# "My Colleague is a Robot"

# – Exploring Frontline Employees' Willingness to Work with Collaborative Service Robots

Stefanie Paluch

(School of Business and Economics, RWTH Aachen University, Aachen, Germany) (Hanken School of Economics, Helsinki, Finland)

Sven Tuzovic

(School of Advertising, Marketing and Public Relations, QUT Business School, Brisbane, Australia)

Heiko F. Holz

(Service and Technology Marketing, RWTH Aachen University, Aachen, Germany)

Alexander Kies

(Service and Technology Marketing, RWTH Aachen University, Aachen, Germany)

Moritz Jörling

(Department of Marketing, EM LYON Business School, Ecully, France)

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**Purpose** – As service robots increasingly interact with customers at the service encounter, they will inevitably become an integral part of employee's work environment. This research investigates frontline employee's perceptions of collaborative service robots (CSR) and introduces a new framework, willingness to collaborate (WTC), to better understand employee-robot interactions in the workplace.

**Design/methodology/approach** – Drawing on appraisal theory, this study employed an exploratory research approach to investigate frontline employees' cognitive appraisal of service robots and their willingness to collaborate with their non-human counterparts in service contexts. Data collection consisted of 36 qualitative problem-centered interviews. Following an iterative thematic analysis, we introduce a research framework of frontline employees' willingness to collaborate with service robots.

**Findings** – First, this study demonstrates that the interaction between frontline employees and service robots is a multi-stage appraisal process based on adoption-related perceptions. Second, we identify important attributes across three categories (employee, robot, and job attributes) that provide a foundation to understand the appraisal of collaborative service robots. Third, we present four employee personas (supporter, embracer, resister and saboteur) that provide a differentiated perspective of how service employee-robot collaboration may differ.

**Practical implications** – The article identifies important factors that enable and restrict frontline service employees' willingness to collaborate with robots.

**Originality/value** – This is the first paper that investigates the appraisal of collaborative

service robots from the perspective of frontline employees. The research contributes to the limited research on human-robot collaboration and expands existing technology acceptance models that fall short to explain post-adoptive coping behavior of service employees in response to service robots in the workplace.

**Keywords** – Robotization, collaborative service robots, human-robot interaction, willingness to collaborate, frontline service employees

**Paper type** – Research Paper

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## Introduction

The robots are coming. Industry reports estimate that the market size for service robotics is likely to grow from $37 billion in 2020 to over $102 billion by 2025 with a CAGR of 22.6% (Markets and Markets, 2020). While robots have been utilized for years behind the scenes across assembly lines, warehouses, and order fulfillment centers (Knight, 2015; Petro, 2020), socially assistive service robots increasingly become an integral part of frontline service operations across a variety of industry sectors including healthcare (Čaić et al., 2018), hospitality (Fuentes-Moraleda et al., 2020) and retail (Bertacchini et al., 2017), both replacing and/or working alongside frontline service staff.

While the reality of working side-by-side with robots may still feel a little far-fetched, both industry experts and academics have started to address the impact of robotization on the human workforce and how human employees might react working together with robot colleagues, especially as robots move toward more interpersonal relationships with increasing artificial intelligence (AI) and human-like embodiment (Gaskell, 2020). Prior research suggests that employees' collaboration with technology is key for a company's success (Huang and Rust, 2017). On the one hand, employees profit from enhancement through intelligent technologies' in crucial parts of businesses, like the ability to communicate with customers, store and analyze customer data (Rust and Huang, 2014). On the other hand, intelligent technology might be perceived as threatening and competitive for employees (Jörling et al., 2019). A recent YouGov poll shows that a majority of men and women are not at ease with the idea of collaborating with a robot (Ranosa, 2019). However, these findings

contradict another survey by Oracle that revealed that nine out of ten workers would trust a robot coworker (Douglas, 2018). Recent research underlines the necessity to investigate and actively define conditions for the co-existence of AI-enabled technologies such as service robots and human employees (Huang and Rust, 2018).

To fill this gap, the purpose of this research is to investigate frontline service employees' perceptions of collaborative service robots by identifying the appraisal process of human employee-robot interactions, which in turn affects employees' willingness to collaborate (WTC) with service robots. Therefore, our research aims to answer the following research question: *What factors influence service employees' willingness to work with a collaborative service robot?*

The contributions of the study are threefold. First, this study contributes to the limited research on human-robot collaboration in frontline service operations. Prior studies on the interaction and acceptance of robot colleagues were conducted primarily in industrial settings. This is one of the first studies that focuses on how frontline personnel evaluates collaborative service robots. Second, we extend prior research on robot adoption that has primarily adopted technology acceptance models as theoretical foundation. This research takes a different lens by drawing on appraisal theory to understand the interaction and collaboration between humans and robots. Our findings indicate that the acceptance of collaborative service robots is a multi-stage appraisal process. In a primary appraisal, employees evaluate the benefits and risks, whereas in a secondary appraisal employees try to cope with the workplace situation which impacts their willingness to work together with their robot counterparts. We propose a categorization scheme to understand employees' evaluations of collaborative service robots considering the personal background of employees and their appraisal of the technology. This perspective emphasizes that technology diffusion will not be a single moment in the future, but rather an evolving process, which underlines

the relevance of appraisal theory in this context. We thus contribute to the research of human-technology interaction and provide an additional perspective for the application of appraisal theory. Third, we introduce a new type of work relationship between human service employees and their robotic counterparts, for which we propose the concept of employees' willingness to collaborate (WTC). Thus, we contribute to the conceptual literature of technologies' affection on jobs (Huang and Rust, 2018) as well as the broader literature of innovative service technologies (van Doorn et al., 2017; Wirtz et al., 2018; Jörling et al., 2019; Mende et al., 2019), which mostly focused on the voluntary technology adoption by customers. Moreover, we link these findings with employee characteristics (Burger, 1992; Parasuraman, 2000) and the general literature of collaboration and team work (Birdi et al., 2008; Jones and George, 1998).

The remainder of this article is organized as follows. First, we provide a theoretical overview of service robots in the workplace and the conceptual background. Next, we discuss our research study and results. The article concludes with a discussion of implications for theory and practice as well as the limitations of our study that offer opportunities for future research.

## Theoretical Overview

### *Collaborative Service Robots*

The study context centers on *collaborative service robots* (CSRs) in the workplace, specifically employed in frontline operations. Service robot literature has defined service robots as "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to an organization's customers" (Wirtz et al., 2018, p. 909) or "information technology in a physical embodiment, providing customized services by performing physical as well as nonphysical tasks with a high degree of autonomy" (Joerling et al., 2019, p. 2).

While robots can be differentiated along different attributes such as anthropomorphism, task orientation, or representation (Wirtz et al., 2018), we focus on service robots with a physical human-like embodiment (e.g., Pepper, Sophia)—excluding virtual assistants (e.g., Alexa)—because it enables them to have dynamic interactions with humans (Tung and Law, 2017).

As service robots increasingly interact with customers at the service encounter, they also become an integral part of frontline employees' work environment. For example, hotels including Hilton, Shangri-La, Aloft, and Crowne Plaza have introduced service robots in various service areas such as front desks and concierge services (Shin and Jeong, 2020). In this context, literature on human-robot interaction refers to robots more and more as *coworkers*, *team members* and/or *colleagues* (e.g., Gombolay et al., 2015; Sauppé and Mutlu, 2015; You and Robert Jr., 2018a). While the emerging use of collaborative robots has been studied in industrial settings (e.g., Sauppé and Mutlu, 2015), only recently this topic has gained attention among service scholars (e.g., Lu et al., 2020). We integrate previous definitions on services robots and collaborative technologies to define CSRs as *embodied machines equipped with some degree of artificial intelligence (AI) and functional autonomy that are designed to work alongside frontline service employees (FSEs) and perform similar service roles as their human counterparts.*

***Human-Robot Interaction and Willingness to Collaborate***

Collaboration within an organization is crucial for the company's success and is therefore a main interest (Tjosvold and Tsao, 1989). Collaboration can be defined as "socially contrived mechanisms for collective action, which are continually shaped and restructured by actions and symbolic interpretations of the parties involved" (Ring and van de Ven, 1994, p. 96). This definition underlines the social perspective, which influences individuals' willingness to work with each other (Smith et al., 1995). Social factors include personal

characteristics, individuals' relations among each other, as well as trust that individuals perceive in each other (Smith et al., 1995; Yilmaz and Hunt, 2001).

As robots more frequently share the same workplace as humans in diverse environments, the topic of "human-robot cooperative interaction" (Iqbal and Riek, 2017) has gained increasing relevance. Prior robotics research distinguishes three types of human-robot interaction: human-robot coexistence, human-robot cooperation, and human-robot collaboration (Meissner et al., 2020). In this study, we refer to human-robot *collaboration* to indicate dyadic interactions between CRSs and FSEs in a service environment. That is, CSRs are expected to work alongside FSEs to achieve a common goal (e.g., co-create service delivery to satisfy customer needs) through the process of human-human and human-robot joint action. Yet, FSEs may have different views regarding their willingness to work alongside CSRs. For example, research found that the willingness to use advice from an imperfect technology is significantly lower than if this advice is given by another human who has previously failed (Dietvorst et al., 2015; Prahl and van Swol, 2017).

Literature in robotics science has studied effects of *human-robot collaboration* (Sauppé and Mutlu, 2015; You and Robert Jr., 2018a) or *human-robot teaming* (Gombolay et al., 2015; Iqbal and Riek, 2017) primarily in manufacturing settings. Table 1 provides an overview of research related to human-robot collaboration. Service scholars have called for organizations to "develop a new approach to human resource planning for service employees, with the view to foster employee engagement" (Tambe et al., 2019) and for more research to "build theories and guide these processes" (Lu et al., 2020, p. 382). Based on the existing knowledge gaps the present research focuses on understanding the FSE perceptions of CSRs and their willingness to collaborate (WTC) with their robot coworkers.

[INSERT TABLE 1 ABOUT HERE]

***Employee Desire for Control and Autonomy***

Whether new technology can be successfully integrated in an organization mainly depends on the intended users' personality characteristics (Lin and Chang, 2011; Lin and Hsieh, 2012; Ramaseshan et al., 2015). Employee characteristics refer to the personal characteristics and attitudes an individual demonstrates when dealing with tasks and people at work. Carson et al. (2004, p. 450) define them as "personality traits and other psychological characteristics including intelligence, which are largely non-modifiable". They have been linked to employees' teamwork performance and their ability to cope with change and manage stress (Muchinsky, 2003). Prior research has outlined the importance of employee characteristics, like helpfulness or the ability to show emotion, for customer satisfaction in service provision (Keh et al., 2013) and service recovery (Kirkbir and Cengiz, 2007). These characteristics are highly personal by nature and vary from employee to employee. They form the psychological and emotional prerequisites for employees committing to tasks or engaging in work-related interactions. As such, they are directly involved in determining employees' satisfaction (Lee and Way, 2010) with their job and their level of engagement (Lappalainen et al., 2019). In a frontline service context, frontline employee characteristics determine employees' adaptive behavior and thereby influence the capacity for service customization (Gwinner et al., 2005). Thus, it is important to consider these characteristics when conceptualizing a model of human-collaborative service robot collaboration. They either facilitate or impede employees' commitment to the collaborative relationship, their engagement with the task, and ultimately their team-work performance when interacting with collaborative service robots.

***Desire for control.*** The level of perceived control experienced by the frontline employee in the situation of dealing with and supporting customers influences their ability to accommodate customer needs (Bitner et al., 1994). Psychological studies on the importance of employees' control perceptions revealed that there is a strong positive connection between

the levels of perceived control by employees and the levels of their job satisfaction, commitment, involvement, and performance (Spector, 1986). For the positive effect on these outcomes, it is not important whether the actual level of control exerted is high but whether employees believe to be in control of a situation or stimulus (Averill, 1973). This emphasizes the human desire for control in dealing with situations, people, or tasks. The concept describes the motivation to perceive control over the events in life. This motivation varies from individual to individual (Burger, 1992). People who have a high desire for control want to make their own decisions and have difficulties to handle a loss of perceived control (Rijsdijk and Hultink, 2003). Thus, employees with a high level of desire for control are particularly ambitious in (re-)gaining control in organizational structures and working situations (Ashford and Black, 1996). In the context of occupational stress at work higher levels of control were shown to benefit employee wellbeing and health (Spector, 2002). The desire for control is thus considered an essential component when assessing employees' willingness to collaborate with frontline service robots.

***Desire for autonomy.*** Some employees prefer to complete tasks completely by themselves, rather than in a team, so assistance in any form is refused. This demonstrates a high level in these employees' desire for autonomy when completing tasks at work. Autonomy in this context is defined as the degree of freedom that employees have in executing their duties, independently and self-reliantly (Zhou and Shalley, 2008). This is especially important for employees working in frontline positions, which require an understanding of individual customer needs (Solomon et al., 1985) and empathic interpretation of the respective service setting (Surprenant and Solomon, 1987). Due to the complex and challenging nature of frontline jobs, retaining an adequate level of autonomy is of high priority for employees working in these positions (Slåtten and Mehmetoglu, 2011). Prior research on the employee role in organization has regularly characterized autonomy as a

foundational requirement for employee performance as it triggers basic human needs for personal development, learning, and growth (Ryan and Frederick, 1997) and fosters employees' engagement in their work (Schaufeli and Bakker, 2004). Looking at employees' propensity to work with collaborative service robots, the desire for autonomy needs to be addressed in designing collaborative relationships in a way that accounts for this fundamental need.

***Employee Appraisal of Collaborative Service Robots***

A number of theories have been used to understand the attributes that influence human-robot interaction (HRI) and the willingness to accept service robots, primarily from a consumer perspective (Fuentes-Moraleda et al., 2020). However, scholars who study human-robot collaboration argue that existing acceptance models are only partially transferrable to the interaction of humans and robots within the workplace (Meissner et al., 2020). In this sense, Cognitive Appraisal Theory (Lazarus and Folkman, 1984) has emerged as a valuable lens for explaining reactions towards information systems (IS) in general (e.g., Beaudry and Pinsonneault 2005; Fadel and Brown, 2010), and in the context of service robots (e.g., Stock and Nguyen, 2019). As Lazarus and Folkman (1984) noted, the choice of coping strategy depends on how humans appraise the situation. Appraisal is typically divided into two conceptual subprocesses termed primary and secondary appraisal. During the primary appraisal, an individual assesses what is personally at stake in the situation, which can lead to irrelevant, benign/positive and stressful outcomes (Fadel and Brown, 2010; Lazarus and Folkman, 1984). The secondary appraisal deals with coping options (Lazarus 1991). Problem-focused coping refers to individuals' ability to adapt to situations and adjust them to be congruent with their goals, whereas emotion-focused coping refers to the ability to adjust to situations that are inconsistent with their goals (Smith and Kirby, 2009). Someone with a high degree of control over the technology-work environment is likely to adapt to take

advantage of the IS capabilities, whereas someone with limited coping options who perceives the IS as a threat, may resort to avoidance and rejection (Fadel and Brown, 2010).

The current study builds on coping literature and cognitive appraisal in the context of technology adoption. We expect that the appraisal will be a multi-stage process in which FSEs determine their willingness to accept the use of service robots in service encounters. As prior research by coping theorists has found that positive and negative appraisals can lead to mixed adaptive reactions (Fadel and Brown, 2010; Lazarus and Folkman, 1984), it is important to explore FSE appraisals of CSRs and gain a deeper understanding of employee-robot collaboration.

## Method

### *Research Design*

Qualitative research was chosen as the methodological foundation for this study. The collaboration between human employees and robot coworkers is a new phenomenon at the organizational frontline and empirical research on this topic is still limited. Therefore, an exploratory research approach was chosen in order to obtain an in-depth understanding of employees' perceptions and opinions about robots as work colleagues and their willingness to collaborate with their non-human counterparts in service contexts.

### *Sample and Selection of Interview Partners*

The data collection consisted of qualitative problem-centered interviews to gather insights on individual employees' perception of technology infusion in the workplace. Considering the assumption that the influence of collaborative service robots in the workplace will continue to increase across industries in the future and particularly in the service industry, a high percentage of professions will be directly or indirectly affected. Therefore, the sample was heterogeneous with a maximum variation of interview partners

and their professional backgrounds (Patton, 2015). In sum, 36 interview partners (21 female; 15 male) were recruited for the personal interviews. The sample includes a variety of professions including logistics, electrical engineering, asset management, automotive, human resources, personnel consulting, chemistry, coaching, student counselling, tourism, marketing, project management and sales. The age ranged from 24 to 61 years. The interview partners were selected by applying a purposive sampling strategy (Patton 2015), which means they had to fulfill two criteria. First, respondents should have experience with service robots and second, they should be working in the service industry. They were contacted through personal contacts and the professional network LinkedIn. The interviews lasted between 40 and 90 minutes and were audio-recorded with the permission of the interview partners.

[INSERT TABLE 2 ABOUT HERE]

***Semi-structured Interview Guideline***

We developed an interview guide which serves as an important instrument for in-depths interviews, since it provides structure and orientation for the interviewer. It also supports the comparability of the interviews. The interview guide for this study consists of four main sections: (1) general knowledge and experiences with collaborative service robots in everyday life, (2) perceived influence of collaborative service robot on the working environment and individual attitudes towards collaborative service robot CSR, (3) willingness for collaboration with robot colleagues, and (4) future developments and scenarios of human-robot collaboration.

***Data Analysis***

All interviews were transcribed verbatim. Transcripts were read to ensure their correctness and then exported to NVivo, a qualitative data analysis software platform (Bazeley and Jackson, 2013). The transcribed interviews were subjected to thematic analysis (Boyatzis, 1998), an analytic technique suitable for identifying “repeated patterns of

meaning" (Braun and Clarke, 2006, p. 86). We followed a systematic stepwise recursive process in the thematic analysis of the data. Transcripts were coded independently by two members of the research team. A code system was established by using 'nodes' from NVivo as coding categories. The coding system was built inductively, based on the in-depth textual analysis. New codes were created in an iterative fashion to capture the meaning of initial code groups (Thomas and Harden, 2007). Nodes in NVivo are organized hierarchically in the shape of a coding tree. In an iterative process, the data material was merged, and the two members of the research team independently formed the main categories, discussed the content and labeling and, after several rounds, agreed on a final set of themes.

## Conceptualizing a Model for Frontline Employees' Willingness to Collaborate with Robot Colleagues

The results are presented as follows. First, we discuss attributes related to the employee, the robot, and the job environment. Second, we highlight the multi-stage appraisal of the human-robot workplace interaction by using appraisal theory. FSE perceptions of CSRs lead to a primary appraisal (cognitive evaluations of the benefits and risks), followed by a secondary appraisal (evaluation of what can be done (coping strategies) based on FSEs control versus CSRs autonomy). Finally, we present four WTC personas. Figure 1 summarizes the proposed framework of frontline employees' WTC with robot coworkers that was derived from the qualitative data.

[INSERT FIGURE 1 ABOUT HERE]

### *Understanding the Workplace Context Factors*

*(1) Collaborative Service Robot Attributes*

The first category stemming from the interview data is related to *CSR's attributes*, i.e. characteristics which have an impact on the human-robot interaction. We identified three key attributes: autonomy, social presence, and humanoid appearance.

***Autonomy***. This category reflects an important service robot attribute, since CSRs are designed to independently perform tasks without human intervention. Based on their system-integration and connectivity, they are able to recognize customers, access information about them through a related database and can make personalized recommendations or provide information. But exactly this autonomy leads to the fact that the employment of CSRs is noticed very differently. Some interviewees like the fact that the CSR is acting autonomously and can help guests without the integration of the employee.

> *If the robot already welcomes the guests and entertains them a little until the next employee is available, that is already a little support. [IP 4]*

Others believe that the CSR cannot provide satisfactory information, so that customers will return to the employee anyway.

> *I do not trust such a system when it runs independently. [IP 16]*

Based on the findings from the qualitative interviews, we conclude that the degree of autonomy of a robot influences the interaction in the workplace. Furthermore, a service robot is only considered helpful by employees if it really is a support and can perform tasks autonomously.

Based on further insights from the qualitative study, the collaborative service robot's degree of autonomy is also seen as a crucial element for employees' WTC at the workplace. The respondents made it relatively clear that autonomy is a major obstacle.

> *I have a bad feeling when a machine makes autonomous decisions. Machines do not consider consequences. [IP 7]*

The autonomy of a collaborative service robot poses a threat to humans. The interview partners were very concerned, also about the role of humans.

*So, if something ... a robot acting autonomously. Then what is the role of humans? they become redundant because they can no longer influence anything anyway. [IP 19]*

They describe the fact that autonomous robots scare them. Employees fear above all that robots have no morals and do not know what behavior is appropriate in social interactions.

*We have already read a lot in the press. A robot has no morals and all that. It doesn't understand what is right or wrong. You have to know the context and judge the situation. I do not believe that a robot can do that. So, independent acting I consider as quite precarious. [IP 12]*

The autonomy of a robot influences FSEs willingness to collaborate with them. Employees fear that robots do not follow the rules and hierarchies and therefore infringe the social network of a company.

***Social presence***. This subcategory deals with how FSEs perceive another entity when interacting with robots. At the moment, it is still hard for employees to imagine a connection with service robots and according to the interview partners social presence can hardly be provided by CSRs.

*I don't think it's pleasant to just work with machines all day. A small talk with colleagues is also part of the job. [IP 31]*

Particularly the interaction and exchange with colleagues was seen as part of their jobs and these interpersonal relations are hard to imagine with a service robot. When you get upset about your job, you want to share your anger with your colleagues and get their support.

*It's also part of the job to exchange ideas with colleagues. sometimes you have to get upset about guests in order to reduce a bit of annoyance. Since robots have no feelings,*

*they can't understand my situation and my anger. Only real colleagues can do that. [IP 23]*

In summary, it can be said that FSEs highly appreciate their human colleagues. The feeling of being able to exchange ideas with colleagues and receive feedback is very important and very difficult to imagine with robots, due to their low social presence.

***Humanoid appearance***. The third category of robot attributes refers to the appearance of a CSR and its influence on the workplace interaction. Robots appear in very different forms. They can be rather technical in appearance, or they can take on very human features and a very human appearance. As respondents reported, in manufacturing people are already used to working with industrial robots. They usually have a technical appearance and do not resemble humans. In the service context, on the other hand, robots with a human appearance are more common and should above all build trust with the customer. But it is the human appearance that deters employees because the resemblance to humans is too great. Employees then attribute human traits to the robots, which they naturally do not possess.

*Although you know of course that it is a machine, it is sometimes scary. The eyes move, the look goes in my direction, you feel like you are being watched. Then you sometimes ask yourself how much of a human being is actually in there? [IP 12]*

In the service context, it is essential to use humanoid robots in customer contact. The human appearance should build trust and also facilitate interaction for the employee. Here it is important to find a good balance—too human appearance can create wrong expectations.

*(2) Job Attributes*

The second category identified in our study refers to *job attributes* entailing different types of jobs, job demands, and job resources. According to our findings, the willingness to work alongside a CSR depends on how important the job for the individual was and the degree to which employees identify with their jobs. Some employees have worked in their

profession for a very long time and see their experience as an important differentiator.

> *I work at the reception desk and I can't imagine that a robot can solve problems so quickly and smoothly. After all, I've been doing this for 20 years, so there's a lot of experience to be gained. [IP 29]*

Employees in higher job positions do not see their job in danger because they consider themselves essential and their role to be very important for the company.

> *Well, I think it's hurting your self-confidence when you must let a machine tell you what to do and what not to do. [IP 6]*

***Job type***. This category highlights that there are different types of service jobs or tasks. Some tasks can be performed very easily by robots, whereas other tasks can still be better performed by a human employee. Thus, employees' WTC with robot coworkers depends on the type of job. From the interviews, it appears that simple repetitive tasks can be performed well by robots (e.g., welcoming guests or answering questions). However, challenging tasks that require empathy, intuition or genuine emotions (e.g., in service recovery situations) should still be performed by human employees. However, some frontline employees simply do not dare to work with a CSR. Especially for the rather simple jobs, employees are worried that they will be replaced by the robot. People in higher positions tend not to have this fear; they are more likely to be certain that they cannot be replaced. In jobs that have a high physical load, employees would feel relieved by a robot. Regarding customer contact tasks and responsibilities, the respondents had mixed views and their opinions did not coincide. Some of the participants saw human employees assigned to direct customer contact because interacting with human employees gives customers a good feeling and they feel better supported. Others said, it is only a matter of time until employees and customers get used to artificial contact, as soon as service robots were established in the service environment, new areas of responsibility can arise for the workforce that lie in the supervision and monitoring

of the robots.

> *[…] there will certainly be a lot of changes, there may be new professions, which then just deal with the monitoring of the AI, with the repair, with the design of the AI, […], but also simply then professions may disappear somehow then, the really monotonous performing activities, assembly line, maybe a gatekeeper […].[IP 28]*

Even for analytical tasks, employees recognize the enormous potential of service robots and would like to use them to do their jobs better.

> *When I think about how much data such a robot can compare in one second and pick out the best result, it is quite impressive, I cannot keep up. [IP 6]*

For some jobs, however, the respondents see difficulties if a CSR is to take over the task. Especially in nursing professions where people have a high emotional bond to the patients, CSRs can support but should not replace the employees.

> *Our profession [nursing home] is about emotional bonding, a human being must do that. [IP 34]*

The results of the qualitative interviews show that employees are aware of a change at the organizational frontline and that some types of jobs may be taken over by robots in the future.

***Job demands***. This subcategory entails job requirements such as technical skills that influence employees' WTC with service robots. For example, some interview partners reported that they were afraid of not being able to operate a robot properly. They lack understanding and technical know-how. However, respondents were aware that in the future it will be one of the skills that will be a basic requirement for employees.

> *Sometimes I also think I am totally overwhelmed. Software, Hardware, checking for updates. I work in a hotel and want to talk to guests. That I have to operate a robot as well is not part of my job. [IP 10]*

Our results show that the majority of interview partners were aware that job demands will change in the future. It was also evident that some of them were afraid that they will no longer be able to keep up with these requirements, especially when it comes to technical skills.

***Job roles.*** The third subcategory refers to the working structure and roles within a service company. Interview partners reported that they were increasingly afraid of losing their job to a robot in the future. However, at the moment they still feel relatively safe. When more collaborative service robots enter the workplace, they definitely expect a clear division of roles. Whether human or machine, everyone must have tasks to perform. The more clearly these roles are distributed, the more open-minded employees become towards the robots.

> *Everyone has their role in the company, and this also applies to robots. There must be clear structures, then you can work together reasonably. [IP 31]*

Furthermore, the advancement of technology over time entails a change in roles. An increase in perceived risk of job loss, workload increase, or loss of autonomy will therefore negatively impact employees' WTC with the technology. Employees expected a clear set of rules and mentioned very specific ideas about how collaboration can be regulated.

> *Responsibilities must be clarified. Who can distribute tasks? Who can execute them? And the question must be resolved, who has the authority to make decisions. I clearly see a human being in the role, but who knows in a few years, that might change. [IP 4]*

Other respondents were already looking far into the future and saw the changes in the division of labor. It also becomes clear once again that the participants saw themselves in the role of supervisors and that robots were clearly subordinate to humans.

> *In a few years I will just sit at the PC and see if all robots are doing their jobs. If there are problems, then humans can intervene. [IP 27]*

Findings from the interviews suggest that robots will change working structures and possibly hierarchies withing service organizations as well. Roles will be redistributed and redefined, as will responsibilities. Employees demand clear structures and see themselves in the more important roles and positions compared to robots.

*(3) Frontline Service Employee Attributes*

The third category deals with FSE *attributes*, which include individual characteristics and attitudes that influence the professional workplace interaction between humans and robots. Employee-related characteristics vary from person to person and need to be considered to understand a person's WTC with robots.

***Individual characteristics***. One of the first findings is that willingness for workplace human-robot interaction depends on the individual characteristics of the employee. Some employees were curious and open to try out the new form of collaboration:

> *I think we could use some support in our area (restaurants). I am really open for new things. [IP 5]*

However, others were more hesitant and less enthusiastic about robot collaboration:

> *I understand that not only because the technology makes it possible, I have to deal with such a robotic robot now. This is all a distraction. I have to concentrate on the customers. [ IP 12]*

In addition, some employees prefer to complete tasks completely by themselves, rather than in a team, so assistance in any form is refused, whereas others prefer to work in teams. It can be concluded that employees' WTC with a service robot depends on their individual characteristics.

***Technology readiness***. The interview data show that employees' technology readiness is considered helpful to lower technology acceptance barriers. If FSEs have already gained experience with technology in other contexts, it might increase the WTC with robots in

professional service contexts as well.

> *In any case, openness, a lot of flexibility, because there are always people who resist a little bit, who always develop a defensive attitude when something is new and first think the same way: 'No, we have always done it that way, so we will continue to do it that way' and I think that it is very important to have openness to it and to accept that the development is just that. [IP 21]*

Hence, considering employees' technology readiness is of utmost importance for the design and management of HRI between FSEs and CSRs in service encounters.

***Robot bias***. An interesting finding from the qualitative study is labeled as *robot bias,* which means that humans in general had mixed feelings regarding the implementation and collaboration with service robots. Participants reported positive and negative experiences and expectations, a fact that once again highlighted their uncertainty towards CSRs. The majority was doubtful about the workplace interaction with CSRs. For example, they mentioned that collaboration with human colleagues and their different characters can lead to multiple advantages such as knowledge sharing and discovering innovation possibilities. If human colleagues were replaced, this opportunity would disappear. Nevertheless, they also acknowledged CSRs could increase productivity and support employees with their tasks.

> *From the company's point of view, I can already see an advantage in employing robots instead of humans. But we must also not forget the employees. Many of them have no experience and cannot imagine what it is like to work with robots. [IP 22]*

Another aspect that added to the robot bias is the option to work voluntarily with a robot, which means employees demanded a self-determined application for which tasks and service contexts they collaborate with service robots. For this purpose, the choice between several technologies or different level of automation should be given.

> *If my boss would oblige me then I would not like that. If you first have to think about*

*where a robot makes sense and slowly get to it. [IP 18]*

A fundamental, unbiased approach of employees towards service robots is beneficial to facilitate the subsequent steps of human robot workplace interaction.

### *Frontline Service Employee Perceptions and Appraisal of Collaborative Service Robots*

#### *(1) Positive appraisal of CSR – when robots are regarded as good colleagues*

Respondents mentioned several positive outcomes that they expect from working with a CSR. For example, CSRs were supposed to establish higher and constant *resilience* compared to human employees resulting in increased reliability. CSRs are programmed once for their tasks and can perform them from the very beginning. It is not possible to expect consistent performance from human employees even though service providers invest a lot into training and employee qualifications. It depends on the experience, competence, and current state of mind of the employee, so performance can always vary.

In the service context, it is particularly important that the service is always provided to the satisfaction of the customer. However, employees cannot always deliver a constant performance; they are influenced by various parameters such as mood, physical and mental condition. Whereas a robot is resilient to such influences and this resilience certainly offers advantages for the service provider.

> *Workload! Robots can work infinitely; you can't expect that from a person. Yes, those are the advantages for me, but clearly then the emotional and interpersonal aspects are lost then of course. [IP 6]*
>
> *Robots don't have a good day or a bad mood. But this can happen to an employee and can also affect guests. [IP 29]*

Another aspect, where respondents saw an advantage, is the improved *efficiency of different workflows* resulting in an overall enhancement of the employee performance on the

individual level and of work results on the organizational level. Increased efficiency through the use of CSR stems mainly from the fact that robots do not experience fatigue or their performance decreases during the course of the day. They also do not need breaks and or have to adhere to legal rest breaks like human employees.

> *I believe that everything is very efficient with a robot, which is not distracted and can work around the clock. I am a bus driver I have to make breaks. [IP 30]*

The analysis of the interviews further revealed that FSEs appreciate the *ability to delegate tasks* when collaborating with robots in the workplace. Robots can take over the physical demanding or repetitive tasks and humans could concentrate on other more engaging tasks. Furthermore, this can lead to higher job satisfaction, if employees can take over more meaningful tasks and leave the simple task for robots.

> *I can already imagine that the work will be easier. The robot does the hard things like carrying the guests' luggage and I can talk to them a little bit more and give them tips for the city tour, just a little bit more personal things for which you don't have time otherwise. I would definitely enjoy that. [IP 10]*

Unwanted or frustrating tasks can be transferred to the robot coworker. Since FSEs can decide which tasks are done by themselves and which are transferred to the robot, the feeling of empowerment is increased.

> *It makes sense if I could delegate tasks. What I don't feel like doing, I give to the robot and it does it well, because it is programmed that way [IP 17]*

Lastly, it can be assumed that interactions with a CSR in service encounters may be perceived as a form of *social relationship building*. Robots are able to communicate and react based upon comments or questions, which brings additional interactivity into the employee-robot relationship. Some respondents also mentioned that they feel alone at work sometimes when there are no customers around.

*A robot can be quite entertaining in its own way. […] Such a robot keeps you company, and you don't feel so alone anymore. [IP 2]*

***(2) Negative appraisal of CSR – when robots are regarded as bad colleagues***

In addition to the positive appraisal of CSR, we also identified several *negative outcomes of CSR* in our qualitative study. Some of the statements can be interpreted as contradictions because some of the respondents see them as benefits while others describe them as risks.

Respondents regarded robots as high-tech devices and they explained to have difficulty establishing some sort of trust in the technology. This is mainly due to the fact that the employees do not yet have sufficient technical knowledge or the competencies to use the technology, and therefore can be regarded as a challenge in the cognitive appraisal process. However, this technology in particular is prone to problems and could make cooperation more difficult. The respondents generally doubt the *trustworthiness* of a robot.

*I don't even know if I can rely on the robot. If the Internet suddenly goes down, the robot won't work properly, and I'll be stuck with the work again. [IP 23]*

*I also lack the experience to know whether I can blindly trust such a robot. With some colleagues with whom I have been working for years, I know that I can rely on them 100%. Such a relationship of trust must first be built up....that develops over time. [IP 28]*

Another important aspect mentioned by the respondents is the *isolation due to the lack of human coworkers*. The respondents were extremely skeptical imagining CSRs as coworker instead of human colleagues, but again this situation could be described as a challenge, since it might be something new for now, yet it might be a 'normal' working situation in the future. It is important to them that personal relationships are also built and maintained at work. For many, a good relationship with colleagues is something valuable, and this is precisely what

makes them feel a sense of belonging to the job and the company. Colleagues can make every day work easier and support them when problems arise. Some respondents have difficulty imagining such a personal relationship with a collaborative service robot. They are afraid that social relationships will then disappear, and they will be focused only on work.

> *After all, you go to work so that you can find friends and be accepted and integrated into a social structure. I cannot imagine that robots can replace this. [IP 2]*
>
> *I also like going to work because I look forward to meeting the people there and we make a good team. We always have something to talk about. If I now imagine that there is only one machine that is not interested in me personally, that demotivates me a bit. [IP 32]*

Respondents also mentioned their fear of being replaced by a robot. This situation can be described as a *thread* to the respondents. Especially those employees with simple jobs have thought about it and admit it is only a matter of time before they are replaced by autonomous robots and they lose their jobs. Respondents explained to be afraid of the personal consequences. Although robots have been little used in the service context, they already pose a serious threat to employees. Many respondents anticipate that they will be replaced by robots.

> *When I think about it, I'm afraid I'll be replaced at some point. Maybe not in the near future, but the technology is getting better and better and then I won't be needed anymore. That's a strange thing to think about. First, I show the robot how everything works and then I get fired. Then you also ask yourself, who will hire me then? [IP 16]*
>
> *I wouldn't be sure if robots are really made for collaboration. In theory, they can do the job better than humans. People make mistakes, robots probably don't. But I think it will take quite a while before all this really works. [IP 21]*

Due to sensors, microphones and cameras, collaborative service robots can collect

numerous data and information during the task performance and throughout the working shift. Respondents expressed a great level of uncertainty when it comes to CSR *data security* and have worries that can severely impact collaboration. FSEs do not want to be under permanent pressure to perform and want to avoid having performance data compared between employees. It is not clear to them what exactly is being recorded and for what reason, which is why employees are very dismissive of the topic of surveillance. They would not expect (or tolerate) a human colleague to monitor their behavior, e.g., when coming to work a little late tomorrow or taking a long lunch break.

> *I do not want to be observed at work. That does not work for me at all. I am very concerned about whether it is even formally permitted to be constantly under surveillance at work. [IP 20]*
>
> *Then they will probably look closely at when he took a break and how often he went to the bathroom. This does not have to be recorded. What for? [IP 9]*
>
> *Afterwards, I am confronted with how or what I have been talking to a guest. That is also something private when I talk to the guests. My boss doesn't have to know everything. [IP 5]*

Employees do not want to work with a robot that records all conversations and situations. It is also not obvious for what purpose this should happen and whether the recordings might be used against them later. For example, that they gave wrong advice or acted wrongly in a situation with a customer. In addition, they do not want the CSR to record private conversations. Basically, the security of the data is a big problem and has the consequence that employees try to avoid collaborating with robots.

> *I don't want a colleague who always makes a "note" when I go out for a smoke. Afterwards, it's deducted from my salary and counted as time absent. [IP 11]*
>
> *I don't want the robot to collect data from me. I don't know what for and where it will*

*go afterwards. If an employer wants something like that, that is not tolerable. [IP 24]*

*That's far too risky for me, I don't want my conversations to be found on social networks afterwards. [IP 14]*

***Secondary appraisal of CSR – coping of service employees***

In addition to the cognitive appraisal of the benefits and risks related to CSRs, this study demonstrates that a secondary appraisal follows that concerns the coping options, specifically employees' WTC. Through the analysis of the qualitative data, we found that the underlying dilemma for the collaboration with robot coworkers in the workplace is a trade-off between human's level of control and robot's level of autonomy.

***The trade-off between control and autonomy***. A central finding from the interviews is employees' paradoxical attitude towards service employees' desire for control and robot's autonomy. Almost all respondents expressed a strong desire to control the robot. For them, control was the basic prerequisite for working with collaborative service robots. Furthermore, respondents requested a clear set of rules for the collaboration and a mutual understanding of responsibilities of work outcomes.

*You can still control machines and should not let machines do what they want, but that you have the possibility to intervene at any time and overrule them. [IP 9]*

Most interview partners had a clear role attribution in mind and accentuated that robots were 'just' support in their workplace, in which robots are taking over subordinate roles by assisting employees during their tasks, but robots should not make autonomous decision without involving the human coworker.

*In general, yes, robots are a supporting effect, not that it makes my workplace obsolete, but that it supports me. It's important that I can rely on robots in my working environment, exactly, […] reliability, is important. [IP 3]*

*I think employees should always have the lead and control the whole process. Robots can just support them, but nothing more than that. [IP 8]*

The respondents made it relatively clear that autonomy is a major obstacle.

*I have a bad feeling when a machine makes autonomous decisions. Machines do not consider consequences. [IP 8]*

The autonomy of a collaborative service robot poses a threat to humans. The interview partners were very concerned, also about the role of humans.

*So, if something … a robot acting autonomously. Then what is the role of humans? They become redundant because they can no longer influence anything anyway. [IP36]*

They describe that autonomous robots scare them. The autonomy of a robot influences the willingness to collaborate with them. Employees fear that robots do not follow the rules and hierarchies and therefore infringe the social network of a company.

All respondents agreed that human employees will always have the superior role. As a result, clear role descriptions and role distributions were necessary to avoid conflicts between employees and robot coworkers. Interview partners also commented that they were afraid that collaborative service robots would destroy the social order and structure in a company. In organizations, social hierarchy is built upon the two pillars of power and status. Hence, social power is identified as a relevant factor for employees' risk perception and WTC with the technology.

*As long as humans have the authority or even the power, everything is in order. But if machines suddenly take over, this is a threatening scenario and turns our structures upside down. [IP 30]*

**"Willingness to Collaborate" Personas**

The previous results detail human-robot collaboration for FSE and identify appraisal of CSR as coworkers and secondary coping behaviors as central constructs. By grouping

sentiments of respondents regarding their individual coping behavior when confronted with the introduction of CSR, four *personas* (supporter, embracer, resister and saboteur) emerge from the results. These *personas* highlight individual's degree of WTC along primary and secondary appraisal of CSR. These personas are represented in Figure 2.

[INSERT FIGURE 2 HERE]

Supporter and embracer personas are positively disposed towards the implementation of CSR at their workplace. However, they differ on the level of involvement in the way technology is integrated into their job. *Embracers* fully cooperate with CSR to create value, integrating unique skill sets of humans and service robots for higher productivity and efficiency. While *supporters* also appreciate the benefits of the technology, their mindset is different. Instead of full cooperation, supporters see the technology as a way to reduce their workload by taking away tedious and repetitive tasks while wanting to remain in control for all their decisions.

On the other side are *resister* and *saboteur* personas, who either refuse to work with CSR or even actively disrupt the use of this service technology at their place of work. They differ on the level of experience with the technology. *Resister* personas refuse to interact with CSR and actively complain about the implementation to managers. However, they have already gathered at least some kind of experience with technology either in private or professional situations. Compared to resisters, *saboteur* personas have no prior experience with technology and are increasing their involvement by not only refusing to cooperate but to actively work to prevent the implementation of objectively better technology (Harris and Ogbonna, 2002).

Additional research is required to further investigate the specifications of the different personas and the interdependencies the individual constructs of our model in the personas' willingness to collaborate with CSR in the workplace. It seems especially worth studying

how resisters and saboteurs could be influenced to turn into supporters of CSR, e.g. by triggering positive emotions and weakening the potential for negative perceptions against the background of the technology readiness construct (Lin and Hsieh, 2012; Parasuraman, 2000; Parasuraman and Colby, 2015a, 2015b).

**Discussion**

Humanoid service robots will increasingly share the workplace with humans which will have an impact on social dynamics at work. While service robots will provide a multitude of benefits, little focus has been given to increasing our awareness of factors that promote or impede their successful integration in working environments. Hence, scholars argue that substantial research is required to fully understand human-robot interactions (e.g., Hinds et al., 2004), opportunities for human—machine integration (Huang and Rust, 2018), and the conditions under which human employees can be encouraged to work in tandem with robot coworkers. Our study answers to this demand for substantial research on human-robot interaction. In the transition from mainly human-centric work to technology-infused working life, our study contributes to the understanding of the challenges and opportunities of a new form of (automation-based) service encounter (McLeay et al., 2020) by deepening our knowledge of frontline employees' perceptions of CSRs. By drawing on appraisal theory, our framework reduces the complexity of employee-robot interaction in service settings by highlighting the role of independent antecedents (CSR attributes, job attributes and FSE attributes) in shaping the workplace interaction. Furthermore, it underlines the necessity of taking into account both obstacles and catalysts of autonomous technology infusion in service workplaces. Our study highlights the dilemma of human-robot interaction in the workplace. On the one hand, robots are characterized by their autonomous actions and can partially take on and perform tasks independently of humans. On the other hand, humans strive to control

the technology and maintain the superiority in the hierarchy. This trade-off significantly determines how FSEs cope with CSRs. Moreover, we identify four different employee personas. These personas imply that managers may group their employees into segments based on their openness towards CSR to more adequately distribute and allocate workforce to relevant tasks involving different levels of service robot involvement. Ultimately, this article adds value to the developing research field on service robot application in workplace environments. It offers important theoretical and managerial insights on how to increase employees' WTC with technology to accentuate the need for a holistic assessment of autonomous robots in service jobs settings.

### *Theoretical Implications*

More than 15 years ago, Hinds et al. (2004, p. 177) have argued that "substantial research [is] required to fully understand human–robot interaction on collaborative tasks". This research contributes to targeting the scarcity of thorough, theory-building research in the field of technology infusion in service provision. It tackles gaps in academic literature by responding to calls for new insights into how service robots can be effectively integrated into the servicescape (Wirtz et al., 2018). The study provides answers to the questions on employees' response to and behavior towards service robots in collaborative working situations (Hinds et al., 2004). It thereby merges the field of autonomous service technologies with research on (frontline) service employees. Findings emphasize the importance of three attributional antecedents, namely employee attributes, job attributes and robot attributes in jointly shaping the human-robot workplace interaction. Employees' perceived benefits and risk pertaining to the collaboration with service robots are identified as central drivers in the qualitative study. Based on their appraisal of this interaction employees' decide on the extent they are willing to interact and cooperate with the robot.

This research proposes a framework of employees' willingness to collaborate with

robot colleagues. The study presents a first venture in understanding how a positive collaboration of intelligent technologies and humans in working contexts can be created. With a special focus on perceived benefits and risks for employees, this article details aspects which drive (good coworker) or hinder (bad coworker) their willingness to collaborate.

### *Managerial Implications*

This study reveals numerous managerial implications for companies seeking to implement service robots into their work processes. Refusing or holding up the process of technology integration in the workplace has crucial implications for enterprises. Service robot technologies prove to be objectively more efficient which can lead to significant cost savings, fewer errors and lower staffing levels (Bughin et al., 2018). Thus, companies need to develop strategies to reduce employees' perceived risk along our proposed dimensions technology characteristics, employee, job demands and resources, as well as autonomy and control. Transitioning into a more technologized world, our model can help managers to address concerns of employees to implement CSR into their everyday work life.

On the one hand, CSRs promise an objectively more efficient future while providing significant cost savings, fewer errors and lower staffing levels (Bughin *et al.*, 2018). On the other hand, employees' collaboration is a crucial prerequisite for companies to reap the benefits of this new technology. Our framework outlines ways for successful workplace interaction for reaping collaborative service robot benefits. Managers should pay special attention to selecting CSR attributes, which match to job and employee attributes of the task. Our qualitative interviews indicate that companies can gather more support for CSR integration by setting clear rules and roles for the collaboration process, thus reducing the chance of rejectionist attitudes of human colleagues. Based on our results, human coworkers can therefore retain perceived control and perceived superiority over collaborative service robots. By gradual, rather than sudden adoptions of CSRs in familiar working processes,

crucial success factors like technology readiness improve and the feeling of perceived loss of control can subside over time. Managers can work to convince employees to see CSRs as 'good' coworkers by integrating a 'simpler' service robot for collaboration. This enables employees to experience the benefits of this technology without immediately seeing it as a risk factor for either psychological or financial reasons. Proving their worth for everyday tasks in real environments, the way will be paved towards accepting more capable and autonomous CSRs for future task divisions.

Furthermore, managers should develop tools based on our theoretical framework, to identify key decision makers and their willingness to collaborate with frontline service robots. Enabling decision makers are crucial in adopting collaborative service robots into numerous work processes and thus improving efficiency of collaborations. Should these decision makers constrain the development of robotic workplace interactions, strategies need to be developed to turn the most important constraining employees into enablers. By identifying employee and job attributes towards the implementation of CSRs along our proposed dimensions, managers can identify factors leading to apprehensive behavior and work towards overcoming them. In general, we recommend that CSRs should be seen as an opportunity to improve service processes and make the work of FLEs easier and the work environment more pleasant and attractive, so that talented employees are retained in the long term. Under no circumstances should CSRs replace FLEs and thus negatively influence the service quality or the reputation of the company.

***Limitations and Future Directions***

Like every empirical study based on a single methodological approach our study faces some limitations that must be considered. First, our study is characterized by methodological preferences which limit its potential to be generalizable. Additional data collection from different methodological approaches may therefore prove valuable to attain more in-depth

views on the interplay of technology, job and employee attributes in collaborative work environments. All participants of our exploratory study live and work in one country which implies reduced generalizability of our findings as some attitudes toward and acceptance levels of new technologies may be subject to cultural beliefs. Future research may therefore address other national and cultural backgrounds to eliminate cultural and social biases and confirm our findings across countries and thereby increase the generalizability. Another fruitful avenue for future research is how technology characteristics become more dominant in affecting risk perceptions and WTC. In particular, the role of anthropomorphistic appearance of robot coworkers and the effect on perceived benefits/risks and ultimately on WTC seems an interesting area of context-specific research (Kim and McGill, 2011).

## Conclusions

Robots are omnipresent today and will drastically change most jobs over the next few years. However, to make this development a success in companies, we emphasize the relevance of considering the multiple facets and needs of all included parties. It is the interplay of technology, job, and human attributes that influences FLEs' appraisal of CSRs in the work environment. It thus determines FLEs' WTC with service robots and ultimately the potential for a successful and beneficial integration of CSRs in the workplace. Not the companies that force employees towards collaboration with CSR will be the most successful, but only the companies that motivate their employees for a daily collaboration will gain all the benefits from the opportunities that emerge from human—robot collaboration in the context of the frontline service workplace.

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Table 1: Overview of empirical studies related to service robots in the workplace

| **Authors / Year** | **Focus** | **Context** | **Research design** | **Findings** |
|---|---|---|---|---|
| Gombolay et al. (2015) | Human-robot teams | Manufacturing | Experiment, N=24 | Robot teammates with the ability to autonomously allocate and schedule tasks can improve both task completion time and the **desire of human workers to cooperate** with their robotic teammates. |
| Hinds et al. (2004) | Human-robot collaboration | Assembly of objects | Experiment, U.S., n=292 | Robots' appearance and relative status of the robot influence how people work with robots. Authors discuss conditions under which humanoid robots may be preferable to machine-like robots. |
| Meissner et al. (2020) | Human-robot collaboration | Manufacturing | Interviews, N=17 | People preferred to cede their control authority to the robot. |
| Sauppé and Mutlu (2015) | Collaborative manufacturing robots | Manufacturing | Ethnographic and interviews, N=17 | Sociality of robot important attribute for integration in manufacturing environment and to change perceptions from industrial equipment to sociable co-worker. |
| You and Robert Jr. (2018a) | Willingness to work with robotic coworker | Warehouse | Experiment, U.S., n=200, U.S. | Human–robot similarity promotes trust in a robot, which leads to **willingness to work** with robots and ultimately willingness to work with a robot over a human co-worker. |
| You and Robert Jr. (2018b) | Emotional attachment of teams to robots | Delivery of objects | Experiment, U.S., n=114, U.S. | Teams performed better and were more viable when they were emotionally attached to their robots. |

Table 2: Overview of interview partners of the qualitative study

| Participant Number | Sex | Age | Education | Current Job Position | Service Relation | Technical Affinity | General Experience with Service Robots |
|---|---|---|---|---|---|---|---|
| P1 | Female | 27 | Master in Business Psychology | Communication Consultant | Consulting | Medium | Low |
| P2 | Male | 48 | Engineer | Manager After Sales | After Sales Service | High | High |
| P3 | Male | 27 | Master in Industrial Engineering | Technical Consultant | Service Consulting | High | High |
| P4 | Female | 40 | Master In Management | Hotel manager | Hospitality | Medium | Low |
| P5 | Female | 36 | MBA | Restaurant Manager | Hospitality | High | High |
| P6 | Female | 32 | Engineer | Technical Consultant | Service Consulting | Medium | Medium |
| P7 | Male | 41 | Industrial Engineer | Sales Respresentative | Service and Sales Consulting | Medium | Low |
| P8 | Male | 50 | MBA | Researcher | Technology Consulting | High | High |
| P9 | Male | 29 | Education as Sales Representative | Salesperson in Retail | Retail Services | Medium | Low |
| P10 | Female | 32 | Education as Hotel Management Assistant | Receptionist in Hotel | Hospitality | Medium | Medium |
| P11 | Female | 45 | Education as Hairdresser | Hairdresser | Hairdresser | Low | Low |
| P12 | Female | 51 | High-School | Flight Attendant | Airlines | Medium | Medium |
| P13 | Female | 39 | High School | Cashier | Customer Support | Medium | Low |
| P14 | Female | 29 | Pharmaceutical technical assistant | Sales rep in Pharmacy | Consulting | Medium | Medium |
| P15 | Male | 34 | High School | Barkeeper | Hospitality | High | High |
| P16 | Male | 40 | High School | Chef | Hospitality | Low | Medium |
| P17 | Female | 46 | MBA | Accountant | Banking | Medium | High |
| P18 | Female | 60 | High School | Kindergarden teacher | Education | Medium | Medium |
| P19 | Female | 55 | - | Cleaning Lady | Airport | Low | Medium |
| P20 | Male | 38 | High School | Restaurant Owner | Hospitality | High | High |
| P21 | Female | 35 | MBA | Entrepreneur | Consultant | High | Medium |
| P22 | Female | 41 | Master of Law | Lawyer | Consulting | Medium | Low |
| P23 | Male | 61 | Physician | Dentist | Medical Services | High | High |
| P24 | Female | 54 | High School | Dentist's assistance | Medical Services | Medium | Medium |
| P25 | Female | 30 | High School | Dentist's assistance | Medical services | High | High |
| P26 | Male | 48 | MBA | Wine Sommelier | Hospitality | High | Low |
| P27 | Male | 30 | Master in Industrial Engineering | Creative Director | Technical Consulting | High | Medium |
| P28 | Male | 47 | MBA | Pilot | Airline | High | High |
| P29 | Female | 39 | Master in Service Management | Hotel Manager | Hospitality | High | Medium |
| P30 | Male | 56 | High School | Bus Driver | Public Services | Medium | Low |
| P31 | Female | 60 | High School | Administrator | Public Services | Medium | Low |
| P31 | Female | 43 | High School | Librarian | Public Services | High | Low |
| P32 | Female | 24 | Master in Marketing | Administrator | Airport | High | High |
| P33 | Female | 33 | High School | Sales Representative | Insurance Service | Medium | Medium |
| P34 | Male | 26 | High School | Therapist | Health Services | Medium | Medium |
| P35 | Female | 42 | High School | Customer Contact | Service Support | Medium | High |
| P36 | Male | 55 | Engineer | Business Owner | Service Consulting | High | High |

Figure 1: Framework of frontline employees' attitudes, appraisal, and willingness to collaborate (WTC) with CSR

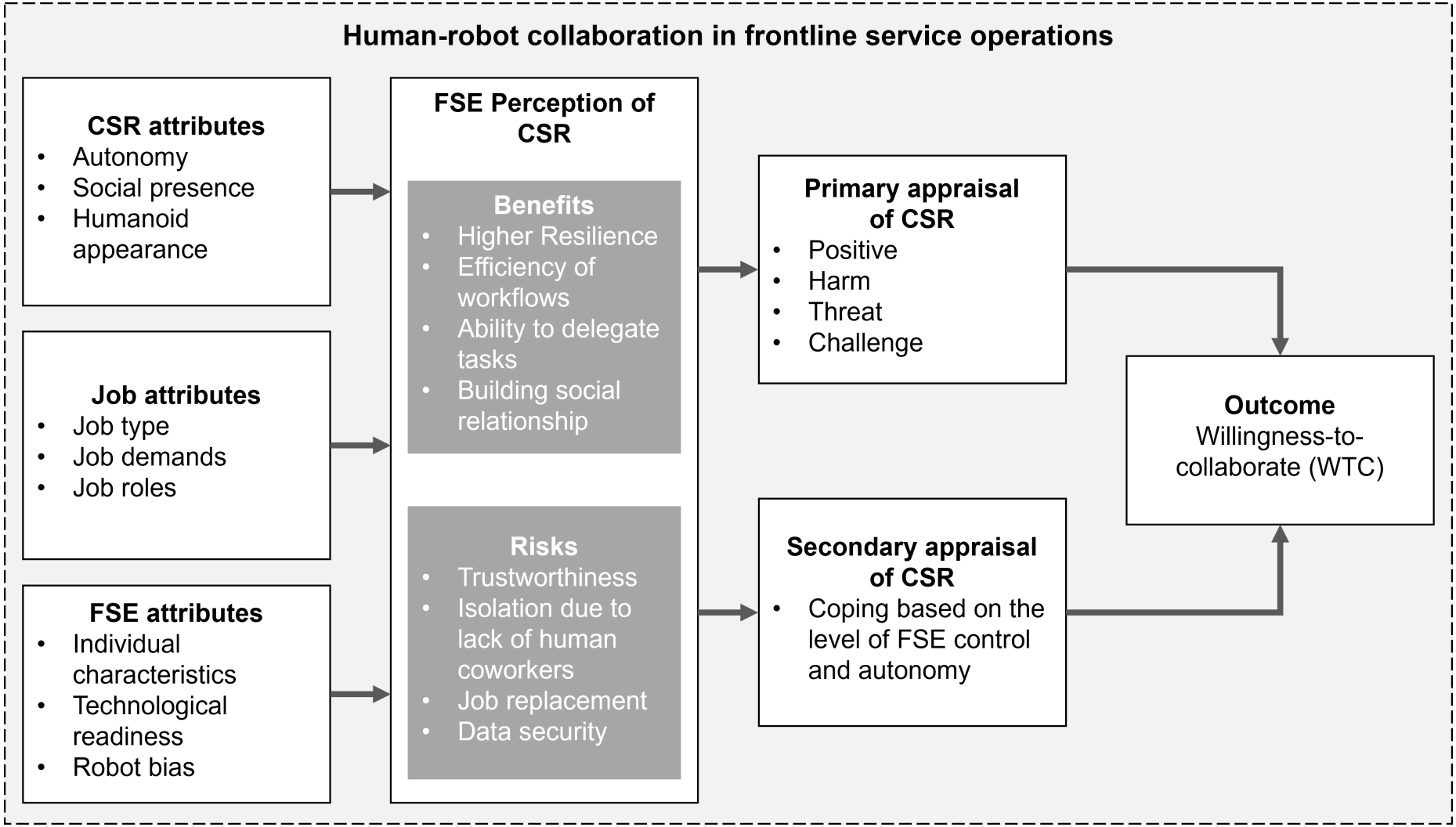

Figure 2: Willingness to Collaborate with CSR Personas