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Robotic role theory: an integrative review of human–robot service interaction to advance role theory in the age of social robots

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Abstract

Purpose – Social robots increasingly adopt service roles in the marketplace. While service research is beginning to unravel the implications for theory and practice, other scientific disciplines have amassed a wealth of empirical data of robots assuming such service roles. The purpose of this paper is to synthesize these findings from a role theory perspective with the aim of advancing role theory for human–robot service interaction (HRSI).

Design/methodology/approach – A systematic review of more than 10,000 articles revealed 149 empirical HRSI-related papers across scientific disciplines. The respective articles are analyzed employing qualitative content analysis through the lens of role theory.

Findings – This review develops an organizing structure of the HRSI literature across disciplines, delineates implications for role theory development in the age of social robots, and advances robotic role theory by providing an overarching framework and corresponding propositions. Finally, this review introduces avenues for future research.

Originality/value – This study pioneers a comprehensive review of empirical HRSI literature across disciplines adopting the lens of role theory. The study structures the body of HRSI literature, adapts traditional and derives novel propositions for role theory (i.e. robotic role theory), and delineates promising future research opportunities.

Keywords Human–robot service interactions, Robotic role theory, Systematic literature review, Social robots

Paper type Research paper

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Introduction

Assuming various manifestations and functions, social robots growingly continue to take on service roles at the organizational frontline (Lu *et al.*, 2020; Wirtz *et al.*, 2018). They serve and seat restaurant customers in Korea (Park, 2020a), greet and direct visitors in hospitals in France (Bayern, 2020), and offer concierge services in hotel chains like Hilton in the US (Mills, 2018). This integration of robots into the marketplace transforms service interactions, for consumers and employees alike. Embodied social robots represent perhaps the most dramatic alterations to face-to-face service interactions (Mende *et al.*, 2019), challenging some fundamental principles of service and with it the roles and role interplay in service encounters (Larivière *et al.*, 2017; Solomon *et al.*, 1985; Subramony *et al.*, 2018).

While the burgeoning interest in the implications of adopting social robots in service roles is reflected in a surge of predominantly conceptual reflections and future research agendas in the service field (Čaić *et al.*, 2019; Larivière *et al.*, 2017; Lu *et al.*, 2020; van Pinxteren *et al.*, 2020; Xiao and Kumar, 2021), empirical insights remain in a nascent stage. Calls to unravel success drivers for integrating social robots in various roles into the organizational frontline are repeatedly echoed as a chief research priority (Schepers and van der Borgh, 2020; Wirtz *et al.*, 2018). Some early efforts in the field attempting to fill this void explore consumer interactions with social robots in general (e.g. Mende *et al.*, 2019) or in specific service domains, such as elderly care (Čaić *et al.*, 2018) and hospitality (Belanche *et al.*, 2020). While such studies provide valuable insights, they only shine a sole spotlight in a dark universe on specific aspects of social robot role performance in a service context.

At the same time, other disciplines have already produced rich knowledge about human–robot interaction (HRI) in both neighboring and distant fields, reflecting insights from communication studies (e.g. Wang *et al.*, 2019), information systems (e.g. Inbar and Meyer, 2019), robotics (e.g. Pinillos *et al.*, 2016), neuroscience (e.g. Kory Westlund *et al.*, 2017), and social psychology (e.g. Kiesler *et al.*, 2008). These varied empirical studies address different types of social robots in a variety of service roles, such that they might hold general implications for service encounter theory development and management across service settings.

A promising way to integrate this multidisciplinary wealth of research findings is provided by one of the longstanding accounts of service research: role theory. Role theory has been applied to explain behavior, mechanisms, and outcomes of service interactions between (human) social actors for over three decades (Biddle, 1986; Henkel *et al.*, 2017; Schepers and van der Borgh, 2020). Also the more recent work on service robots has witnessed an appreciation of role theory as a guiding principle to develop conceptual frameworks of service interactions between humans and robots, including service robot acceptance (Stock and Merkle, 2017; Wirtz *et al.*, 2018), the changing roles of service actors (Larivière *et al.*, 2017), and a typology of transformative robot roles (Henkel *et al.*, 2020). Role theory thus seems to provide an intuitive basis to also explain service interactions between human and *robotic* social actors. Its reliance on general principles across service settings and role performers provides an elegant alternative to treating each service encounter as a unique experience (cf. Solomon *et al.*, 1985). Yet, beside an identified need (Schepers and van der Borgh, 2020), no attempts have been undertaken to apply a role theory lens to integrate empirical findings from HRI in service settings, let alone to analyze these interactions to inform role theory on the transition to the age of social robots in service (for a comprehensive overview of systematic reviews on consumer interactions with service robots, see Online Appendix 1).

Therefore, the core objective of the underlying paper is to conduct a comprehensive review of studies investigating HRI from a role theory perspective across scientific disciplines in accordance with two central research questions: (1) How can the scattered literature on HRI in a service context be structured and synthesized from a role theory perspective? (2) How can this synthesis serve as a baseline to develop role theory for the age of social robots in service (i.e. *robotic role theory*)?

To this end, we seek to make four key contributions. First, we extend the boundaries of the field, and synthesize extant literature on HRI in service settings across scientific disciplines from a role theory perspective. Second, via content analysis, we identify themes related to role theory within our data and propose a structure of the human–robot service interaction (HRSI) literature. Third, based on our synthesis, we adapt and extend seminal service encounter theory and translate the propositions of role theory by Solomon *et al.* (1985) to the case of consumers interacting with *robotic* social actors. Integrating our findings, we develop a framework of robotic role theory. Fourth, we pinpoint critical research needs based on our analysis.

Theoretical and conceptual background

Role theory

Role theory describes a mid-range theory which can be leveraged to explain behavior, mechanisms, and outcomes of dyadic, people-based service interactions of social actors (Biddle, 1986; Mead, 1934; Solomon *et al.*, 1985). It encompasses three key elements: (1) role enactment or behavior, (2) role expectations, and (3) role congruence that together result in six propositions (Biddle, 1986; Solomon *et al.*, 1985). (1) Role enactment describes all behaviors displayed by a social actor in a joint role play. The appropriateness of an enacted behavior in a service encounter is determined by others in the social structure (e.g. consumers) and the context (e.g. luxury vs. budget segment). An actor's role enactment is thus interdependent with their counterpart's role enactment. (2) To show the appropriate behavior, it is crucial that actors can emphasize and take on their counterpart's perspective to derive relevant role expectations. Role expectations are defined as a set of expected behaviors of an actor in a certain role (Mead, 1934). Based on expectations, over time individuals form an internal role set which consists of a range of different role-related behaviors they enact themselves and they expect from their counterparts (Solomon *et al.*, 1985). (3) If role expectations are clear and roles are enacted accordingly by both actors, role congruence emerges (Solomon *et al.*, 1985; Biddle, 1986). For example, in a service context, satisfaction with the encounter is a function of the congruence between perceived and expected role enactment of both role players (Solomon *et al.*, 1985). Role congruence includes two dimensions: intra- and inter-role congruence. The former describes a clarity of actors that they know what others expect from them in their role enactment. The latter refers to the extent of agreement both actors share concerning the appropriateness of role enactment in joint play (Solomon *et al.*, 1985).

Human–robot service interaction

Our focus for this review lies on interactions between embodied, autonomous social robots and consumers in a service setting which we refer to as HRSI. Service literature defines 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). Since the current review seeks to integrate empirical findings of physical HRSI, we adopt a more narrow definition, in line with research in robotics, according to which robots must be embodied and able to move autonomously (Guizzo, 2020). In reference to social robots in service settings, we include only embodied, autonomous, social robots that can act as role players (i.e. display social behavior) with a human counterpart.

Since social robots can offer verbal and non-verbal human-like cues to express emotions and intentions (Breazeal, 2003), they can theoretically take on service roles and be effectively integrated into the organizational frontline, as robotic complements or substitutes for frontline service employees (Huang and Rust, 2018). Through the mental schemas they evoke, humans perceive them as social peers and interaction partners (Fong *et al.*, 2003; Qiu *et al.*, 2020). However, despite their resemblance with humans, social robots are still machines that

are distinct also with respect to their problem-solving creativity (Wirtz *et al.*, 2018), machine agency (Novak and Hoffman, 2019), and capacity for social and emotional intelligence (Huang and Rust, 2018; Wirtz *et al.*, 2018).

Method

In order to synthesize HRSI literature, we conducted a narrative systematic literature review which we depict in Figure 1 (Siddaway *et al.*, 2019). This approach ensures a comprehensive and unbiased selection, paired with a critical analysis and synthesis of extant research (Jesson *et al.*, 2011). It is particularly well suited for the literature on HRSI, which spans diverse disciplines, methodological approaches, and theoretical concepts (Siddaway *et al.*, 2019).

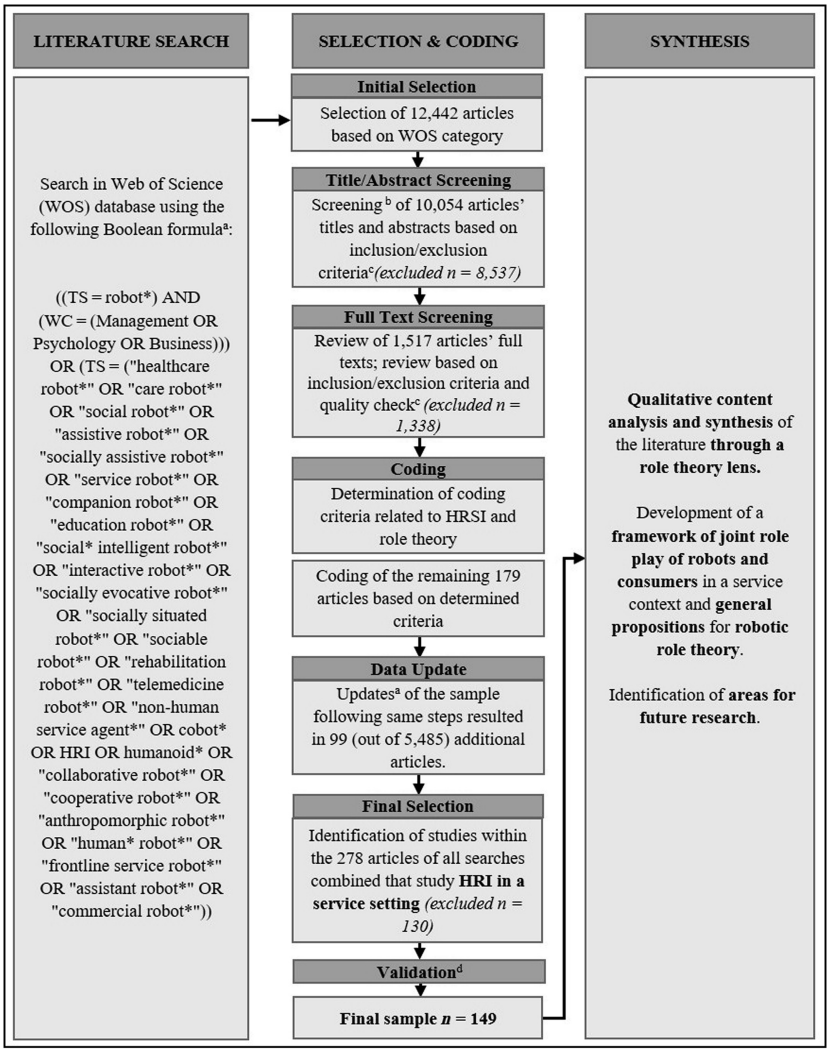
Systematic search and data extraction

Search process. In a first step, we turned to the Web of Science (WOS) database, as it includes the main corpus of HRI research in diverse scientific fields published in peer-reviewed journals (Antons and Breidbach, 2018). The scope of this systematic review encompasses only empirical studies of human interactions with embodied social robots, which are suitable for adopting roles at the organizational frontline. With this goal in mind, we drafted Boolean phrases based on the authors' knowledge of the literature and a preliminary, non-systematic literature search aimed at extracting additional keywords. Eventually, we adopted a highly cautious and conservative approach and included all articles studying robots in a social (e.g. "social robot," "assistive robot") or service context ("service robot," "care robot") across disciplines as well as all robot-related articles in fields that are core or adjacent to service (i.e. business, management, or psychology) in line with Blaurock *et al.* (2022). Figure 1 depicts the detailed Boolean formula.

Screening and data extraction. In the first screening round we excluded WOS categories outside of our research scope (e.g. plant sciences, nuclear physics). Next, two independent coders assessed the title and, if needed, abstract of the remaining 10,054 articles to determine their fit with our research scope (Calabrò *et al.*, 2019). Inconsistencies were subject to additional screening by a third coder. We then consulted the full texts of all remaining articles (n = 1,517) and screened out all studies that could directly feed our research questions: empirical evidence of human behavioral or psychological outcomes resulting from direct or scenario-based interactions with embodied social robots (see Online Appendix 2 for inclusion/exclusion criteria and quality measures; cf. Blaurock *et al.*, 2022). We updated the data in January 2021 following the same steps and finally, we extracted all articles that investigated robots enacting service-related roles (n = 148). We validated the completeness of our dataset by cross-checking it with existing HRI reviews and the literature review sections of empirical HRI articles published in service journals (see Figure 1). We identified one additional article to adopt in our final dataset (n = 149 articles).

Qualitative content analysis

To gain detailed insights into the HRSI literature, we analyzed the content of the articles in the final dataset (Hsieh and Shannon, 2005). First, we extracted and coded several dimensions, including research objective, methodology, theoretical framework, robot model and type, robot service role, variables studied, and main results. Next, through the lens of role theory, we coded role-related elements pertaining to each article and identified emerging themes. These included both adaptations of traditional role theory elements resulting from a translation of the latter to an HRSI context and new themes that emerged from novel elements in HRSI versus traditional service interactions. All codes were checked by a separate coder from the author team and any inconsistencies were resolved by consensus.



Note(s): [a] We conducted the first search in May 2019 and updated the data in January 2021. Both searches combined revealed a total of 17,927 (12,442 + 5,485) articles; [b] Intercoder reliability score of initial screening $I_r = 0.922$ exceeds suggested threshold of 0.70 (Rust and Cooil, 1994); [c] see Online Appendix 2; [d] We cross-checked our final dataset against all HRSI literature reviews in the field of services management/marketing published before 2022 (see Online Appendix 1), and the literature backgrounds of all other six HRSI-related studies published in service journals which we identified through our review (1) Belanche *et al*. (2020); (2) Čaić *et al*. (2018); (3) Choi *et al*. (2020); (4) McLeay *et al*. (2020); (5) Mende *et al*. (2020); (6) van Pinxteren *et al*. (2019); Boolean formula and selection & coding c.f. Blaurock *et al*. (2022)

Figure 1.
Systematic research process

A structure of the HRSI literature through a role theory lens

Our final dataset includes a total of 149 articles published in 69 different journals between 2007 and 2020. In accordance with standing HRSI reviews (Blaurock *et al.*, 2022; De Keyser and Kunz, 2022), we find that the number of publications shows a steep growth over time with 47 (31%) publications in 2020 alone which speaks for the topicality of research on HRSI. Most studies rely on quantitative methods (111; 75%) versus qualitative approaches (21; 14%), while the remaining papers leverage a mixed methods approach (17; 11%). Moreover, we find that social robots in HRSI literature take on a variety of frontline service roles such as medical assistant (e.g. Lee *et al.*, 2017), tutor (e.g. Serholt, 2018), and concierge (e.g. Shin and Jeong, 2020).

We also note that the majority of theories used are robot-centric such as robot acceptance (e.g. Unified Theory of Acceptance and Use of Technology; Venkatesh *et al.*, 2003) or perceptions of robot appearance and behavior (e.g. Uncanny Valley Theory; Mori *et al.*, 2012; Computers are Social Actors Paradigm, Nass *et al.*, 1994). While we identify some studies that use robots as a new context to test a wide variety of theories that originally explained human interactions (e.g. Theory of Planned Behavior; Ajzen, 1991; Attribution Theory; Weiner, 1982), none of the 149 included articles rely on role theory or any theory that explicitly addresses the interactive element of service encounters.

While empirical research remains short of applying role theory to explain HRSI-related phenomena, all articles in our final dataset implicitly contain information on the role play of robots and humans in service interactions. The findings can therefore still inform role theory development in the age of social robots in service. Synthesizing and structuring the data from a role theory perspective, we identified seven themes which reflect study foci that we find in our data as depicted in Table 1. We identify five themes with a focus on either one of the focal actors in HRSI (i.e. three themes that cluster around robots, and two themes around consumers), and two themes that relate to studies in which not actors are at focus but rather the outcome or the context of their joint role play. For each theme, we also present the respective implications on how, when, and where to effectively integrate social robots in service. Finally, we indicate their relevance for advancing the six original propositions of role theory (Solomon *et al.*, 1985) and informing the development of propositions for HRSI. An allocation of articles to the identified role theory theme(s) and the theory bases used in the respective studies is presented in the Online Appendix 3.

Robot

We cluster all studies under *robot* as focal actor which are related to consumer evaluations of robots taking on service roles and identify three themes: (1) *robot role interface*, (2) *robot role enactment*, and (3) *robot role suitability*.

Robot role interface. Studies under this theme analyze consumer evaluations of a robot's appearance, including the effects of a robot's morphology (e.g. android vs. machine-like; Vlachos *et al.*, 2016, or humanoid vs. machine-like face display; Broadbent *et al.*, 2013), or perceived robotic form realism (Paauwe *et al.*, 2015) on consumer outcomes. Findings in this theme inform service scholars and practitioners on how consumers evaluate specific robotic appearances and what hardware design and robot type to deploy for which service role.

Robot role enactment. HRSI studies under this theme focus on consumer evaluations of robots enacting various behaviors within their role as frontline employees, including consumer perceptions of a robot's politeness (e.g. Lee *et al.*, 2017), emotion expression (e.g. Johnson *et al.*, 2016), and personality (e.g. Meerbeek *et al.*, 2008). Results inform researchers and service managers on how consumers evaluate specific robotic role enactment and give implications on robot software design and deployment measures.

Robot role suitability. This theme includes studies that focus on consumer evaluations of a robot's suitability to enact a specific service role. In so doing, research under this theme

Actor	Study focus: Role play theme	Research objective and example studies	Implications for service researchers and service managers	Informs proposition
Robot	Role interface	Studies that focus on consumer evaluations of robot role interfaces taking on various service provider roles • Analysis of how a robot's appearance affects consumer perceptions of the robot's mind, personality, and eeriness (Broadbent *et al.*, 2013) • Analysis of consumers' preferences for various features of robot appearance in HRSI (Paauwe *et al.*, 2015)	Understanding of how consumers evaluate specific robotic appearances (i.e. role interface) offers implications on robot hardware design (i.e. morphology) and their suitability to take on specific service roles	1, 2
	Role enactment	Studies that focus on consumer evaluations of robots enacting various specific behaviors within their role as a service provider • Analysis of the effect of multimodal behavioral patterns (i.e. combinations of gestures, eye LED patterns, and verbal expressions) on social robots' entertainment value in HRSI (Johnson *et al.*, 2016) • Analysis of the effect of a robot's politeness behavior in a healthcare role on consumer compliance (Lee *et al.*, 2017)	Understanding of how consumers evaluate specific robotic role behavior provides implications on robot software design (i.e. behavioral functionalities)	1, 2, 3, 4, 5, 6
	Role suitability	Studies that focus on understanding the needs, concerns, performance expectations, and deployment preferences consumers have when interacting with robots taking on a service provider role • Analysis of older adults' expectations and needs in interaction with robots for personal care (Čaić *et al.*, 2018) • Analysis of health workers' and patients' concerns about the deployment of service robots in professional care facilities for different tasks (Tuisku *et al.*, 2019)	Understanding consumers' needs, concerns, performance expectations, and deployment preferences for robots taking on service roles enables stakeholders to make informed decisions on how and when to implement robots in service settings	2, 5, 6

(*continued*)

Table 1.
Thematic structure of the HRSI literature from a role theory perspective

Table 1.

Study focus: Actor	Study focus: Role play theme	Research objective and example studies	Implications for service researchers and service managers	Informs proposition
Consumer	Individual factors	Studies that focus on individual factors affecting consumers' role enactment as well as consumers' evaluation of robots' role enactment and interface in service provider roles • Analysis of how individual attitudes towards robots (Stafford *et al.*, 2014) or trust (Park, 2020b) affect consumers' robot evaluation and intentions • Analysis of the effects of gender (Gallimore *et al.*, 2019) or cultural background (Choi *et al.*, 2021) on consumers' robot evaluation	Understanding consumer idiosyncrasies informs stakeholders on when and where to deploy robots and how to market and personalize robotic services according to consumers' individual characteristics	2, 6
	Role behavior	Studies that focus on exploring consumer behavior in response to interacting with a robot taking on a service provider role • Analysis of how children behave towards a robot tutor in a learning interaction (Oh and Kim, 2010) • Analysis of how consumers and employees interact with and respond to a robot deployed in a hospitality context (Mingotto *et al.*, 2021)	Understanding consumer role behavior when confronted with robots can inform robot design to sense relevant human social behavioral cues	1, 4, 5
Role performance outcomes		Studies that focus on global outcomes of joint role play of robots and consumers in HRSI. • Analysis of how robot-provided risk messages affect information retention and behavioral intentions of consumers (Rainear *et al.*, 2019) • Analysis if interactions with social robots can improve social life and decrease social vulnerability among elderly users (Khaksar *et al.*, 2016)	Understanding outcomes of robotic service provision (e.g. impact on social vulnerability or message retention when service is provided by a robot) that transcend the two focal actors provides implications on how to deploy and market robots accordingly	2, 6
Role play context		Studies that focus on contextual and situational factors affecting role play in HRSI. • Analysis of how different contextual factors (e.g. hotel segment) influence robot perceptions and HRSI outcomes (Chan and Tung, 2019) • Analysis of how and to what extent consumers attribute service failures to robotic versus human service providers (Leo and Huh, 2020)	Understanding of contextual/situational factors influencing HRSI outcomes that need to be considered when deploying and marketing robotic services	4, 6

investigates needs, concerns, performance expectations, and deployment preferences of consumers related to a robot in a service provider role. Studies, for example, include investigations of consumers' needs, concerns, and expectations related to robots assuming a care role in an elderly care context (e.g. Čaić *et al.*, 2018; Tuisku *et al.*, 2019) or a companion role in rural schools (Broadbent *et al.*, 2018). Results inform researchers and practitioners on expectations humans hold for robotic actors and where they deem them suitable to take on a service role. Implications are provided on the software and hardware design of (future) social robots and when and where to deploy robotic services.

Consumer

We cluster all studies focusing on the human actor's role play in HRSI into: (1) *consumer individual factors* and (2) *consumer behavior*.

Consumer individual factors. This theme encompasses all studies that analyze individual consumer characteristics that affect their role behavior in HRSI, alongside their role expectations and evaluations of robot role enactment and interfaces. Examples include studies that investigate the impact of individual culture (Choi *et al.*, 2021) or gender (Gallimore *et al.*, 2019) on the perception and acceptance of social robots. This theme also includes investigations on the effects of individual factors that are less dispositional and can change over time such as attitudes towards robots (Stafford *et al.*, 2014) or trust in robots (Park, 2020b) on HRSI outcomes. Studies under this theme inform researchers and practitioners on when, where, and how to deploy robots as well as how to market and personalize robotic services in accordance with consumer individual preferences.

Consumer role behavior. Under this theme, we cluster all studies that explore consumer role behavior in response to an interaction with a service robot. Examples include the demeanor of older adults when encountering a robot (Wang *et al.*, 2019), the behavioral reaction of children towards an educational robot (Oh and Kim, 2010) or consumer behavioral responses towards robots in hospitality contexts (Mingotto *et al.*, 2021). Results of these studies inform researchers and practitioners on consumer behavior in interactions with robots. Based on this understanding, robots can be designed to understand human social behavioral cues – an aspect that is crucial for successful role play (Solomon *et al.*, 1985).

Finally, we identify two themes that focus on the joint role play of robots and consumers in HRSI, rather than on a single role actor: (1) *role performance outcomes* and (2) *role play context*.

Role performance outcomes

This theme emphasizes the (global) outcomes of joint robot-consumer role plays. For example, Rainear *et al.* (2019) uncover that robots function as technological distractors during risk message retention in a peacekeeping context, since people ruminate on visual stimuli and the content delivery medium, rather than the content and behavior during message delivery. Moreover, Khaksar *et al.* (2016) reveal that deploying robots for elderly care services increases service innovation and reduces social vulnerability among older people. Results inform researchers and practitioners on outcomes of robotic services that transcend the two focal actors which provide implications on how to deploy and market them accordingly.

Role play context

We cluster all studies that focus on the contextual and situational factors affecting joint role play under the role play context theme. Rather than focusing on the interplay of robots and consumers, these studies attempt to establish the global effectiveness of social robots in different service environments and situations. These studies focus on the influence of different service environments on HRSI outcomes (e.g. consumer perceptions of robots in

different hotel segments; Chan and Tung, 2019), or study robot and consumer interplay in service failure situations (Choi *et al.*, 2020; Leo and Huh, 2020). This theme informs researchers and practitioners on conceptual/situational factors influencing HRSI outcomes that need to be considered when deploying and marketing robotic services.

Towards robotic role theory

A framework of robotic role theory

In response to our first research question, we synthesized the HRSI literature by developing a structure through a role theory lens distilling key information on studying and deploying social robots in service roles in a comprehensive overview for service researchers and practitioners. In line with our second research question, we next discuss the conceptual implications of our findings against the traditional assumptions of role theory in a human-human context (Solomon *et al.*, 1985), and update this longstanding service encounter theory for the age of social robots in service by advancing *robotic role theory*.

To this end, we integrate the insights from the literature under each of the identified HRSI themes with existing knowledge of role theory (i.e. traditional role theory themes) and develop a framework of robotic role theory (see Figure 2). The framework is organized along the two focal actors in HRSI (i.e. robots and consumers), and depicts the elements of role theory that emanated from our analysis as well as the propositions they inform. Arrows indicate how individual framework elements inform each other.

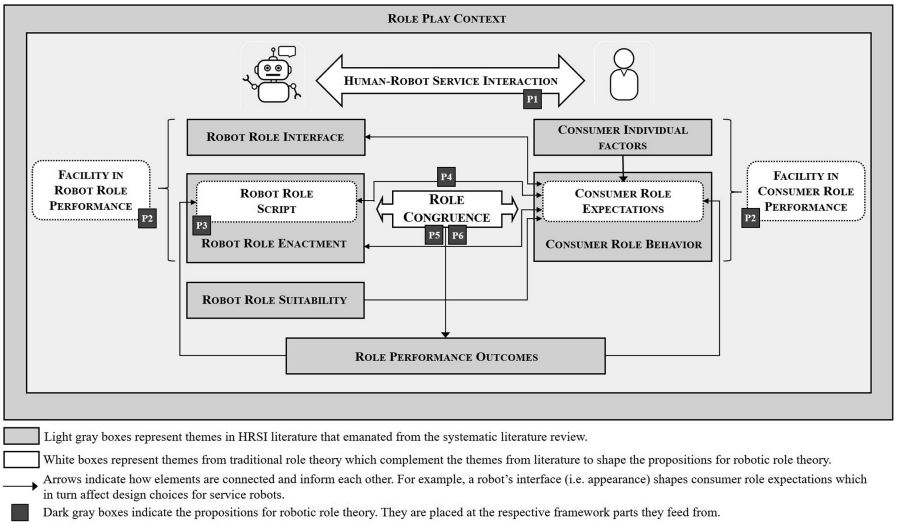
Propositions for robotic role theory

To provide scholars with an updated role theory in the age of social robots, we advance detailed propositions for robotic role theory based on our comprehensive analysis and synthesis of empirical insights from HRSI literature (for a juxtaposition of the original propositions with our robotic role theory propositions please see Online Appendix 4). To move the field forward, we also identify related future research implications. We depict our propositions and future research avenues in Table 2 and discuss each proposition and how it feeds from the identified HRSI themes in detail below.

P1. HRSI can be characterized as role performances. The structure of the interaction is socially defined with associated meanings that guide and direct the behavior of the human interactant and the design of the role interface (i.e. appearance) and role enactment (i.e. role script) of the robotic interactant.

We advance the first proposition by contrasting the role enactment of consumers and robots. While consumers may interpret socially defined norms and their associated meaning in social interactions to define their behavior, a robot's role performance depends upon its role interface (hardware) and role enactment (software) design. Findings in the HRSI literature that focus on consumer role behavior document that consumers perceive robot encounters as social interactions with associated meanings and related role interpretations. For instance, older adults engage in social interactions with domestic service robots similar to human assistants (Wang *et al.*, 2019) and children form social relationships with robots in schools (Oh and Kim, 2010).

Moreover, we identify themes in the literature that investigate how consumers evaluate robot role enactment and interfaces. They inform practitioners on effective programming of robot role behavior and interface design that mirror the underlying associated meaning consumers connect with a role. For instance, robot companions designed to exhibit human-like, social behavior evoke greater likability and acceptance (e.g. Chu *et al.*, 2019), and consumers associate more mind and personality to an anthropomorphized robot in a healthcare role (Broadbent *et al.*, 2013). Possibly, human-like social robots fit the mental



Note(s): All elements that relate to either the robot or consumer as focal actor are represented underneath the respective icon. The individual role play elements are presented in a hierarchical order: Robot role enactment is determined by the role interface (i.e., robot appearance) and its role script (i.e., (programmed) behavior). In turn, the enactment of a service provider role is a prerequisite to evaluate the suitability of a robot taking on such roles. For the consumer, individual characteristic partly shape consumer role expectations which in turn determine consumer role behavior

Figure 2.
A framework of robotic role theory

schemas of caregiving better than machine-like robots, further feeding Proposition 1 (Lee *et al.*, 2005).

Even though we note first attempts in the literature to understand associations (i.e. mental schemas) related to service robots (Broadbent *et al.*, 2011), opportunities abound to further fuel our understanding of how mental schemas related to robotic service roles affect consumer role behavior and what the underlying mechanisms are (e.g. McLeay *et al.*, 2020; Mende *et al.*, 2019). Scholars might investigate what associations for which frontline roles evoke (un)favorable consumer role behavior and how this could be managed through robot design. For example, robot human-like appearance and behavior might feed into warmth associations which might be beneficial in care roles, however, unfavorable in instructional roles (e.g. security guard) where competence associations are crucial for consumers to follow robot orders.

P2. Role behavior/enactment is ritualized, learned, or programmed behavior.

P2a. The content of roles is relatively consistent across actors.

According to Solomon *et al.*, (1985), this proposition implies a high degree of consensus on role content across service actors. As such, it should be possible to define the content of a service actor's role and identify key behavioral elements to feed into role scripts. Since service robots are already programmed successfully to take on professional service roles in areas such as hospitality (e.g. Pan *et al.*, 2015) or education (e.g. Michaelis and Mutlu, 2018), we conclude that this part of the second proposition holds for HRSI. Yet, we urge service researchers to conceptualize context independent key behavioral elements of robotic service provision. For

example, researchers could identify with what speed should different types of service robots approach consumers.

P2b. Facility in human role performance in HRSI is a function of experience, communication, and consumers' role expectations. These role expectations affect role behavior and are a function of consumer individual characteristics, the robotic interface, the robot's role enactment, perceived robot role suitability, and expectations of human service provision. Facility in robot role performance is a function of programming (role scripts), machine learning, appearance, and physical dexterity.

Based on research in the themes of robot role enactment, robot role interface, robot role suitability, and consumer individual factors, we revise the original proposition and add consumer expectations of a robot's role as a third factor of facility in *human* role performance in HRSI. We specify that role expectations are a function of (1) consumer individual characteristics, and their perceptions of a robot's (2) interface, (3) role enactment, and (4) role suitability, and (5) expectations derived from human service interactions. While individual factors (e.g. age, gender, robot affinity/aversion) still seem to have a stronger effect on consumers' adoption intentions than robot appearance (Belanche *et al.*, 2020; Gallimore *et al.*, 2019; Fernández-Llamas *et al.*, 2018; Tussyadiah *et al.*, 2020), robot morphology can significantly affect consumer expectations. For example, it may increase consumers' mind perceptions, positive personality attributions, and service participation (Broadbent *et al.*, 2013; Mann *et al.*, 2015). Furthermore, the role enactment of robots is inextricably linked to consumer expectations which are directly derived from human service interactions (Edwards *et al.*, 2019). As such, if robots take on traditional service roles, they will likely be evaluated by expectations set for human employees, which in turn affects consumer role enactment. Robots meeting consumer expectations facilitates interaction outcomes. For instance, robots have been successfully placed in a promotional sales role (Shiomi *et al.*, 2013).

We define *robot* role performance as a function of programming, machine learning, appearance, and physical dexterity. Hitherto, off-the-shelf robots are not capable of forming individual role expectations or adapting role enactment based on interaction history. Their service scripts are programmed in a static decision tree logic (e.g. Pepper; Softbank, 2021). However, advancements in machine learning will likely soon allow service robots to learn from past interactions and exhibit behavior that is more congruent with prevalent service scripts and related role expectations (e.g. Posh, 2019). For example, whether or not to program robots to respond empathically to service failures impacts perceived robot role performance (Cameron *et al.*, 2021). Beyond software, also hardware components determine facility in robot role enactment. For instance, robot role performance is affected by appearance and physical dexterity which determine its ability to express desired human-like, non-verbal communication (e.g. gestures; Salem *et al.*, 2013) and to perform tasks (e.g. carrying items; Di Nuovo *et al.*, 2018).

Based on the literature forming this proposition, we recommend future research to investigate to what extent consumer role expectations are translated from a human to a robotic service encounter and if additional role expectations from robotic service providers (e.g. leveraging consumer data for instant, personalized, flawless service) are formed. Further, even though we find a large body of literature on robot role behaviors, such as verbal expression or non-verbal behavioral cues (van Pinxteren *et al.*, 2020), there is little evidence of essential role behaviors that service robots *should* display across service contexts. Next to original empirical research, meta-analyses may inform such questions and derive minimal required service robot capabilities.

P2c. Service scripts, containing information about the role set, are learned by human consumers and programmed for robotic service providers.

As outlined above, role enactment and thus, service scripts of current off-the-shelf service robots are programmed in a decision tree logic. We revised Proposition 2c to reflect the

current state-of-the-art, adding the notion that service scripts are programmed and not learned for service robots. However, we also acknowledge current developments in robotics which might soon allow robots to learn from past interactions and form own service scripts. Future research may investigate the appropriateness of generalizable robot-specific service scripts to feed (programmed) service excellence in the future. Moreover, we recommend to study how such service scripts can be effectively developed collaboratively engaging robot designers, service practitioners, and consumers (van den Broek *et al.*, 2020).

P3. Role similarity is a potential basis for classifying robotic services.

This proposition remains unchanged in the HRSI context. Based on our content analysis, we identified that social robots just like human service employees adopt similar roles across service contexts, including information providers in hospitality and healthcare contexts (e.g. concierge; Shin and Jeong, 2020; medical assistant; Mann *et al.*, 2015), and providers of emotional support in service contexts such as education (e.g. Broadbent *et al.*, 2018) and healthcare (e.g. Beran *et al.*, 2013). Thus, the different roles that service robots take on span across a diversity of contexts and serve as a basis for classification. Future research might identify similarities in service roles that robots take on which are unique for robotic compared to human service providers.

P4. Role behaviors are interdependent. The appropriateness of behaviors is determined by others (management, co-workers, consumers, programmers/robot designers) and the service context.

Once a service actor has identified the counterpart's role, role enactment will be adjusted accordingly as behaviors of actors are interdependent. The appropriateness of these role behaviors is determined by others (Solomon *et al.*, 1985). We adapt this fourth proposition by further specifying "others" and add the service context as another relevant factor based on the identified theme in the HRSI literature of role play context. While Solomon *et al.* (1985) include management, co-workers, and consumers, we add programmers/robot designers as relevant stakeholders for determining the appropriateness of role enactment. Following from our second proposition, today's robot role enactment depends upon its designer's choices. Since robot behavior is preprogrammed, the robot designer defines potential service robot's behavioral responses to consumer role behavior which harbors an interpretive element in terms of appropriate behavior. We also add the service context as a determining factor of the appropriateness of behavior in HRSI. For example, robotic service providers should be able to adapt their role enactment in the context of a service failure to ensure adequate behavior (e.g. Cameron *et al.*, 2021). The context is also relevant for highly personal and safety-related services such as elderly care and security provision; domains in which consumers might challenge the use of robots entirely for reasons of ethics or privacy (Gallimore *et al.*, 2019; Smarr *et al.*, 2014; Suwa *et al.*, 2020).

To move the field forward, we recommend investigating how biases and individual differences (e.g. age, gender, and race) of robotic programmers and designers together with biased or unrepresentative training data feeding into algorithmic bias impact service outcomes (Ukanwa and Rust, 2021). For example, Zabel and Otto (2021) have shown gender differences in programming affect user satisfaction with a chatbot. We recommend scholars to investigate if the individual characteristics of robot designers might affect robot programming and with it, role enactment and reactions to consumers. The perception of appropriateness might then differ based on both, individual characteristics of programmers and consumers. We also encourage future research to investigate potential underlying mechanisms that explain the varying perception of appropriateness in HRSI. Moreover, relevant questions remain around the role of the service context in affecting consumers' perceptions of the appropriateness of a robot's role enactment. For instance, service recovery scripts for robotic employees might differ from those of humans, and robots might be

perceived as less appropriate in luxury services. Future research might also study which ethical considerations service organizations should take when introducing robots in their service provision. Furthermore, we find that some highly inter-personal service domains where social robots might effectively take on service roles (e.g. legal services), have received relatively little research attention. Future research could benefit from focusing on domains that received less research attention to expand the broader comparative framework and derive implications on how the service context affects the perceived appropriateness of robot behavior which do not pertain to only a subsection of service contexts.

P5. Congruent role expectations/scripts of consumers and robots facilitate social interaction.

P5a. When consumers and robotic service providers read from a common script (high inter-role congruence), the encounter is more satisfying for the consumer.

According to Solomon *et al.* (1985), service encounter satisfaction is dependent on the congruence of expected and enacted behaviors of the interaction partner. Thus, both parties have a congruent understanding of each other's role and read from a common script. We adapt this premise for the case of HRSI by specifying that reading from a common service script is only relevant for the human satisfaction as robots do not make affective evaluations. However, empirical evidence on the effects of common scripts between robots and consumers is scarce and presents an opportunity for future research.

P5b. When service employees and the organization share common role expectations for robotic service providers, employee role clarity and job satisfaction increase.

Social robots will likely augment human employees as team members in service provision (e.g. Huisman and Kort, 2019) and change employee roles (Mingotto *et al.*, 2021). Based on studies under the themes of consumer role behavior and robot role suitability, we thus revise the original proposition by including the positive effect of shared common role expectations of human and robotic service employees. The former will have a clear understanding of a robot's capabilities, what tasks it can take over, and what part of their own role needs to be emphasized when robots are introduced in practice. Role clarity in turn will positively affect human service employees (Lang *et al.*, 2007).

According to our analysis, most studies adopt a consumer perspective, rather than considering employees' perceptions of robots taking on service and team member roles. We recommend including the perspectives of employees and other stakeholders as robots are continuously embedded into service ecosystems (Subramony *et al.*, 2018). Future research might investigate how robots should be introduced in service to maximize role clarity for employees (e.g. by introducing interaction rules or introductory workshops) and the consumer network (e.g. relatives of elderly in nursing homes). We also recommend to consider how robot aversion or employees' fear of being replaced affect emergence of congruent role expectations of employees and the organization. One promising direction could be researching explainable AI (Rai, 2020) and how social robots might effectively explain their own use to ensure role clarity and thus service encounter success.

P6. Discrepant role expectations/scripts of consumers and robots decrease service efficiency and effectiveness.

As much as role congruence facilitates positive outcomes of joint role play of robots and consumers in a service context, role discrepancy decreases service efficacy. Analog to Proposition 5, Solomon *et al.*'s (1985) original sixth proposition relates to discrepant role expectations of both actors that lead to role discrepancy. However, as established in Proposition 2b, while consumers may form own role expectations which guide their role

enactment, current off-the-shelf service robots' role enactment is affected by implicit role expectations of their human programmers/designers. We thus adapt the proposition for the case of HRSI and pose that discrepant role enactment of robots and consumers decreases service efficiency and effectiveness. We clarify these revisions by advancing the following two sub-propositions.

P6a. When robots enact their role based on role scripts that are at odds with consumer role expectations, the encounter becomes inefficient.

Our analysis shows that robot role enactment that is discrepant to consumer expectations decreases service efficiency. This becomes especially apparent in research that directly compares consumer evaluations of human and robot service. For instance, robot coaches are perceived as less competent and warm than human caregivers, which negatively affects consumers' behavioral engagement intentions (Čaić *et al.*, 2020). Similarly, the interaction quality that guests perceive in hotel settings is higher when they interact with human rather than robot service providers (Choi *et al.*, 2019). These effects might be rooted in violations of traditional consumer role expectations and robot role behavior that deviates from established service scripts.

P6b. When robots enact their role based on role scripts that are at odds with consumer role expectations, the encounter becomes ineffective and may result in service failure (i.e. a human frontline employee must take over).

Finally, particularly based on our review of consumer individual factors and robot role enactment and suitability, we posit that service robots that enact their role based on role expectations that are at odds with consumer role expectations, may cause undesired outcomes and ultimately service failure. For example, Mende *et al.* (2019) report perceptions of greater eeriness and identity threats in response to robots versus human staff, which can cause consumers to engage in status consumption or unhealthy choices. Furthermore, if robots and consumers do not read from a common role script, the encounter may fail as robots are unable to adapt their behavior, while consumers might not be able or willing to adapt their own behavior to trigger an appropriate reaction of the robot. In this case, a human service employee must take over as the encounter runs in a dead end. For instance, a longitudinal field study in an education context highlights four explanations for why robotic tutor interactions break down: (1) the robot's inability to evoke initial engagement and identify misunderstandings, (2) confusing scaffolding, (3) lack of consistency and fairness and (4) controller problems (Serholt, 2018). Thus, a mismatch of robot role design (i.e. role enactment) and consumer expectations may result in role play break down. Scholars still advise service managers to deploy service robots as complements to human employees, and to leave the choice of service provider (human vs. robot) up to consumers (e.g. Mende *et al.*, 2019).

In our analysis of the extant HRSI literature, few studies explicitly address the emergence of service failure and its link to consumer role expectations (but see Belanche *et al.*, 2020; Choi *et al.*, 2020; Leo and Huh, 2020). We thus urge scholars to fill this void and explore how firms can manage consumer role expectations and train them for interactions with robots (e.g. simple and concise language; Pelikan and Broth, 2016) to avoid service failure. Moreover, future research could investigate how service firms and robot designers can collaborate to equip robots with role expectations that are aligned with the firm's service culture and at ease with consumer expectations (i.e. reducing risk for service failure). Since current off-the-shelf service robots have limited capacities and their role performance might suffer from technological glitches, robot service failures will be inevitable in the near future. As research shows, consumers attribute the blame in this case to the firm (Leo and Huh, 2020). We recommend scholars to investigate how service firms can train employees to manage service recovery in case of HRSI failure to mitigate negative effects.

Table 2.
Propositions for robotic role theory and future research avenues

Propositions	Future research avenues
P1. Human–robot service interaction can be characterized as role performances. The structure of the interaction is socially defined with associated meanings that guide and direct the behavior of the *human interactant* and the design of the role interface (i.e. appearance) and role enactment (i.e. role script) of the *robotic interactant.*	• What associations (i.e. mental schemas) do consumers have of different types of social robots in different service roles? • What associations for which frontline roles evoke beneficial or unfavorable consumer role behaviors and how can this be managed through robot design? • What are the underlying psychological mechanisms that evoke consumer associations with robots in HRSI? • How do consumer role expectations translate from human to robotic service encounter? Are there any additional expectations from service robots (e.g. instantly personalized service according to personal preferences based on consumer data or flawlessness)? • What general robot role behaviors (e.g. non-verbal social cues, voice and speech design) are essential for robot role performance and thus generalizable across service contexts? • What are appropriate service scripts for robots and how can they best be collaboratively developed? How can service excellence be "learned" by robots in the future?
P2. Role behavior/enactment is ritualized, learned, or programmed[a] *behavior.* a. The content of roles is relatively consistent across actors. b. Facility in *human role performance* in HRSI is a function of experience, communication, and consumers' role expectations. These role expectations affect role behavior and are a function of consumer individual characteristics, the robotic interface, the robot's role enactment, perceived role suitability, and expectations of human service provision. Facility in *robot role performance* is a function of programming (role scripts), machine learning, appearance, and physical dexterity. c. Service scripts, containing information about the role set, are learned by human consumers and programmed for robotic service providers.	
P3. Role similarity is a potential basis for classifying robotic services. *P4. Role behaviors are interdependent. The appropriateness of behaviors is determined by others (management, co-workers, consumers, programmers/robot designers) and the service context.*	• What are distinct role similarities of service roles that robotic service providers take on? • How do biases and individual differences of programmers/robot designers and unrepresentative training data of algorithms affect service outcomes? • How does a service context with related ethical considerations affect appropriateness of a robot's role enactment? • How should robots be introduced in service networks to ensure role clarity for employees and consumers alike (e.g. by interaction rules or workshops)? • How can robots support the formation of employee role clarity (e.g. by explaining their own use)? • How does robot aversion or fear of being replaced affect the emergence of congruent role expectations of employees and the organization? • How can service firms manage consumer role expectations and consequent behavior to avoid service failure in HRSI? • How can service firm and robot designers collaborate to equip robots with role enactment that is aligned with the service firms' service culture? • How can service firms train employees to manage service recovery in case of service failure during HRSI to mitigate negative effects for the firm?
P5. Congruent role expectations/scripts of consumers and robots[b] *facilitate social interaction.* a. When consumers and robotic service providers read from a common script (high inter-role congruence), the encounter is more satisfying for the consumer. b. When service employees and the organization share common role expectations for robotic service providers, employee role clarity and job satisfaction increase.	
P6. Discrepant role expectations/scripts of consumers and robots[b] *decrease service efficiency and effectiveness.* a. When robots enact their role based on role scripts that are at odds with consumer role expectations, the encounter becomes inefficient. b. When robots enact their role based on role scripts that are at odds with consumer role expectations, the encounter becomes ineffective and may result in service failure (i.e. a human frontline employee must take over).	

Note(s): All propositions are advanced based on Solomon *et al.*'s (1985) original propositions; for a detailed juxtaposition, see Online Appendix 4. [a]Role enactment and thus service scripts of current off-the-shelf service robots are programmed in a decision tree logic. However, advancements in machine learning will likely soon allow service robots to learn from their own past interactions. [b]While consumer role expectations determine their role enactment, robot role expectations and enactment are programmed by robot designers into role scripts

Conclusion

This systematic review synthesizes insights from HRSI studies across disciplines through the lens of role theory. It provides service scholars with a comprehensive overview of the HRSI literature and lays the foundation for service encounter theory in the age of service robots by advancing robotic role theory. Our work also informs managers on how to integrate robots successfully into the service frontline. In so doing, we advance four important contributions.

First, we leverage a qualitative approach to integrate the disparate HRSI literature, identify themes related to role theory, propose a structure of the HRSI literature, and indicate managerial implications for each theme (see Table 1). This organizing framework can also serve to structure and design future HRSI research, and support managers in defining strategies for including social robots in the organizational frontline. A detailed outline of all articles and their corresponding role-theoretical elements is provided in Online Appendix 3. Our work may thus serve service managers and researchers as a reference book on empirical evidence on particular aspects of the joint role play of robots and consumers and its underlying theoretical basis.

Second, we develop a role theory account of HRSI (i.e. robotic role theory) by developing an overarching framework and adapting and extending standing role theoretical propositions from Solomon (cf. Solomon *et al.*, 1985). This theoretical perspective unburdens scholars of treating each interplay of consumers and robots as singular events (Solomon *et al.*, 1985). Moreover, robotic role theory considers the *interplay* of actors in HRSI while other commonly used theoretical bases such as the technology acceptance model (TAM; Davis, 1993) or the computers are social actors paradigm (CASA; Nass *et al.*, 1994) mainly focus on one actor and are hence not ideally suited to explain crucial constructs in the service field, such as value co-creation (Čaić *et al.*, 2018). The resulting theoretical basis considers the idiosyncrasies of robotic service while respecting the interactive elements of service encounters between social actors. Robotic role theory thus might serve as a theoretical foundation for future empirical research on robots taking on service roles.

Third, our comprehensive analysis of the extant literature represents the first systematic, integrative review of empirical HRSI studies across scientific fields from a role theory perspective. Our study thus directly responds to previous calls for assessing the roles and impact of social robots in service provision as well as the theoretical underpinnings of HRSI studies (Lu *et al.*, 2020; Schepers and van der Borgh, 2020). The scattered fields of HRSI benefit from our analysis by gaining an overview of theory bases beyond their own discipline which may serve as a catalyst for future empirical HRSI studies. Hitherto, the wealth of knowledge in different literature streams is often neglected as researchers mostly focus on journal outlets in their respective field (e.g. Subramony *et al.*, 2021). Our integrative approach consolidates the richness of insights on HRSI and also provides a summary of topic-relevant high-quality journal outlets. The latter might serve as a starting point to broaden journal lists of departments conducting work on HRSI and spark transdisciplinary collaboration.

Fourth, despite a large body of HRSI-related literature, a plethora of important, critical questions remain unaddressed. Based on our propositions, we simplify and consolidate knowledge relevant for the service community in order to delineate promising research avenues for HRSI.

References

Ajzen, I. (1991), "The theory of planned behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50 No. 2, pp. 179-211.

Antons, D. and Breidbach, C.F. (2018), "Big data, big insights? Advancing service innovation and design with machine learning", *Journal of Service Research*, Vol. 21 No. 1, pp. 17-39.

Bayern, M. (2020), "How robots are revolutionizing healthcare", available at: https://www.zdnet.com/article/how-robots-are-revolutionizing-healthcare/ (accessed 28 October 2020).

Belanche, D., Casaló, L.V., Flavián, C. and Schepers, J. (2020), "Robots or frontline employees? Exploring customers' attributions of responsibility and stability after service failure or success", *Journal of Service Management*, Vol. 31 No. 2, pp. 267-289.

Beran, T.N., Ramirez-Serrano, A., Vanderkooi, O.G. and Kuhn, S. (2013), "Reducing children's pain and distress towards flu vaccinations: a novel and effective application of humanoid robotics", *Vaccine*, Vol. 31 No. 25, pp. 2772-2777.

Biddle, B.J. (1986), "Recent developments in role theory", *Annual Review of Sociology*, Vol. 12 No. 1, pp. 67-92.

Blaurock, M., Čaić, M., Okan, M. and Henkel, A.P. (2022), "A transdisciplinary review and framework of consumer interactions with embodied social robots: design, delegate, and deploy", *International Journal of Consumer Studies*, doi: 10.1111/ijcs.12808 (forthcoming).

Breazeal, C. (2003), "Toward sociable robots", *Robotics and Autonomous Systems*, Vol. 42 No. 34, pp. 167-175.

Broadbent, E., Lee, Y., Stafford, R.Q., Kuo, I.H. and MacDonald, B.A. (2011), "Mental schemas of robots as more human-like are associated with higher blood pressure and negative emotions in a human-robot interaction", *International Journal of Social Robotics*, Vol. 3 No. 3, pp. 291-297.

Broadbent, E., Kumar, V., Li, X., Sollers, J., Stafford, R.Q., MacDonald, B.A. and Wegner, D.M. (2013), "Robots with display screens: a robot with a more humanlike face display is perceived to have more mind and a better personality", *PloS One*, Vol. 8 No. 8, p. e72589.

Broadbent, E., Feerst, D.A., Lee, S.H., Robinson, H., Albo-Canals, J., Ahn, H.S. and MacDonald, B.A. (2018), "How could companion robots Be useful in rural schools?", *International Journal of Social Robotics*, Vol. 10 No. 3, pp. 295-307.

Čaić, M., Odekerken-Schröder, G. and Mahr, D. (2018), "Service robots: value co-creation and co-destruction in elderly care networks", *Journal of Service Management*, Vol. 29 No. 2, pp. 178-205.

Čaić, M., Mahr, D. and Oderkerken-Schröder, G. (2019), "Value of social robots in services: social cognition perspective", *Journal of Services Marketing*, Vol. 33 No. 4, pp. 463-478.

Čaić, M., Avelino, J., Mahr, D., Odekerken-Schröder, G. and Bernardino, A. (2020), "Robotic versus human coaches for active aging: an automated social presence perspective", *International Journal of Social Robotics*, Vol. 12 No. 4, pp. 867-882.

Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., Massis, A. and Kraus, S. (2019), "Innovation in family firms: a systematic literature review and guidance for future research", *International Journal of Management Reviews*, Vol. 21 No. 3, pp. 317-355.

Cameron, D., Saille, S. de, Collins, E.C., Aitken, J.M., Cheung, H., Chua, A., Loh, E.J. and Law, J. (2021), "The effect of social-cognitive recovery strategies on likability, capability and trust in social robots", *Computers in Human Behavior*, Vol. 114, 106561.

Chan, A.P.H. and Tung, V.W.S. (2019), "Examining the effects of robotic service on brand experience: the moderating role of hotel segment", *Journal of Travel and Tourism Marketing*, Vol. 36 No. 4, pp. 458-468.

Choi, Y., Choi, M., Oh, M. and Kim, S. (2019), "Service robots in hotels: understanding the service quality perceptions of human-robot interaction", *Journal of Hospitality Marketing and Management*, Vol. 29 No. 6, pp. 613-635.

Choi, S., Mattila, A.S. and Bolton, L.E. (2020), "To Err is human(-oid): how do consumers react to robot service failure and recovery?", *Journal of Service Research*, Vol. 24 No. 3, pp. 354-371.

Choi, Y., Oh, M., Choi, M. and Kim, S. (2021), "Exploring the influence of culture on tourist experiences with robots in service delivery environment", *Current Issues in Tourism*, Vol. 24 No. 5, pp. 717-733.

Chu, L., Chen, H.-W., Cheng, P.-Y., Ho, P., Weng, I.-T., Yang, P.-L., Chien, S.-E., Yang, C.-C., Wang, T.-M., Fung, H.H. and Yeh, S.-L. (2019), "Identifying features that enhance older adults' acceptance of robots: a mixed methods study", *Gerontology*, Vol. 65 No. 4, pp. 441-450.

Davis, F.D. (1993), "User acceptance of information technology: system characteristics, user perceptions and behavioral impacts", *International Journal of Man-Machine Studies*, Vol. 38 No. 3, pp. 475-487.

De Keyser, A. and Kunz, W.H. (2022), "Living and working with service robots: a TCCM analysis and considerations for future research", *Journal of Service Management*, Vol. 33 No. 2719, pp. 165-196.

Di Nuovo, A., Broz, F., Wang, N., Belpaeme, T., Cangelosi, A., Jones, R., Esposito, R., Cavallo, F. and Dario, P. (2018), "The multi-modal interface of Robot-Era multi-robot services tailored for the elderly", *Intelligent Service Robotics*, Vol. 11 No. 1, pp. 109-126.

Edwards, A., Edwards, C., Westerman, D. and Spence, P.R. (2019), "Initial expectations, interactions, and beyond with social robots", *Computers in Human Behavior*, Vol. 90, pp. 308-314.

Fernández-Llamas, C., Conde, M.A., Rodríguez-Lera, F.J., Rodríguez-Sedano, F.J. and García, F. (2018), "May I teach you? Students' behavior when lectured by robotic vs human teachers", *Computers in Human Behavior*, Vol. 80 No. 3, pp. 460-469.

Fong, T., Nourbakhsh, I. and Dautenhahn, K. (2003), "A survey of socially interactive robots", *Robotics and Autonomous Systems*, Vol. 42 3 No. 4, pp. 143-166.

Gallimore, D., Lyons, J.B., Vo, T., Mahoney, S. and Wynne, K.T. (2019), "Trusting Robocop: gender-based effects on trust of an autonomous robot", *Frontiers in Psychology*, Vol. 10, p. 482.

Guizzo, E. (2020), "What is a robot?", IEEE.org, New York City, New York, available at: https://robots.ieee.org/learn/what-is-a-robot/ (accessed 17 August 2020).

Henkel, A.P., Boegershausen, J., Rafaeli, A. and Lemmink, J. (2017), "The social dimension of service interactions", *Journal of Service Research*, Vol. 20 No. 2, pp. 120-134.

Henkel, A.P., Čaić, M., Blaurock, M. and Okan, M. (2020), "Robotic transformative service research: deploying social robots for consumer well-being during COVID-19 and beyond", *Journal of Service Management*, Vol. 31 No. 6, pp. 1131-1148.

Hsieh, H.-F. and Shannon, S.E. (2005), "Three approaches to qualitative content analysis", *Qualitative Health Research*, Vol. 15 No. 9, pp. 1277-1288.

Huang, M.-H. and Rust, R.T. (2018), "Artificial intelligence in service", *Journal of Service Research*, Vol. 21 No. 2, pp. 155-172.

Huisman, C. and Kort, H. (2019), "Two-year use of care robot Zora in Dutch nursing homes: an evaluation study", *Healthcare*, Vol. 7 No. 31, pp. 1-15.

Inbar, O. and Meyer, J. (2019), "Politeness counts: perceptions of peacekeeping robots", *IEEE Transactions on Human-Machine Systems*, Vol. 49 No. 3, pp. 232-240.

Jesson, J., Matheson, L. and Lacey, F.M. (2011), *Doing Your Literature Review: Traditional and Systematic Techniques*, Sage, Thousand Oaks, CA.

Johnson, D.O., Cuijpers, R.H., Pollmann, K. and van de Ven, A.A.J. (2016), "Exploring the entertainment value of playing games with a humanoid robot", *International Journal of Social Robotics*, Vol. 8 No. 2, pp. 247-269.

Khaksar, S.M.S., Khosla, R., Chu, M.T. and Shahmehr, F.S. (2016), "Service innovation using social robot to reduce social vulnerability among older people in residential care facilities", *Technological Forecasting and Social Change*, Vol. 113 No. 12, pp. 438-453.

Kiesler, S., Powers, A., Fussell, S.R. and Torrey, C. (2008), "Anthropomorphic interactions with a robot and robot–like agent", *Social Cognition*, Vol. 26 No. 2, pp. 169-181.

Kory Westlund, J.M., Jeong, S., Park, H.W., Ronfard, S., Adhikari, A., Harris, P.L., Desteno, D. and Breazeal, C.L. (2017), "Flat vs expressive storytelling: young children's learning and retention of a social robot's narrative", *Frontiers in Human Neuroscience*, Vol. 11, p. 295.

Lang, J., Thomas, J.L., Bliese, P.D. and Adler, A.B. (2007), "Job demands and job performance: the mediating effect of psychological and physical strain and the moderating effect of role clarity", *Journal of Occupational Health Psychology*, Vol. 12 No. 2, pp. 116-124.

Larivière, B., Bowen, D., Andreassen, T.W., Kunz, W., Sirianni, N.J., Voss, C., Wünderlich, N.V. and Keyser, A.D. (2017), "'Service Encounter 2.0': an investigation into the roles of technology, employees and customers", *Journal of Business Research*, Vol. 79 No. 10, pp. 238-246.

Lee, S., Lau, I.Y., Kiesler, S. and Chiu, C.-Y. (2005), "Human mental models of humanoid robots", *Proceedings of the 2005 IEEE International Conference on Robotics and Automation*, IEEE Operations Center, IEEE, Barcelona, Spain, Piscataway, NJ, pp. 2767-2772.

Lee, N., Kim, J., Kim, E. and Kwon, O. (2017), "The influence of politeness behavior on user compliance with social robots in a healthcare service setting", *International Journal of Social Robotics*, Vol. 9 No. 5, pp. 727-743.

Leo, X. and Huh, Y.E. (2020), "Who gets the blame for service failures? Attribution of responsibility toward robot versus human service providers and service firms", *Computers in Human Behavior*, Vol. 113 No. 12, 106520.

Lu, V.N., Wirtz, J., Kunz, W.H., Paluch, S., Gruber, T., Martins, A. and Patterson, P.G. (2020), "Service robots, customers and service employees: what can we learn from the academic literature and where are the gaps?", *Journal of Service Theory and Practice*, Vol. 30 No. 3, pp. 361-391.

Mann, J.A., MacDonald, B.A., Kuo, I.-H., Li, X. and Broadbent, E. (2015), "People respond better to robots than computer tablets delivering healthcare instructions", *Computers in Human Behavior*, Vol. 43 No. 2, pp. 112-117.

McLeay, F., Osburg, V.S., Yoganathan, V. and Patterson, A. (2020), "Replaced by a robot: service implications in the age of the machine", *Journal of Service Research*, Vol. 24 No. 1, pp. 104-121.

Mead, G.H. (1934), *Mind, Self and Societty*, Vol. 111, University of Chicago Press, Chicago.

Meerbeek, B., Hoonhout, J., Bingley, P. and Terken, J.M. (2008), "The influence of robot personality on perceived and preferred level of user control", *Interaction Studies*, Vol. 9 No. 2, pp. 204-229.

Mende, M., Scott, M.L., van Doorn, J., Grewal, D. and Shanks, I. (2019), "Service robots rising: how humanoid robots influence service experiences and elicit compensatory consumer responses", *Journal of Marketing Research*, Vol. 56 No. 4, pp. 535-556.

Michaelis, J.E. and Mutlu, B. (2018), "Reading socially: transforming the in-home reading experience with a learning-companion robot", *Science Robotics*, Vol. 3 No. 21, eaat5999.

Mills, M. (2018), "There are robots on staff at this San Gabriel hotel", available at: https://www.sgvtribune.com/2018/08/28/there-are-robots-on-staff-at-this-san-gabriel-hotel/ (accessed 28 October 2020).

Mingotto, E., Montaguti, F. and Tamma, M. (2021), "Challenges in re-designing operations and jobs to embody AI and robotics in services. Findings from a case in the hospitality industry", *Electronic Markets*, Vol. 31, pp. 493-510.

Mori, M., MacDorman, K. and Kageki, N. (2012), "The Uncanny valley [from the field]", *IEEE Robotics and Automation Magazine*, Vol. 19 No. 2, pp. 98-100.

Nass, C., Steuer, J. and Tauber, E.R. (1994), "Computers are social actors", in Adelson, B. (Ed.), *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Celebrating Interdependence*, ACM, Boston, MA, New York, NY, pp. 72-78.

Novak, T.P. and Hoffman, D.L. (2019), "Relationship journeys in the internet of things: a new framework for understanding interactions between consumers and smart objects", *Journal of the Academy of Marketing Science*, Vol. 47 No. 2, pp. 216-237.

Oh, K. and Kim, M. (2010), "Social attributes of robotic Products: observations of child-robot interactions in a school environment", *International Journal of Design*, Vol. 4 No. 1, pp. 45-55.

Paauwe, R.A., Hoorn, J.F., Konijn, E.A. and Keyson, D.V. (2015), "Designing robot embodiments for social interaction: affordances Topple realism and Aesthetics", *International Journal of Social Robotics*, Vol. 7 No. 5, pp. 697-708.

Pan, Y., Okada, H., Uchiyama, T. and Suzuki, K. (2015), "On the reaction to robot's speech in a hotel public space", *International Journal of Social Robotics*, Vol. 7 No. 5, pp. 911-920.

Park, M. (2020a), "A.I. robot serves customers at Seoul restaurant", *Reuters Media*. available at: https://www.reuters.com/article/us-health-coronavirus-southkorea-serving-idUSKBN2661KB (accessed 27 June 2021).

Park, S. (2020b), "Multifaceted trust in tourism service robots", *Annals of Tourism Research*, Vol. 81, 102888.

Pelikan, H.R. and Broth, M. (2016), "Why that Nao?", *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pp. 4921-4932.

Pinillos, R., Marcos, S., Feliz, R., Zalama, E. and Gómez-García-Bermejo, J. (2016), "Long-term assessment of a service robot in a hotel environment", *Robotics and Autonomous Systems*, Vol. 79 No. 5, pp. 40-57.

Posh (2019), "Posh - credit union 2.0", available at: https://cu-2.com/credit-union-fintech-company/posh/ (accessed 16 June 2021).

Qiu, H., Li, M., Shu, B. and Bai, B. (2020), "Enhancing hospitality experience with service robots: the mediating role of rapport building", *Journal of Hospitality Marketing and Management*, Vol. 29 No. 3, pp. 247-268.

Rai, A. (2020), "Explainable AI: from black box to glass box", *Journal of the Academy of Marketing Science*, Vol. 48 No. 1, pp. 137-141.

Rainear, A.M., Lachlan, K.A. and Fishlock, J. (2019), "Exploring retention and behavioral intentions when using social robotics to communicate a weather risk", *Computers in Human Behavior*, Vol. 90 No. 1, pp. 372-379.

Salem, M., Eyssel, F., Rohlfing, K., Kopp, S. and Joublin, F. (2013), "To Err is human(-like): effects of robot gesture on perceived anthropomorphism and likability", *International Journal of Social Robotics*, Vol. 5 No. 3, pp. 313-323.

Schepers, J.J.L. and van der Borgh, M. (2020), "A meta-analysis of frontline employees' role behavior and the moderating effects of national culture", *Journal of Service Research*, Vol. 23 No. 3, pp. 255-280.

Serholt, S. (2018), "Breakdowns in children's interactions with a robotic tutor: a longitudinal study", *Computers in Human Behavior*, Vol. 81 No. 4, pp. 250-264.

Shin, H.H. and Jeong, M. (2020), "Guests' perceptions of robot concierge and their adoption intentions", *International Journal of Contemporary Hospitality Management*, Vol. 32 No. 8, pp. 2613-2633.

Shiomi, M., Shinozawa, K., Nakagawa, Y., Miyashita, T., Sakamoto, T., Terakubo, T., Ishiguro, H. and Hagita, N. (2013), "Recommendation effects of a social robot for advertisement-use context in a shopping mall", *International Journal of Social Robotics*, Vol. 5 No. 2, pp. 251-262.

Siddaway, A.P., Wood, A.M. and Hedges, L.V. (2019), "How to do a systematic review: a best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses", *Annual Review of Psychology*, Vol. 70, pp. 747-770.

Smarr, C.-A., Mitzner, T.L., Beer, J.M., Prakash, A., Chen, T.L., Kemp, C.C. and Rogers, W.A. (2014), "Domestic robots for older adults: attitudes, preferences, and potential", *International Journal of Social Robotics*, Vol. 6 No. 2, pp. 229-247.

Softbank (2021), "Building a dialogue tree | SoftBank robotics developer center", available at: https://developer.softbankrobotics.com/pepper-qisdk/lessons/discovering-qichat-sbr-language-creating-chatbots/building-dialogue-tree (accessed 16 June 2021).

Solomon, M.R., Surprenant, C., Czepiel, J.A. and Gutman, E.G. (1985), "A role theory perspective on dyadic interactions: the service encounter", *Journal of Marketing*, Vol. 49 No. 1, pp. 99-111.

Stafford, R.Q., MacDonald, B.A., Li, X. and Broadbent, E. (2014), "Older people's prior robot attitudes influence evaluations of a conversational robot", *International Journal of Social Robotics*, Vol. 6 No. 2, pp. 281-297.

Stock, R. and Merkle, M. (2017), "A service robot acceptance model: user acceptance of humanoid robots during service encounters", *IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)*, pp. 339-344.

Subramony, M., Solnet, D., Groth, M., Yagil, D., Hartley, N., Beomcheol Kim, P. and Golubovskaya, M. (2018), "Service work in 2050: toward a work ecosystems perspective", *Journal of Service Management*, Vol. 29 No. 5, pp. 956-974.

Subramony, M., Groth, M., Hu, X.'. and Wu, Y. (2021), "Four decades of frontline service employee research: an integrative bibliometric review", *Journal of Service Research*, Vol. 24 No. 2, pp. 230-248.

Suwa, S., Tsujimura, M., Kodate, N., Donnelly, S., Kitinoja, H., Hallila, J., Toivonen, M., Ide, H., Bergman-Kärpijoki, C., Takahashi, E., Ishimaru, M., Shimamura, A. and Yu, W. (2020), "Exploring perceptions toward home-care robots for older people in Finland, Ireland, and Japan: a comparative questionnaire study", *Archives of Gerontology and Geriatrics*, Vol. 91, 104178.

Tuisku, O., Pekkarinen, S., Hennala, L. and Melkas, H. (2019), "Robots do not replace a nurse with a beating heart": the publicity around a robotic innovation in elderly care", *Information Technology and People*, Vol. 32 No. 1, pp. 47-67.

Tussyadiah, I.P., Zach, F.J. and Wang, J. (2020), "Do travelers trust intelligent service robots?", *Annals of Tourism Research*, Vol. 81, 102886.

Ukanwa, K. and Rust, R.T. (2021), "Algorithmic bias in service", SSRN Electronic Journal No. 3654943, doi: 10.2139/ssrn.3654943.

van den Broek, E., Sergeeva, A. and Huysman, M. (2020), "Managing data-driven development: an ethnography of developing machine learning for recruitment", *Academy of Management Proceedings*, Vol. 2020, No. 1, 17689.

van Pinxteren, M.M., Pluymaekers, M. and Lemmink, J.G. (2020), "Human-like communication in conversational agents: a literature review and research agenda", *Journal of Service Management*, Vol. 31 No. 2, pp. 203-225.

Venkatesh, V., Morris, M.D., Davis, G.B. and Davis, F.D. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly*, Vol. 27 No. 3, pp. 425-478.

Vlachos, E., Jochum, E. and Demers, L.-P. (2016), "The effects of exposure to different social robots on attitudes toward preferences", *Interaction Studies*, Vol. 17 No. 3, pp. 390-404.

Wang, N., Di Nuovo, A., Cangelosi, A. and Jones, R. (2019), "Temporal patterns in multi-modal social interaction between elderly users and service robot", *Interaction Studies*, Vol. 20 No. 1, pp. 4-24.

Weiner, B. (1982), "An attribution theory of motivation and emotion", *Series in Clinical and Community Psychology: Achievement, Stress, and Anxiety*, pp. 223-245.

Wirtz, J., Patterson, P.G., Kunz, W.H., Gruber, T., Lu, V.N., Paluch, S. and Martins, A. (2018), "Brave new world: service robots in the frontline", *Journal of Service Management*, Vol. 29 No. 5, pp. 907-931.

Xiao, L. and Kumar, V. (2021), "Robotics for customer service: a useful complement or an ultimate substitute?", *Journal of Service Research*, Vol. 24 No. 1, pp. 9-29.

Zabel, S. and Otto, S. (2021), "Bias in, bias out – the similarity-attraction effect between chatbot designers and users", in Kurosu, M. (Ed.), *Human-Computer Interaction. Design and User Experience Case Studies. HCII 2021. Lecture Notes in Computer Science*, Vol. 12764, Springer International Publishing, Basel.

Appendix

The Appendix for this article can be found online.

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