *et al.*, 2018).

Originating from process automation, robots have become highly effective at performing repetitive tasks previously performed by humans (Lacity and Willcocks, 2016), such as carrying objects and undertaking monotonous assembly jobs. Recent developments demonstrate that robots are increasingly capable of more sophisticated physical as well as cognitive activities, such as detecting worsening dementia (Lay, 2019), identifying hazards such as spills on a shop floor (Cheng, 2019), and offering wealth management advice (Avery, 2019). More advanced functions of service robots can be found in professional services, ranging from financial auditing to assisting in medical surgery through voice-activated robotic arms (Barrett *et al.*, 2012). According to the Service Robot Deployment model (Paluch et al., 2020, Wirtz *et al.,* 2018), service robots will be able to deliver service tasks with almost any degree of cognitive complexity and virtually all tasks with low emotional/social complexity. However, service tasks high in emotional/social complexity will largely have to be delivered by frontline employees as service robots will not be able to engage in deep emotional acting and will not have agency for the foreseeable future. Finally, tasks high in cognitive and emotional complexity are expected to be delivered by humans supported by robots (Wirtz *et al.*, 2018).

While scholars and practitioners have highlighted the potential role of service robots in enhancing customer service, and thereby customer satisfaction and sales revenue (Lacity and Willcocks, 2016; Schatsky and Arora, 2017), as much as 61 percent of customers remain uncomfortable with the idea of engaging with robots (West, 2018). Further, recent examples of service robots being ‘fired’ raise challenges concerning their deployment for service delivery. For

example, Henn-na Hotel in Japan eliminated about half of its 250 service robots as they caused problems for their guests (e.g., in-room robotic assistants thought that snoring sounds were commands and woke up guests repeatedly), and productivity gains did not always materialize as employees had to constantly recover robots-caused service failures (Gale and Mochizuki, 2019). Given the disparity in views, it seems to be of value to investigate and synthesize what academic articles in leading business journals have concluded on the impact of service robots on customers and service employees, the main affected parties in service delivery. This study aims to contribute to the literature by responding to several calls for research highlighting the role of robots in the service delivery (Marinova *et al.*, 2017; Rafaeli *et al.*, 2017). Specifically, the two primary objectives of this article are:

- To synthesize the findings of extant research through a systematic review of academic articles published in leading business and service-oriented journals about the impact of service robots on customers and service employees to provide a narrative on the current understanding.
- To identify knowledge gaps regarding the impact of robots on customers and service employees, and provide guidance for promising future research directions with high potential theoretical and managerial impact.

Literature review and synthesis of research on service robots

To obtain a global understanding of what we know about service robots and what insights have been garnered from academic research, we conducted a systematic literature review. A systematic approach helps cover a wide area of literature and ensures an objective picture of the current state without overemphasizing potential popular views. We conducted this review in two stages. First, we examined past literature reviews on service robots, which are summarized in

Table 1. Second, we conducted a detailed analysis of academic publications on service robots and how they relate to customers and service employees.

Examining Table 1 shows that these reviews tend to focus on specific contexts such as hospitality and tourism, and within these industries, focus on topics such as robot design, adoption and commercialization challenges (Ivanov *et al.*, 2019), failures in human-robot interaction (Honig and Oron-Gilad, 2018), value co-creation capability and challenges (Kaartemo and Helkkula, 2018), customer sentiments and acceptance toward robots across various service settings (Savela *et al*., 2018), and robot usage in aged care settings including the perception and experience of elderly customers and related ethical issues (Vandemeulebroucke *et al.*, 2018a, 2018b). However, none of the reviews provided a comprehensive literature analysis of service robots in general and of their impact on customers and service employees in particular, which is the focus of our article. In the following, we detail our analysis method and explain the findings.

[Insert Table 1 about here]

Journal inclusion criteria

Our systematic literature review included conceptual, qualitative and empirical studies that specifically discussed the impact of robots on customers and employees in the service sector. We included articles that were published over the past 21 years (1998–2019) in the *Financial Times top 50* (FT50) journals. These journals are widely perceived to be the top-tier group of journals in business research due to their prestige and impact (Ormans, 2016; Tüselmann *et al.*, 2016). In addition, we included six leading service research journals (i.e., *Journal of Service Management*, *Journal of Service Research*, *Journal of Services Marketing*, *Journal of Service Theory and Practice*, *Service Science*, and *Service Industries Journal*). Finally, we expanded the reach of our review by including the SERVSIG literature alerts, which features academic service articles published in non-service journals during the 1998-2019 period (Kunz, 2019). We are

confident that these sources together provide largely comprehensive coverage of the academic business literature related to service robots and their impact on customers and employees.

Article search strategy and selection criteria

From the sources detailed in the previous section, we identified potential articles in each journal using the following search string: *(Health OR Hospitality OR Insurance OR Consulting OR Retail OR "Professional Service" OR Service*) AND ("Robot*" OR "Artificial Intelligence" OR Automation) AND (Consumer OR Customer OR Employee)*. The initial list of 4,028 articles was then screened manually. Based on the information provided in their abstracts, the majority of the articles were deemed as not relevant for this study. This process narrowed the list to 87 articles for which we then evaluated the full text. Articles that did not meet the inclusion criteria (i.e., did not cover the impact of robots on customers and/or service employees) were eliminated from the review. Examples of articles that were deemed out of scope included studies that discussed the impact of advanced information technology on service innovation and the design of smart technologies. A final set of 20 articles emerged that was included in our detailed analysis and is listed in Table 2.

[Insert Table 2 about here]

The 20 manuscripts included for the review were published in the following nine journals (listed in alphabetical order and the number of articles reviewed from each journal is shown in brackets): *Cornell Hospitality Quarterly* (1), *Harvard Business Review* (4)*, Journal of Marketing Research* (1), *Journal of Service Management* (2), *Journal of Service Research* (4), *Journal of Services Marketing* (3), *MIT Sloan Management Review* (2), *Organization Science* (2), and *Organization Studies* (1).

Data extraction and synthesis

The key information published in each article was extracted into a standardized template for analysis. This information included research focus, theoretical underpinning (if applicable), method and context, and key findings related to the impact of robots on customers and service employees (see Table 2 for a high-level summary). Owing to the small number of studies available, the high diversity in the research issues, and the heterogeneous nature of the research findings, we decided to undertake a narrative summary approach (Paré *et al.*, 2015) as discussed in the next section.

Findings

The overview in Table 2 shows the wide variety of theoretical underpinnings that range from the theory of job replacement and coordination to the technology acceptance model and the co-creation/destruction perspective. Most of these studies provided scholarly viewpoints about a range of relevant issues, such as drivers of service and customer outcomes (Jörling *et al.*, 2019; Mende *et al.*, 2019; van Doorn *et al.*, 2017; van Pinxteren et al., 2019; Wirtz *et al.*, 2018), value co-creation (Čaić *et al.*, 2019), service failures (Fan *et al.*, 2016), the future of service jobs (Fleming, 2018; Gray and Suri, 2017; Huang and Rust, 2018), learning and skill development for employees (Beane, 2019; Beck and Libert, 2017), and abilities of robotic service automation (Benmark and Venkatachari, 2016; Davenport, 2017; Noone *et al.*, 2012). Four empirical studies investigated topics in health care settings (Barrett *et al.*, 2012; Beane and Orlikowski, 2015; Čaić *et al.*, 2018; Green *et al.*, 2016), while the fifth empirical study focused on the general impact of robots on employees and customers (Lacity and Willcocks, 2016).

The topic areas of the current literature can be organized according to the Frontline Service Technology Infusion Model by De Keyser *et al.* (2019). Their model highlights the interactions between smart technologies (i.e., service robots in our context), customers and

frontline employees for service delivery and suggests that the introduction of smart technologies leads to new challenges for both stakeholders. Figure 1 illustrates the major themes of current research concerning the service robot-customer and -employee interactions in relation (and as discussed in the introduction section) to the definition of service robots, their types, and the services and tasks they are likely to take on. We next highlight the findings and organize them into two sections, first the impact of robots on customers, and second, on service employees.

[Insert Figure 1 about here]

Customers as recipients of robotic service

Nine of the 20 studies in Table 2 explored how robots might affect service customers. The following findings warrant highlighting.

Overarching frameworks on the acceptance and usage of service robots. There are two comprehensive conceptual frameworks: the Service Robot Acceptance Model (sRAM; Wirtz *et al.*, 2018) and the Automated Social Presence (ASP; van Doorn *et al.*, 2017). First, sRAM explains the acceptance and use of service robots. Here, Wirtz and colleagues (2018) draw on the technology acceptance model (Davis, 1989) and role theory (Solomon *et al.*, 1985) to focus on needs and role congruency. They advance that "consumer acceptance of service robots depends on how well robots can deliver on the functional needs (i.e., related to dominance) and the social-emotional and relational needs (i.e., related to warmth) to achieve role congruency" (Wirtz *et al.*, 2018, p. 915). In their sRAM, they specified that functional elements (namely, perceived ease of use, perceived usefulness, subjective social norms), social-emotional elements (including perceived humanness, perceived social interactivity, perceived social presence), and relational elements (i.e., trust, rapport) together drive customer acceptance of service robots and, ultimately, actual customer usage of service robots.

Second, Van Doorn and team (2017) introduced ASP, which refers to "the extent to which

technology makes customers feel the presence of another social entity" (p. 43). They presented a moderated mediation framework to demonstrate the impact of ASP on service and customer outcomes (e.g., satisfaction, loyalty/re-patronage, engagement, and well-being). According to this framework, the influence of ASP on customer and service outcomes is mediated by social cognition (i.e., warmth, competence) and psychological ownership (i.e., receptiveness, attractiveness, manipulability). The mediated relationships are influenced by three customer-related factors, namely, relationship orientation (communal vs. exchange orientation), the anthropomorphism of the focal technology, and technological readiness.

*Characteristics of service robots and contextual factors***.** Researchers have started to take into account the characteristics of service robots and contextual factors in driving customer behavior. For instance, van Pinxteren *et al.* (2019) highlighted the impact of anthropomorphism on customers' trust, intention to use, and enjoyment when interacting with robots. In another study, the perceived autonomy of the robots was shown to lead to a decrease in customers' perceived behavioral control and, subsequently, their perceived responsibility for positive outcomes (Jörling *et al.*, 2019). Further, contextual factors matter to customers' responses to robotic services, such as the presence of other customers (Fan *et al*., 2016) and social belongingness (Mende *et al*., 2019).

Potential for enhanced and deteriorated customer experience. It has been suggested that robots can contribute to facilitating and enhancing the customer experience (Benmark and Venkatachari, 2016; Čaić *et al*., 2018, 2019; Lacity and Willcocks, 2016), while also causing potential negative consequences (Čaić *et al*., 2018, 2019; Mende *et al.*, 2019). A number of conceptual studies advanced potential generic benefits of robot-delivered service (e.g., convenience, speed, and accessibility) and potentially intervening mechanisms that might strengthen or diminish the value of robotic service delivery (e.g., emotional complexity of a

service; Wirtz *et al.,* 2018).

Empirical studies over the past two years have started uncovering several important insights. For instance, Čaić *et al.* (2018) examined the role of socially assistive robots in the care of the elderly across three functions, namely safeguarding, social contact, and cognitive support. Their investigation is valuable because it highlights the perceived positive impact of service robots on co-creating service value (e.g., as an ally, an enabler, and an extended self) as well as potential negative effects (e.g., as an intruder, a replacement, and a deactivator). Potential negative impacts of service robots were also highlighted by Mende *et al.* (2019), who found that humanoid service robots can elicit customer discomfort (such as feeling of eeriness and perceived threat to the human identity), which resulted in negative customer responses.

Service employees and service robots

Most studies about the impact of robots on service employees are conceptual in nature, except for some empirical studies in the health care sector (Barrett *et al.*, 2012; Beane and Orlikowski, 2015; Green *et al.*, 2016). Overall, reviewed literature discusses four broad issues: (1) how robots can benefit employees through streamlined service processes and other benefits, (2) the challenges employees might encounter when organizations implement service robots, (3) human-robot collaboration in service delivery, and (4) the effects of robots on service jobs and related employee up-skilling and development requirements.

Potential benefits for employees. Robots are generally seen to take over the routine and mundane tasks from service employees (Huang and Rust, 2018). For example, robots can outperform humans in data gathering and analysis (Beck and Libert, 2017), in handling generic customer inquiries (Benmark and Venkatachari, 2016), and generally, in executing tasks that are typically repetitive, common, and structured, with little to no differentiation (Davenport, 2017). Here, robots have the ability to deliver services in an accurate, reliable, efficient, convenient, and

speedy manner (Wirtz *et al.,* 2018). Overall, robots are seen as more likely to deliver services that fulfill either primarily functional needs (e.g., ticketing services) and those with complex functional needs in combination with simple social-emotional needs (e.g., insurance; Wirtz *et al.,* 2018).

Scholars have further indicated that robots can enhance productivity and employee satisfaction at the same time (Lacity and Willcocks, 2016). For instance, Noone *et al.* (2012) suggested that robots could augment employees' cognitive capacity. In a health care context, Barrett *et al.* (2012) found that the usage of pharmaceutical-dispensing robots in hospitals allows pharmacists more time to engage with and care for their patients.

Potential negative impact of robots on service employees. Scholars have highlighted numerous potential negative impact robots can have on service employees. For example, employees can experience frustration and perceived loss of autonomy in their service jobs (Barrett *et al.*, 2012). In a health care setting, robots can challenge employees in their task coordination (Beane and Orlikowski, 2015). These together, in turn, produce various tensions for employees such as depersonalization (i.e., experience of disengagement and disruption), clinical voyeurism (i.e., service employees experiencing discomfort when watching their patients through the screen), intangibility negotiation (i.e., feelings of dismemberment and disempowerment), and the need to manage change in relation to their roles and identities (Green *et al.*, 2016). Robotic technologies might also make it harder for employees to learn, leading to confusion, decreasing trust, and miscommunication (Beane, 2019).

Opportunities for service employee-robot collaboration. Around a third of current full-time occupations will be transformed into robot and AI augmented services that are delivered jointly by employee-robot-teams (Gray and Suri, 2017). The opportunity for human-robot collaboration in specific service categories has been clearly articulated in the conceptual studies by van Doorn

et al. (2017) and Wirtz *et al.* (2018). Drawing on the interplay between automated social presence (ASP) and human social presence, van Doorn *et al.* (2017) suggest that human employees and social service robots will collaboratively provide services characterized by high human and high automatic social presence, such as those in the health care and hospitality industries. In a similar vein, the Service Robot Deployment Model advances that human employees should team up with robots to deliver services characterized as high in terms of both social/emotional and cognitive/analytical needs (Paluch *et al.,* 2020; Wirtz *et al.,* 2018). According to these scholars, while service employees contribute to the co-delivery of the service through their social presence – building rapport with customers and offering them the necessary psychological comfort, robots help to reduce uncertainty and develop a sense of trust with customers in the technical quality of a service (e.g., that the core service will be delivered efficiently, reliably and correctly). As such, human-robot collaboration offers interesting enhanced roles for service employees who will be supported by AI and robots regarding the technical parts of the service (Wirtz *et al.,* 2018).

Job insecurity and upskilling needs. Finally, in a time of service automation, employees can be understandably wary about their jobs (Lacity and Willcocks, 2016) as many routine tasks, such as those in many standard customer contact centers, are likely to be taken over by service robots and AI (Huang and Rust, 2018; Wirtz *et al.,* 2018). Given the superiority of service robots in those tasks, scholars have highlighted the need for service employees to upgrade their skills to either act as caretakers and managers of the robots (Barrett *et al.*, 2012) and/or remain superior in their service delivery capabilities.

According to Beane (2019), it is essential for organizations to redesign service roles such that employees are incentivized to learn how to work with robots, allow employees to make mistakes in their learning, empower them to play instructing and coaching roles, and build a skill repertoire containing the tools and expertise needed for robot infusion in service roles. In addition

to technical expertise, workers must also acquire relevant skills to not only manage robots but also build relationships and alliances with relevant stakeholders in the organizations, thereby shielding themselves from being automated out of their jobs (Fleming, 2018).

Furthermore, and perhaps most importantly, service employees should differentiate themselves by seeking professional development opportunities to sharpen human capabilities currently under-serviced in training and education. These prized soft skills include creative thinking, intuition, and emotional intelligence, particularly in relation to persuasion, social understanding, and empathy (Beck and Libert, 2017; Huang and Rust, 2018). Together, these skills enable service employees to focus on 'feeling' tasks in order to respond to customers' emotional needs (Huang *et al.*, 2019).

Finally, despite the exponential increase in the adoption of robots across service industries, robots are seen as only taking over parts of the larger service tasks (Lacity and Wilcocks, 2017). Drawing on the concept of bounded automation, Fleming (2018) argues that industries are not enduring mass job destruction because of a range of environmental constraints that shape the diffusion of technologies, such as labor pricing, power relations within the organizations, and the nature of specific job tasks. Instead, it is likely that employees are presented with exciting new opportunities (Gray and Suri, 2017), including collaboration with robots to deliver services and upgrading relevant skills for the viability of their jobs in the future.

Future research directions

New service technologies present both opportunities and challenges to customers and employees (Kunz *et al.*, 2019). Early empirical efforts (Barrett *et al.*, 2012; Beane and Orlikowski, 2015; Čaić *et al.*, 2018; Green *et al.*, 2016) have shown different aspects of robot implementation in health care and aged settings. While these settings have attracted much research attention (also see Mende *et al.,* 2019, pp. 537-538), business and service research has

failed to keep up with the acceleration of robotic technologies and their potential applications across virtually all service sectors.

Notably, our literature review shows that the integration of robots in service delivery processes has predominantly been a 'down-stream' approach from the service organization's perspective with less focus on the role played by employees and customers. Furthermore, much of the current research is either conceptual in nature, uses laboratory experiments with hypothetical scenarios and/or examines the adoption of robot-delivered services. However, service organizations must gain a better understanding of actual customer motivations, their changing expectations, and concerns over time, and their long-term use (vs adoption) of robot and AI-delivered service.

At the same time, just as the education sector must prepare students for an unknown future dominated by robots and AI (Lu, 2018), service organizations must understand their employees' concerns, adoption and barriers, and their long term use of and collaboration with robots and AI, and equip them with the relevant skills to succeed in a future dominated by robots.

We structure our key themes for further research into customer and employee-related issues, and because of the importance of ethics and their overlap for both stakeholders, we grouped customer- and employee-related ethical research topics into a combined section. Figure 2 provides an overview of key areas for potentially impactful further research and the following sections discuss a set of research questions we find of particular interest.

[Insert Figure 2 about here]

Service customers

We group the customer-related research questions into an overarching customer–service robot interaction framework and the three stages of the service encounter (i.e., pre-service encounter, service encounter, and post-service encounter (c.f., Lovelock and Wirtz, 2004, p. 35;

Tsiotsou and Wirtz, 2015).

Customer–service robot interaction frameworks. We identified two comprehensive conceptual frameworks concerning the acceptance and usage of service robots. They are the Service Robot Acceptance Model (sRAM; Wirtz *et al.*, 2018) and the impact of automated social presence (ASP on service outcomes (van Doorn *et al.*, 2017). These two conceptual frameworks have provided the initial yet crucial first step for future inquiries into the impact of service robots on customer behavior. Furthermore, implicit in these frameworks is an overall customer journey perspective. To be successful, it is critical for service organizations to design the overall customer journey in robotic service deliveries well (c.f. Benmark and Venkatachari, 2016). However, to the best of our knowledge, to date, these conceptual frameworks have not been empirically tested, nor have studies examined the overall customer journey. Furthermore, as these models and the majority of articles reviewed in Table 2 are conceptual in nature, empirical studies seem to offer many interesting opportunities to test the proffered conceptual models and develop them further.

Pre-service encounter stage. Scholars have theorized and conducted laboratory experiments on the potential factors that may promote or hinder customer acceptance and usage of robots and their boundary conditions. As important next steps, we need more empirical studies on actual customer behaviors. For example, do customers really experience in a real-life context anxiety about service robots because of sociotechnical blindness (i.e., omission and ignorance of the human contexts in which AI programs are utilized), confusion about perceived autonomy (i.e., conflation of autonomy in AI and human beings), and inaccuracy in the conception of AI advances (c.f. Johnson and Verdicchio, 2017).

Furthermore, statistical significance in a lab experiment may not translate into managerial relevance (e.g., small absolute differences that may be statistically significant may be too small to concern managers) and service organizations may well design communications and promotional

strategies to get customers 'over the first hump' and try to adopt a service. While extant research has focused on examining factors such as negative attitudes toward robots and robot anxiety (Nomura *et al.*, 2008) and exploring customers' reluctance to accept social behaviors from robots (de Graaf *et al.*, 2019), there is limited understanding concerning how organizations can educate service customers about the benefits of service robots and alleviate their fears and anxieties. According to Moon (2004), it is essential to generate excitement among customers and continuously gather customer feedback for further development. Organizations must build trust with their customers by demonstrating that AI-enabled technologies can help them navigate through the nuances of competing choices and offerings, thereby reducing effort, costs, and risks (Dawar, 2019). To guide these efforts, more research is needed to understand customer motivators and barriers (and how the latter can be mitigated) of service robot adoption in actual field settings. We encourage research on how service providers can implement marketing and communication strategies that purposefully address the requirements of the different customer needs and concerns to support successful implementation of service robots.

Service encounter stage. The service encounter is regarded as the critical 'moment of truth' in which customers form their judgment about service quality. Modern service encounters are technology dominant and characterized by complex service systems and an increasingly active co-creation role of the customer (Larivière *et al.*, 2017). Thus, it is important for future research to investigate the roles played by customers in the integration of robots into service provisions and customer responses to the technology-infused servicescape. Specifically, questions should be asked regarding how customers can be better equipped to play their enabler, innovator, coordinator, and facilitator roles in modern service encounters (c.f. Larivière *et al.,* 2017).

There seems to be no single perfect design of a robot (Broadbent *et al.*, 2009). Thus, it will be useful to understand what a robots' design should be. It seems likely that service context (e.g.,

hedonic vs. utilitarian service) and individual characteristics (e.g., demographics, personality traits, attitudinal factors) are important determinants of what makes an effective robot design for adoption, and perhaps even more importantly, for its long-term use. For instance, customers who look for social interactions may prefer humanoid elements, while customers who focus on pure functional tasks might not find more value in a less humanoid appearance. Other design parameters include when service robots should be physical or virtual, and when robots should be more 'human-like' or more 'machine-like.' Further, cross-cultural differences might affect the optimal design of service robots. There are several examples of robot-based service models from Japan with robots in all shapes, while European societies seem to be less open to robot-provided service and more conservative in their design. An experimental study in social robotics by Li and colleagues (2010) found that individuals' cultural orientations (e.g., Chinese, Korean, German) can impact their perception of a robot's likeability and subsequently their trust, engagement, and satisfaction with the robot. Future research should explore how service robots can successfully maintain their engagement with customers in a multi-cultural environment.

Furthermore, technology is evolving so fast that constantly new possibilities for service robots are created. We see the combination of existing sensor technologies as a development that might revolutionize the application field of robots but also influence the behavior of individuals with robots. For instance, it is already possible to equip robots with webcams, infrared sensors, and microphones. With these data, the robot can not only better understand the meaning of a customer response and the customer's emotions, but also investigate how truthful this response is based on variation in the voice, pulse, skin temperature, and response speed. We expect once customer are aware of these possibilities, customer behavior with robots might change dramatically.

Related to the previous point, the role of robots as conversations partner might change

tremendously over the next years. Although natural language processing has accomplished recently remarkable achievements, it is not clear whether AI-generated responses will be perceived as equally valuable compared to human responses and in which contexts. It seems due to the current hype around AI and robots, a number scholars suggest that robots could serve as equivalent interaction partners. We invite researchers to investigate more deeply the value of robots as interaction partners and in which cases they might be most useful.

A major difference between service robots and service employee is that service employee are also human beings that give genuine responses (Wirtz *et al.,* 2018). Service robots miss this characteristic. Thus, the way we use, interact or ignore a robot has no bigger meaning for customers. This attitude has strong implication on the customer behavior. The TV-Show "Westworld" plays in extreme with this difference as it introduces a world, where humans shot and hurt robots for fun without experiencing any moral or ethical conflict. For current research this means, we should research the different behavior and attitude of customer in a human versus robot delivery model.

Future research on customers' interaction with service robots can follow Novak and Hoffman's (2019, p. 222) "interpersonal circumplex model framework for consumer-object relationships", which broadly categories possible relationships between customers and smart objects based on their agentic roles and their communal orientation. Accordingly, customer-robot relationships can be seen as master-servant relationships (i.e., power trade-offs between customers and robots), partner relationships (i.e., customers and robots cooperating and expressing similar values), or unstable relationships (i.e., customers and robots behaving in opposite ways that do not complement each other, leading to possible breakdown of the relationships). In this regard, we encourage empirical studies on the characteristics of these relationship styles and the extent to which they might strengthen or diminish customer experience

and service outcomes.

Relatedly and in our mind critically important, most conceptual and empirical work focuses on the initial adoption but not on the long-term use of robot-delivered services. We do not know how to understand, model, and manage actual long(er) term customer behaviors related to robot-provided service. Most robot-delivered services are not yet mainstream and customer can and are probably likely to change their perceptions, views, and responses to them once they are established. For instance, while the first conversations with a personal assistant like Alexa might be experienced as exciting, over time this interacting with Alexa becomes common and does not receive much attention anymore. Thus, first empirical results (e.g., surveys with attitudinal and behavior intention question, and lab settings) might be superseded as technology and customer learning develop and suggest the need for academic inquiries to be updated, verified, and extended regularly. For example, will customers after months or years of usage still perceive anxiety, dehumanization, and algorithm aversion, or will robot-delivered service become the ATM-equivalent of the future that will be used by the vast majority of customers without any concerns? Studies that examine these questions can be based on cases, surveys, and field experiments, and collaborating with organizations that test and implement service robots seem obvious next steps (c.f. Benoit *et al.*, 2019). That is, we believe that service robots are here to stay, but how we deal with them might change dramatically over the next years. Furthermore, researcher should be careful not overestimate their first insights into service robots. It is essential to differentiate the hype from the underlying substance.

Post-service encounter stage. Research is needed to understand the extent to which service robots influence customers' overall service quality perceptions and service satisfaction. For example, is SERVQUAL (Parasuraman *et al.*, 1988) still relevant for customer interactions with service robots? Recent work by Morita *et al.* (2019) concluded that the five SERVQUAL

dimensions (reliability, assurance, tangibility, empathy, and responsiveness) did not sufficiently capture how customers evaluated services provided by robots. Morita and colleagues (2019) suggested two additional service quality dimensions, namely interactivity of the robots and entertainment factor of the robots. Notably, these service dimensions were tested in an experimental context and future empirical research should test their validity and applicability in various robotic service settings.

The issue of how customers might react in the case of service failure by robots compared with human-robot teams is another worthy future research direction. Research on robotic service failure is scant since much effort has been spent on examining the functions, design, and acceptance of service robots. In an experimental laboratory study, Merkle (2019) found that contradictory to his theoretical reasoning based on uncanny valley paradigm (Mori, 1970) – which assumes that if a robots become too humanoid, people perceive this experience as creepy and unpleasant – and attribution theory; customers indicated a higher level of satisfaction when they experienced a service failure caused by a robot than when they encountered a failure by a frontline service employee. In Merkle's (2019) study, customers attributed the service failure to external circumstances because they perceived it to be beyond the control of the robots. However, such findings should be validated in a field context. Further, it is important to examine how customers might respond differently when a service failure is caused by a human-robot team.

Service employees

We will next discuss a range of employee-related issues that need to be better understood relating to service employees, both the organization and individual levels.

Organizational issues. With the inclusion of robots in service deliveries across different settings, organizations must develop a new approach to human resource planning for service employees, with the view to foster employee engagement (Tambe *et al.*, 2019) and make a

compelling case to build employee trust in the organization's vision-related to AI and robotic technologies (Fountaine *et al*., 2019). The presence of technology can complicate employees' service roles (Wirtz and Jerger, 2016) and even lead to employees becoming obsolete in their traditional roles in service encounters (Larivière *et al.*, 2017). Research is needed to build theories and guide these processes.

By 2022, more than half of all employees will require significant re- and up-skilling to take advantage of the advances in robotic technologies predicted (World Economic Forum, 2018). As robotic technologies continue to advance, it is essential for employees to differentiate themselves by developing skills (Beck and Libert, 2017) or sharpening human skills and capabilities that are not automatable (Davenport, 2017). A key approach, according to Fountaine *et al.* (2019), is to encourage employees to undertake cross-functional collaboration to take advantage of the mix of skills, experience, and perspectives within the organizations. Therefore, we urge business management scholars to investigate the implications of service robots for selection, training, and retention of employees, particularly in terms of skill requirements for modern service delivery.

This is a significant gap not only in our review but also highlighted by Ivanov *et al.* (2019). Humans outperform robots in building trust, demonstrating empathy, and applying flexibility. In the foreseeable future, critical soft skills such as creativity, working in teams, solving complex problems, taking initiative, thinking critically, paying attention to detail, and resilience will enable employees to triumph over robots in those tasks where these skills are needed. However, there will also be plenty to routine tasks that do not need those skills (much) and include many customer contract center jobs, checkout staff at retailers (e.g., Amazon Go replacing tills), drivers of all kind (e.g., due to autonomous vehicles), and food delivery drivers (e.g., drones are already being tested in Shenzhen, China).

Employee engagement and development. Amid media excitement, industry predictions, and

diverse scholarly perspectives, it is understandable that service employees are wary about potential job loss. Recent research shows that the reaction of employees to the integration of service robots in their work might be context-specific. For instance, Wolbring and Yumakulov (2014) found that, in the disability care service, employees indicated robots could not replace service workers whose human touch, human interaction, and emotional companionship are vital to successful service delivery and meaningful relationships with customers. In the hospitality industry, hotel employees seem more likely to quit if they are more aware of an implementation of AI and robotic platforms in their organization; however, the association between AI/robotic awareness and turnover intention is weaker when employees perceive a high level of support from the organization (Li *et al.*, 2019). These findings are in line with those identified by Brougham and Haar (2018), who find that employees' awareness of smart technologies, AI, robotics, and algorithms are negatively related to their organizational commitment and career satisfaction; further, such awareness of advanced technologies is positively associated with turnover intentions, cynicism, and depression.

As a result, it is critical to examine how service employees respond to internal development and communications efforts, thereby alleviating their anxiety about their lack of control on robotics development and implementation in the frontline. Evidently, previous research has shown that internal marketing tools (e.g., internal value exchange, internal vertical communication) can contribute to facilitating employee commitment to the organization (Bermúdez-González *et al.*, 2016). It is worth investigating how internal marketing tools can motivate and facilitate the development of employees' capabilities to co-create service delivery alongside robots as their caretakers or hybrid team members.

We believe that the role of the robotization of service offerings is twofold. It can act as an additional layer of stress for service employees because of their concern about job insecurity

(Subramony *et al.*, 2018), mainly when technologies are seen as their substitutes (Larivière *et al.*, 2017). Alternatively, it can represent an opportunity and space for employees to undertake more customer-oriented work (Barrett *et al.*, 2012), especially when robots act as the network facilitator or augment roles for service employees (Larivière *et al.*, 2017). In this regard, it is useful for scholars to investigate the extent to which the presence of service robots on the frontline influences employees' emotional labor as well as their organizational citizenship and service-oriented behaviors.

Finally, service failures by robots are not uncommon. For instance, Flippy, the burger-flipping robot at Cali Burger (California), was taken offline after just one day of work for being too slow (Holley and Eltagouri, 2018). In Scotland, Fabio, the grocery store robot, was deemed a failure because it confused customers and did not fully understand their questions (Nichols, 2018). Likewise, certain robot chefs and waiters in restaurants in China failed to meet customer expectations because they were considered not intelligent enough (Ge, 2018). According to Honig and Oron-Gilad (2018), employee-robot failures can be categorized as technical failures (e.g., problems with hardware or software) or interaction failures (e.g., problems communicating with humans and the environment). Research on human-robot interaction, as recognized by Honig and Oron-Gilad (2018), has predominantly focused on the technical aspects of robots (i.e., rendering them more reliable) and given limited attention to service recovery and failure handling. In this regard, a fruitful area of research could be to explore how organizations can better support and empower employees to act as troubleshooters when technology is failing.

Ethical Issues

Scholars note that usage of robotics technology must comply with the principles of law and ethics in a transparent and carefully regulated environment, many of which vary around the world and are largely untested (Leenes *et al.*, 2017; Lin *et al.,* 2011). For instance, the Ethics Guidelines

for Trustworthy Artificial Intelligence of the European Union is currently in its pilot phase, drawing from the key requirements related to human agency and oversight, technical robustness and safety, privacy and data governance, transparency, societal and environmental well-being, accountability, we well as diversity, non-discrimination and fairness (European Commission, 2019). The report by the Law Library of Congress (2019) further confirms that the regulation of AI across the globe is diverse and in its infancy, with the most advanced regulations to be in the area of autonomous vehicles.

In our review, the conceptual work by Wirtz *et al.* (2018) was the only study explicitly highlighting several ethical concerns for customers, employees, and organizations. Ethical concerns for customers range from privacy and security risks, and algorithm-based decision making to customers feeling dehumanized and socially deprived, and the immense amounts of data generated by AI-governed service delivery platforms (c.f. Lobschat *et al.,* 2020; Lwin *et al.*, 2007, 2016; Wirtz *et al.*, 2019). For example, robots are becoming increasingly sophisticated in their appearances and behaviors; researchers should question what makes robots acceptable to customers and the wider society. Are sex robots, care robots for elderly with dementia, therapy bots for children with autism the right approach to handling these needs, and under which circumstances are they acceptable?

Hence, organizations must address the ethical concerns related to the rise and increasing prevalence of service robots as part of their corporate digital responsibility (CDR) strategy. CDR refers to the set of shared values and norms that guide the operation of an organization with respect to digital technology and data (Lobschat *et al.*, 2019), including the development and deployment of AI and robots within the organization. Extending the views from Asaro (2006), Lin *et al*. (2011), and Lobschat *et al*. (2019), we identify a number of research questions related to the design and deployment of service robots. These questions include the following but are not

limited to: How can robots be built with moral intelligence and rights? Is it ethical for organizations to create or deploy robots as artificial moral agents that can make nuanced distinctions and understand context-based communications from humans? What are the specific ethical norms applicable the design, manufacturing, programming, and implementation of service robots? What can organizations do to prevent unintended unethical outcomes and behaviors caused by robots (e.g., the case of Tay, Microsoft's AI chatbot becoming racist and adopting hate speech)? Will an organization be considered unethical when it does not provide advanced robots with ethical reasoning capabilities?

The potential widespread impact of robots and AI on employment is supported by statistics showing that almost half of job activities across 800 occupations can be subject to automation, including 57 percent of jobs in the OECD, 69 percent in India, and 77 percent in China (McKinsey Global Institute, 2017). However, the International Federation of Robotics (2018a) has emphasized its beliefs about the positive impact of robots on facilitating the productivity and competitiveness of organizations. The positive impact of robots is expected to result in an increase in customer demand and thereby creates new opportunities for service workers, including wage growth and the demand for labor with the right combination of technical expertise and people skills. This is consistent with Bughin's (2018) view that organizations should take advantage of AI development to innovate and position themselves for growth, thus increasing employment. To do so, it is essential that an agile, experimental, and adaptable mentality be developed within the organization, reducing the fear of failure (Fountaine *et al.*, 2019). However, robots and AI will soon predominantly affect lower-skilled workers. Can these really be upskilled to perform more complex jobs, and what will happen to those that cannot build these skills?

To this end, there are multiple research questions that require the scholarly attention of

service and business management researchers. These include (but not limited to): What is the extent to which the prevalence of service robots contributes to growing the so-called 'precariat,' a term coined by Standing (2016) for a new class system due to the continuous restructuring of the global economy? As the production and design costs of service robots decrease, should organizations be allowed to replace all frontline employees with services robots because they are cheaper? How can customers and employees trust the judgments made by service robots (e.g., should they follow robots' instructions in case of emergencies)? What are the rights and responsibilities of individuals (customers and employees) when something goes wrong with a service robot? What can humans do to fully understand and be educated about the design and functions of the robots without suffering from unintentional interpretation or deception about human-robot interaction? Is it fair to deploy robots to service vulnerable customers (e.g., children, the elderly, people requiring therapy or mental healthcare)? How should robots treat people (employees and customers), and vice versa?

Conclusion

Robots have become increasingly common in the service sector and are expected to grow exponentially in the coming years. Our literature analysis shows that current understanding of the impact of service robots remains fragmented and under-researched. We have identified a number of key research gaps related to how and the extent to which service robots might fundamentally transform the behaviors and experience of service customers and employees. Accordingly, we have identified a range of future research directions that can be pursued, particularly regarding the use of field data, industry data and longer-term studies of how customer and employees interact and use service robots, taking into account a range of ethical concerns that must be systematically addressed. We hope that this article not only serves as a catalyst for serious conversations among researchers but also leads to the realization that much work needs to be

done regarding the role and impact of service robots across multiple service contexts. Indeed, we trust the next wave of empirical studies on the role of service robots across a number of industry and service consumption settings will generate much-needed insights for service practitioners and policymakers alike in their quest for productivity, scalability and service excellence as well as a business-, employee- and customer-friendly regulatory environment.

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Table 1. Literature reviews on service robots and AI

Study	Research objectives	Contextual focus	Analytical themes
Ivanov et al. (2019)	• Review of research on robotics	• Travel, hospitality and tourism context • 131 articles, conference papers and book chapters	• Design of robots (e.g., appearance, mapping, vision calibration and image recognition, object manipulation, persuasiveness, and interactivity) • Adoption of robots by customers and employees related to robot usability, social acceptance, user experience and societal impact • Commercialization challenges for robot manufacturers in the hospitality context • Firm's advantages and disadvantages of robotic applications and integration into existing operations • Servicescape-related implications for robot navigation and interaction design, and servicescape requirements to accommodate robots • The impact of the external environment on the implementation of robotic technologies in hospitality (e.g., labor costs, customer demand) • Industry trends and related education, training and research-related issues
Honig and Oron-Gilad (2018)	• Review of research on failures in human-robot interactions	• Cross-sectional • 52 articles	• Technical vs. interaction failures - Technical failures: software (e.g., design, communication, and processing failures) vs. hardware failures - Interaction failures (i.e., social norm violations, human errors, environmental interventions) • Robot Failure Human Information Processing (RF-HIP) model describes: - How failures caused by robots are communicated (e.g., visual indicators such as flashing red lights on robots, through smart phones, and audio cues from the robots) - Customer perception of and attitude towards the failures - Customer attempts to solve robot-caused failures (e.g., searching for available alternatives) and respond (e.g., customers change their facial expression, head/body movement, and verbal communication)
Kaartemo and Helkkula (2018)	• The current state of AI and robots in value co-creation in marketing and service research	• 17 marketing and service journals • 32 articles	• Generic advancement of the field, article suggests a lack of discussion on how AI or robots can influence value co-creation • Benefits of AI and robots for service providers (e.g., forecasting, understanding customers, predicting market change, and supporting new product developments) • Resource integration between service providers and customers (e.g., provision of more personalized service through more human-like features added to frontline technology) • Supportive roles (e.g. enabler, intruder, ally, replacement, extended self, deactivation) of AI and robots for customers' well-being in health-care context and the need to take into account customers' existing value network in robot design
Savela *et al.* (2018)	• Acceptance of robots in various	• Cross sectional • 42 articles	• Examines positive and negative sentiment of customers towards robots in social and health care contexts, and in surveillance and military, education, cultural and communication, business, administrative,

	occupational fields and tasks		agriculture, industrial, and others. • Most studies suggest that users have positive and approving attitudes towards robots when they had real exposure to the robots in question. However, when the robots were hypothetical, research participants predominantly showed negative and ambivalent attitudes.
Vandemeule-broucke *et al.* (2018a)	• User responses to socially assistive robots	• Aged care services • 23 articles	• Positive and negative perceptions from older adults about the usage of socially assistive robots in aged care were examined, including: - The roles of a socially assistive service robots - The technical and social interactions between elderly customers and robots - The appearance of the robot and related user responses - Ethical issues related to the utilization of socially assistive robots in aged care
Vandemeule-broucke *et al.* (2018b)	• Ethics related to aged care robots	• Aged care services • 28 articles	• There are two forms of the ethical debate on aged care robots, namely an ethical assessment of care robots (i.e., merits of using or not using care robots), and an ethical reflection about these robots (i.e., debating the impact and values of care robots) • Research on the use of robots in aged care has taken four ethical stances, including: - Deontological approaches (emphasizing human rationality and individuals' responsibility): the need for human to be respected for their autonomy and dignity, perceived deception and truth (negative consequences of anthropomorphization), social isolation vs. connectedness - Principlist approaches (discerning respect for autonomy, beneficence, non-maleficence, and justice principles): autonomy vs. privacy of care robot users, users' autonomy vs. robot's independence, the role of care robots in promoting user well-being, responsibility for failure, and the right to use care robots - Objective-list approaches (an objective account of aged care): opportunities to achieve key human capabilities, emergence vs. disappearance of human capabilities due to the introduction of care robots, the impact of social contexts, older adults' welfare - Care-ethical approaches (meaningful care relationships): morality of care when robots replace human caregivers, the context-sensitive nature of the care process, the political context of care
Royakkers and van Est (2015)	• Technological trends, ethical questions and regulatory issues	• Home, healthcare, traffic, police force, and military contexts • Number of articles was not provided	• Technological trends in robotics in the short, medium, and long-term • Social gains of robotics (e.g., freeing up time for customers, entertainment, and quality of life) • Concerns related to robots as an information technology (e.g., privacy, security, hacking, and public safety) • Challenges related to robots' lifelike appearances (e.g., replacing social interactions between humans, and perception of deceit) • Dehumanization issues (e.g., objectification of patients, and loss of interest in human companionship) • Governance of robots (e.g., the need for debates on responsibility, liability, decision making process)

Note: The studies are organized in reverse chronological order by year, and within the same year in alphabetical order.

Table 2. Articles included in the literature analysis examining the impact of robots on customers and service employees

Study	Research focus	Theoretical underpinning	Method & context	Key findings
Beane (2019)	• Employee learning to work alongside robots and AI	• Shadow learning concept	• Observation research • Employee-focus • Across service contexts	• Identified a number of potentially negative consequences for service employees, incl.: • Trainees/junior employees have fewer opportunities to undertake complex tasks and learn from their mistakes • Employees have less contact with customers • Employees often do not have the right skills to learn new technologies and fail to understand the benefits of robotics, leading to confusion, resistance, and decreasing trust in robots
Čaić *et al.* (2019)	• Value of social robots	• Social cognition perspective	• Conceptual • Customer-focus • Health care	• Robots offer functional, emotional, and social support to customers • Customers' personal values (e.g., customers' openness to change) drives their interaction with robots • Customer's evaluation of robots' co- creation/destruction capability is moderated by (a) perceived warmth, and (b) perceived competence of the robots
Jörling *et al.* (2019)	• Determinants of responsibility for outcomes obtained by service robots	• Attribution theory	• Interviews and scenario-based experiments • Customer-focus • Across service contexts	• Customers feel responsible for robot-delivered service outcomes if they are the owners of the robot • Customers experience lower levels of control and responsibility for positive service outcomes due to the robot's high level of autonomy • Customers feel responsible for the negative service outcomes when they own the robot • Customers' ability to interrupt the robots' autonomy make customers feel more in control and more responsible for positive outcomes
Mende *et al.* (2019)	• Impact of humanoid robots (vs. human employees) on customer responses	• Uncanny valley theory	• Experimental studies • Customer-focus • Food services	• Compared to humans, humanoid service robots elicit greater discomfort of customers (including eeriness and human identity threats). • Customers cope with humanoid service robots by engaging in compensatory behaviors (e.g., increased calorie intake, favoring a status product, and seeking social affiliation) • How customers respond to humanoid service robots is moderated by (a) customer's social belongingness, (b) perceived healthfulness of food, and (c) whether robots are machinized or anthropomorphized
van Pinxteren *et al.* (2019)	• Drivers of trust in humanoid robots	• Anthropo-morphism theory	• Experimental field study • Customer-focus • Public service	• Anthropomorphism drives customer trust, intention to use, and enjoyment • If customers are comfortable with robotic interactions, human-like appearance of robots is more important than social functioning features (e.g., robots displaying non-verbal communication)

				• If customers are uncomfortable with robotic interactions, social functioning of robots is more important than their human-like appearance
Čaić *et al.* (2018)	• Role of service robots in elderly care	• Value co-creation and co-destruction	• Interviews • Customer-focus • Health care	• Robots play both co-creation (positive) and destruction (negative) roles along three dimensions. • They are (a) Safeguarding (enabler vs. intruder), (b) social contact (ally vs. replacement), and (c) cognitive support (extended self vs. deactivator)
Davenport (2018)	• AI driving job commoditization	• n.a.	• Conceptual • Employee-focus • Financial services	• Service robots can streamline service processes by taking over common and repetitive tasks, and thereby replace service employees (e.g., financial advisors) • However, the automation of financial service jobs will take time due to organizational inertia and employee resistance
Fleming (2018)	• Impact of robots on jobs	• Bounded automation concept	• Conceptual • Employee-focus • Across service contexts	• Service robots will streamline service processes as they take over parts of the jobs and most jobs will become semi-automatic • However, there will be no mass joblessness due to environmental constraints • The introduction of service robots will require employees to upskill
Huang and Rust (2018)	• Role of AI in service provision	• AI job replacement theory	• Conceptual • Employee-focus • Across service contexts	• Service robots will streamline service processes; they will take over parts of jobs, starting with mechanical tasks then those requiring higher intelligence • Employees will need to upskill with a focus on soft skills (e.g., empathy, creative thinking, intuition intelligence, and analytical intelligence)
Wirtz *et al.* (2018)	• Potential role service robots will play in the medium to long-term future	• Technology acceptance model • Role theory • Needs congruency	• Conceptual • Customer- and employee-focus • Across service contexts	• Service robots will streamline service processes and deliver services with speed, accuracy, reliability and high productivity; this applies especially to services of almost any degree of cognitive/analytical complexity and those of simple social/emotional complexity • Service robots will provide services with primarily functional needs and/or those with simple social, emotional elements • Human-robot collaboration will co-deliver services with high cognitive/analytical complexity and complex social/emotional task • Customer acceptance is explained by the Service Robot Acceptance Model (sRAM) with its key variables of (a) functional elements (perceived ease of use, perceived usefulness, subjective social norms), (b) social-emotional elements (perceived humanness, perceived social interactivity, perceived social presence), and (c) relational elements (trust, rapport)
Beck and Libert (2017)	• Impact of AI on skill development	• n.a.	• Conceptual • Employee-focus • Professional services	• Service robots streamline service processes as (a) they outperform humans in data gathering and analysis, and (b) they are becoming better with more complex tasks, producing precise results

				• Employees need to upskill with a focus on emotional intelligence, persuasion, social understanding, and empathy
Gray and Suri (2017)	• Role of humans in AI-assisted augmented services	• n.a.	• Conceptual • Employee-focus • Across service contexts	• Service robots automate some work which enhances the productivity of service employees • Employees increasingly supporting robot-enabled service delivery and work together with robots • Employees need to upskill by focusing on creativity and learning to make informed decisions
Van Doorn *et al.* (2017)	• Impact of automated social presence (ASP) on customer outcomes	• Social presence and ASP	• Conceptual • Customer-focus • Across service contexts	• Employee-customer interactions are facilitated by robotic technologies (e.g., hologram-based meetings) • Humanoid robots can replace frontline service employees or collaborate with employees to deliver customer service • Characteristics of robots (e.g., perceived warmth, competence, attractiveness) and customer attributes (e.g., relationship orientation, technological readiness, anthropomorphization of the robots) determine customers' service outcomes (e.g., satisfaction, loyalty, well-being)
Benmark and Venka-tachari (2016)	• Impact of AI technologies	• n.a.	• Conceptual • Employee-focus • Retailing services	• Service robots streamline service processes and provide relevant, personal, and helpful interactions with customers at scale and with efficiency
Fan *et al*. (2016)	• Impact of anthropomorphism on customers	• Self-service technology failure • Anthropo-morphism motivation model	• Quasi-experimental study • Customer-focus • Hospitality services	• Anthropomorphism negatively influences customer's switching intentions; e.g., a human-like voice encourages customers to continue using the machines (rather than switching to a human) • Customers with lower sense of power are more tolerant of service failure caused by robots with a more human-like voice; e.g., they are less likely to switch away from robotic technologies
Green *et al.* (2016)	• Experiences of medical professionals in technology-infused service delivery	• Service separation	• Interviews • Employee-focus • Health care	• Identified a number of potential negative employee consequences, incl.: (a) employees can experience depersonalization due to lack of engagement with customers; (b) they can feel uncomfortable interacting with customers due to the lack of customer privacy; (c) they can have feelings of eeriness, unfamiliarity and disempowerment due to the interference of technology; and (d) employees faced difficulties in managing multiple roles and identities as a result of technology infusion into service delivery
Lacity and Willcocks (2016)	• Rationale for service automation	• n.a.	• Interviews • Employee-focus • Across service contexts	• Service robots streamline service processes whereby robots take over repetitive and boring work, and employees collaborate with robots to deliver services • Employees are more productive and have higher job satisfaction • However, employees are also wary about service automation and loss of their jobs

Beane and Orlikowski (2015)	• Impact of robotic telepresence on healthcare	• Coordination literature	• Field study • Employee-focus • Health care	• Robots intensify coordination of service delivery among employees (i.e., technologies enable stronger connections between teams); coordination becomes challenging when employees have different understandings of and exposure to each other's work
Barrett *et al*. (2012)	• Impact of robots on hospital pharmacies	• Tuning approach • Relational-material perspective	• Field study • Employee-focus • Health care	• Benefits for employees include that (a) robots facilitates team collaboration; (b) free up time for the employees to engage in specialized and customer-centered work; (c) increase employees' institutional legitimacy (i.e., employees reinforcing their role and status in the organization); and (d) employees can upgrade their technical skills as authorized caretakers of the robots • Potential negative employee consequence include (a) a loss of autonomy and frustration due to lack of interaction with customers; and (b) employees feel a disruption to their normal routine when robots bring changes to their jobs
Noone *et al.* (2012)	• Benefits of robots	• n.a.	• Case study • Customer- and employee focus • Hospitality services	• Service robots streamline service processes and help to reduce service time and improve customer service quality • Service robots have a positive impact on employees by augmenting their cognitive capacity (i.e., extending employee's ability to connect, synthesize data and make informed decisions)

Note: The studies are organized in reverse chronological order by year, and within the same year in alphabetical order.

Figure 1. Central research topics on service robots as related to consumers and employees

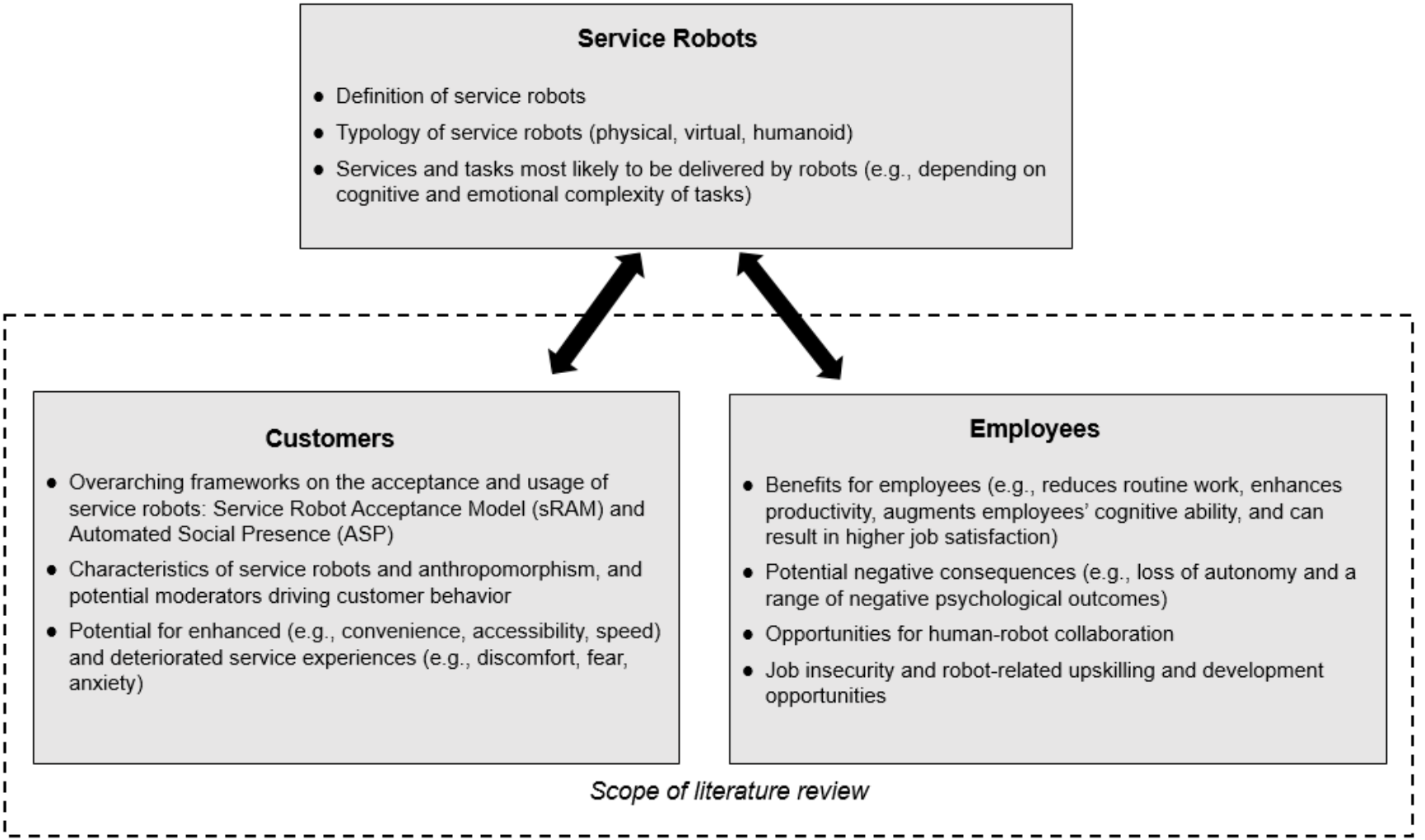

Figure 2. Future research directions on robotic service encounter