Marketing Science Institute Working Paper Series 2021

Report No. 21-128

Power to the Robots!? How Consumers Respond to Robotic Leaders in Cobotic Service Teams

Ilana Shanks, Maura Scott, Martin Mende, Jenny van Doorn, Dhruv Grewal

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How Consumers Respond to Robotic Leaders in Cobotic Service Teams

Ilana Shanks
Assistant Professor of Marketing
Stonybrook University, Stonybrook, NY 11794

Maura L. Scott **(**Corresponding Author)**
Persis E. Rockwood Professor of Marketing
College of Business, Florida State University, Tallahassee, FL 32306-1110
mlscott@fsu.edu

Martin Mende
Jim Moran Professor of Business Administration
Professor of Marketing
College of Business, Florida State University, Tallahassee, FL 32306-1110
mmende@fsu.edu

Jenny van Doorn
Professor of Marketing
Faculty of Business and Economics, University of Groningen, The Netherlands
j.van.doorn@rug.nl

Dhruv Grewal
Professor of Marketing and Toyota Chair in Commerce and Electronic Business
Babson College, Babson Park, Massachusetts 02457-0310
dgrewal@babson.edu

Grant Acknowledgement:
The authors gratefully acknowledge a Marketing Science Institute Grant, which helped to support this research.

MSI Research Priorities:
This research is closely aligned with MSI Research Priorities (e.g., The Evolving Landscape of Mar-Tech; specifically, Priority 2.3 on the Customer-Technology Interface).

Report Summary

As service robots are an increased presence, we will likely see the emergence of human-robot teams rather than robots that substitute human employees. Further, with technological advances, robots that lead human-robot teams are an increased reality. Humans and robots working in collaborative teams, or cobotics, are used in the manufacturing and military industries. However, it is unclear how consumers will react when cobotic teams are implemented in the services industry.

In an examination of cobotic teams in the medical industry, Ilana Shanks, Martin Mende, Maura Scott, Jenny van Doorn, and Dhruv Grewal examine if the use of a robot (vs. human) led cobotic team results in aversive reactions from consumers. They study the unfavorable response in terms of behavioral intentions to the medical team.

Four studies, including two experiments with live interactions with robots, reveal that consumers report lower behavioral intentions to a robot-led team leader as compared to a human-led team leader. The paper next identifies a boundary condition of the effect, such that decreased behavioral intentions to the robot leader are mitigated in consumers with higher levels of power distance belief. The research next demonstrates that consumers are willing to pay more to upgrade to a human-human team when they first interact with a robot-led cobotic team.

Managerial Implications

Studies suggest that the increased use of technology in healthcare results in financial and well-being benefits for both consumers and companies. Therefore, these findings have important implications for firms considering implementing robot-led cobotic service teams. Companies can segment consumers based on factors that lead to a more favorable response to human-robot teams. For example, firms can segment consumers on cultural backgrounds that emphasize power distance. Firms can also provide consumers with the option of upgrading to a human-human team which will result in increased well-being benefits for the consumer and greater financial returns for the firm.

> "…the fact that robots are getting better and better as employees in some fields probably hints that there is a growing potential for robots to be team leaders in these fields" (Hou and Jung 2018, p. 328).

Even as service robots take on expanding roles (Huang and Rust 2018; Waytz and Norton 2014), they are unlikely to completely substitute for human employees. Instead, robots might work alongside human employees in human–robot or *cobotic service teams* (Peshkin and Colgate 1999), such that the frontline employees and robots collaborate in a co-located space to provide service to customers.

The field of cobotics is concerned with the design and evaluation of robotic systems built to collaborate with humans (Moulières-Seban et al. 2016; Peshkin and Colgate 1999). Early configurations already exist in practice; for example, in the health care sector, U.S. hospitals are testing whether a robot assistant called Moxi can function well as a nurse's aide (Hennes 2019), and the 'Robert robot' is designed to work with medical staff to encourage patients to engage in rehabilitation exercises with patients (Kuka 2019). Moreover, recent technological advances suggest medical robots may function increasingly independent from human control (Walliser et al. 2019): for instance, the Monarch Platform can diagnose lung cancer and might soon be able to perform surgeries on its own (Chafkin 2018). In short, in health care, cobotic service teams are realistic and evolving rapidly.

This growth of cobotics in health care reflects the growing need for medical staff and human resource shortages (Kavilanz 2018). By relying on cobotic teams, providers gain greater capacity to provide medical services and avoid service gaps, as well as achieve better diagnostic accuracy, fewer patient complications, more opportunities for employees to engage in personal conversations with patients, and reduced costs (Marr 2018; Yan 2018). Yet despite these anticipated benefits, consumers often express negative responses to novel technology (e.g.,

Castelo, Bos, and Lehmann 2019; Leung, Paolacci, and Puntoni 2018; Longoni, Bonezzi, and Morewedge 2019), potentially including human–robot teams. Such negative responses might be intense when robots assume collaborative or even superordinate roles in cobotic teams, because such roles give them more power than would be the case if the robotic technology were simply being used as a tool by human service providers. For example, *robots might soon function as physicians* (Edwards, Omilion-Hodges, and Edwards 2017; Hoorn and Winter 2018), which is in line with proposals by roboticists that we need "robots in power" in "situations where human leaders do not do well and robots in higher power roles may be preferred," due to humans' limited cognitive ability to process vast data (Hou and Jung 2018, p. 325).

We seek to address and predict the outcomes for service providers by investigating specifically the role that robots take in cobotic teams. We posit that consumers might be more accepting of cobotic teams in which robots serve in *subordinate* roles (e.g., assisting humans) than those in which robots take on relatively more powerful, *superordinate* roles (e.g., being assisted by humans). Furthermore, we investigate conditions in which consumers might be more favorable toward robots, even in superordinate service roles. By considering the power dynamics in cobotic service encounters, we seek to determine how organizations can offset these negative reactions to cobotic health care teams. We test our hypotheses in four studies, designed to:

> (1) Illuminate the effects of distinct role allocations (i.e., subordinate vs. superordinate) between humans and robots on consumer intentions (e.g., to recommend, re-patronage); and
>
> (2) Examine boundary conditions that help marketers mitigate negative consumer responses to cobotic teams (e.g., leveraging consumers' power distance beliefs).

Our research, with its overarching focus on power dynamics in cobotic service encounters, makes three main contributions to marketing. First, by studying cobotic teams, we address an important but under-researched aspect of service robotics (Hou and Jung 2018); more

broadly, we go beyond traditional human-human team relationships, to be the first to explore the important effects of power and authority in consumer–robot service interactions. Yet, we take this insight further to study how consumers respond to a cobotic team when either the human leads the team as the physician and the robot is the assistant, or vice versa.

Second, our work responds to recent calls for empirical studies "to understand how people will react to an authoritative robot" (Hou and Jung 2018, p. 326). We identify a novel relationship between humans and robots. When consumers encounter a robot (vs. human) physician leading the team, they perceive the robot physician as less powerful than the human physician. This provides novel conceptual and managerial insights that extend research on service robots and, specifically, role allocations between humans and robots, which is a topic of increasing relevance in both marketing and robotics (e.g., Janssen et al. 2019).

Third, to help organizations mitigate unfavorable consumer responses, we examine some actionable boundary conditions that are conceptually linked to power dynamics. In a demonstration of the moderating effect of consumers' power distance beliefs (Zhang, Winterich, and Mittal 2010), we show that unfavorable responses to a robot-led team tend to be mitigated among consumers with stronger (vs. weaker) power distance beliefs, an insight that is valuable for customer segmentation.

In terms of their conceptual relevance, our findings offer new insights about when and why power dynamics between humans and robots may have unintended consequences for consumers and service providers. Regarding their managerial relevance, our findings identify strategies to mitigate consumers' negative reactions to cobotic teams, as well as specify which consumer segments react less negatively to robot-led teams (e.g., those with strong power distance beliefs). Thus, we provide actionable suggestions for how to introduce and use cobotic

teams.

Evolution of Robots from Tools, to Collaborators, to Leaders

Traditionally, marketing literature has conceptualized technology as a tool and studied, for example, how consumers integrate technology into their lives, which motivations lead them to respond favorably to technology (Meuter et al. 2000), when they prefer service interactions with a human or technology (Giebelhausen et al. 2014), and how expertise influences the adoption of technology innovations (Moreau, Lehmann, and Markman 2001). Related developments in the robotics literature seek to determine how humans and robots coexist. In the human–robot interaction (HRI) research domain, which focuses on "understanding, designing, and evaluating robotic systems for use by or with humans" (Goodrich and Schultz 2007, p. 203), studies reveal the relevance of trust in and accountability of robots (Hancock et al. 2011), the roles of support robots (Scholtz et al. 2004), and which task allocations might optimally combine the skills of robots and humans (Tsarouchi, Makris, and Chryssolouris 2016). Here again, HRI studies typically view robots as tools, even though evolving technology allows robots to move beyond subordinate roles, adopt collaborative functions, and work with humans in teams (Bauer, Wollherr, and Buss 2008; Hinds, Roberts, and Jones 2004).

In medicine, humans and robots frequently collaborate on surgical procedures. For example, the da Vinci surgical robot has completed more than 5 million surgeries (Intuitive n.d.). Although the existing robotic systems are currently controlled by physicians, surgical robots are expected to increasingly act independently (Strickland 2016), where this is effective to better combine human and machine intelligence (Panesar 2018).

In short, the evolution of the relationship between robots and humans implies increasingly independent and collaborative robots. This evolution has prompted research on cobotics that mainly focused on manufacturing and military settings and on efficiency goals (Moulières-Seban et al. 2016). Such efficiency considerations are relevant to health care as well (Broadbent, Stafford, and MacDonald 2009). For example, radiology reviews that rely on artificial intelligence (AI) can be completed 62%–97% faster (Kalis, Collier, and Fu 2018). Other evidence affirms that robot-assisted surgical procedures result in five times fewer complications (Marr 2018). These insights highlight the relevance of internal team dynamics for ensuring efficiency (Gombolay et al. 2018; You and Robert 2019), which depend on how tasks and activities get assigned and balanced between humans and robots (Janssen et al. 2019). We use these insights as a foundation for our investigation of role allocations in cobotic teams.

Role Allocations and Consumer Responses to Cobotic Service Teams

From a marketing perspective, the crucial question is whether and how role allocations in cobotic teams affect consumers. To explain how consumers respond when a robot (vs. a human) leads the team, we combine insights into the effects of hierarchical power structures with evidence related to cobotic teams to derive our predictions using a power perspective. *Power* refers to the degree to which a team member can influence the behavior of other team members (Ryan and Sysko 2007). Notably, various technologies already exhibit substantial power. For example, Uber's algorithms govern workers and customers by making decisions about which passengers get assigned to which drivers (Hou and Jung 2018; Wagenknecht et al. 2016). Another timely example is the camera- and speaker-equipped dog-like robot that patrols parks in

Singapore and instructs people how to behave in order to "enforce social distancing" guidelines amidst the COVID-19 pandemic (Inskeep 2020).

These examples of robot power notwithstanding, early findings suggest that "people are generally skeptical about the idea of robots in power" (Hou and Jung 2018, p. 327). We go beyond such physical or operational indicators to investigate the level of power implied by the role a robot takes in a cobotic team. Here, early research indicates that consumers are more comfortable with robots in subordinate roles (assistant, servant) rather than egalitarian roles (friend, mate) (Dautenhahn et al. 2005). In a cross-sectional online survey, Reich-Stiebert and Eyssel (2015) find that respondents are more open to classroom robots that serve as a teacher's assistant rather than as a teacher. More generally, when consumers believe they can control a focal technology, they tend to accept it more readily (Venkatesh 2000); in turn, a perceived loss of control tends to elicit aversive human responses (Cramer et al. 2009; Stein, Liebold, and Ohler 2019). For example, people who watch a video of an autonomous (vs. non-autonomous) robot express more negative attitudes and less willingness to support further research on robots (Złotowski, Yogeeswaran, and Bartneck 2017).

Although this evidence that consumers are less comfortable with robots with more power is insightful, it does not consider cobotic teams, in which power is necessarily a relative concept, reflecting how consumers assess the power of a robot relative to a human. Therefore, we turn to studies that investigate consumer judgments of technology relative to humans providing a similar service. Although such studies do not examine relative power in cobotic teams, they offer some predictive insights about how consumers may evaluate power dynamics in a cobotic team. For example, in a study of how elderly consumers evaluate a robotic exercise coach's warmth and competence, Čaić et al. (2020) find that people evaluate the robot as *less* warm and *less*

competent than a human exercise coach. Consistent with this finding, marketing research on uses of artificial intelligence (AI) reveals that consumers "mistakenly believe that algorithms lack the abilities required to perform subjective tasks" (Castelo, Bos, and Lehmann 2019, p. 809) and thus trust those algorithms less, especially for subjective tasks. Moreover, in a health care setting, Longoni, Bonezzi, and Morewedge (2019, p. 629) show that consumers believe AI is less able than human providers "to account for their unique characteristics and circumstances," so they tend to resist medical AI.

Based on these insights, we anticipate that consumers will evaluate robots and humans differently in cobotic service teams, and we apply that prediction to our considerations of power. Even if a robot (vs. human) takes a superordinate role, such as functioning as the physician in health care service provision (e.g., Edwards, Omilion-Hodges, and Edwards 2017; Hoorn and Winter 2018), consumers might assign a robotic physician relatively *lower levels of power* than they would presume for a human physician, because consumers tend to perceive robots as less capable than humans (Čaić et al. 2020; Longoni, Bonezzi, and Morewedge 2019). If consumers indeed perceive a robot (vs. a human) physician to be less powerful, this would undermine established characteristics of how patients typically view physicians and their assistants. Accordingly, we expect robot-led (vs. human-led) teams to cause negative downstream effects; we focus on consumers' behavioral intentions.

We expect negative downstream effects on consumers' *behavioral intentions*. Prior work shows that differences in consumer evaluations of AI (vs. humans) affect downstream responses, such as their willingness to use or pay for AI-provided services (Longoni, Bonezzi, and Morewedge 2019). Similarly, these evaluations could make health care consumers less likely to share positive word-of-mouth (WOM) or re-patronize services in which a robot serves as the

physician. Consumers are less likely to select a human doctor who appears powerless (Goodyear-Smith and Buetow 2001), and we expect this effect to spread to robot physicians, too. Thus, we expect that adverse reactions to robot physicians (vs. human physicians) undermines their downstream behavioral intentions (e.g., re-patronage, WOM intentions).

We thus derive a hypothesis to predict how consumers respond to cobotic teams in which the robot serves in either a *subordinate* role (assists a human physician) or a *superordinate* role (robot physician is assisted by a human). We expect that these role allocations affect critical consumer behavioral intentions (WOM and re-patronage) (van Doorn et al. 2010; Zeithaml, Berry, and Parasuraman 1996). Formally:

H_1: Consumers report less favorable behavioral intentions (re-patronage, WOM) when a robot (vs. human) physician leads the cobotic service team.

Overview of Studies

Drawing on research in robotics (e.g., Bauer, Wollherr, and Buss 2008), we study cobotic service teams that include a human and a robot, collaborating in a co-located space, to serve a customer. Robots can be defined in multiple ways, but in line with current real-world examples (e.g., the Nao robot), we study embodied, humanoid robots; that is, devices housed in mobile, human-like bodies, which operate on the basis of powerful software that enables them to perform in a rational, seemingly human way (Broadbent, Stafford, and MacDonald 2009; Duffy 2003).

Among our four experiments, we conduct two live, in-person interactions in which participants come face-to-face with a cobotic service team. In the Pilot Study, a field experiment conducted in an elder care facility, we affirm that consumers rate a cobotic team less favorably than a human provider alone. Study 1 similarly demonstrates that consumers, who encounter an actual cobotic team providing health care services, report less favorable behavioral intentions

when the doctor is a robot (and the assistant is human) as compared to when the doctor is a human (and the assistant is a robot).

Study 2 considers the moderating role of consumers' power distance beliefs. Consumers with weaker power distance beliefs express lower behavioral intentions toward a robot-led (vs. human-led) team; however, those with stronger power distance beliefs tend to think they should follow the directions of any entity in a position of power (i.e., human or robot), so their behavioral intentions do *not* vary with the leader.

Next, with Study 3 we examine whether consumer power might influence these negative responses to robot-led cobotic teams, such as when consumers possess the power to "upgrade" from a cobotic to a human team. Study 3 demonstrates that, when the robot is the physician, consumers have greater interest and are willing to pay more to upgrade to a human-human team.

Pilot Study: Exploratory Field Study of a Human–Robot Team in Elder Care

We surveyed actual patients at an elder care institution during the introduction of a health care robot to assist during their weekly physical exercise sessions. This Nao robot, named Zora, was programmed explicitly to function in health and elder care institutions, to provide occupational and physical therapy alongside human caregivers. The robot can perform physical exercises, play games, and dance to music. The robot is used alongside human care providers in human–robot medical teams. It performs the actual exercises, while the human provider completes other aspects of the session and helps patients if needed.

Method

Data were collected from participants in weekly physical exercise classes in an elder care facility. Participation in the class is voluntary. We surveyed patients who were, according to care

facility records and the judgment of the human physical therapist, mentally competent and capable of participating. The data were collected in two waves. All patients were female. In wave 1, a human physical therapist conducted the exercise class with 15 patients, and in wave 2, the robot Zora conducted the exercise class together with the same human physical therapist for 16 patients. Zora showed the participants which exercises they should perform, using movements and spoken instructions. The human physical therapist performed the exercises alongside the robot and helped participants when needed (e.g., giving extra encouragement, clarifying the exercises). Thirteen patients participated in both waves of the survey (M_{Age} = 83.62 years) and constitute our sample.

We administered the questionnaire immediately after the class, prompting participants to indicate the extent to which they were favorable toward the exercise class and their behavioral response. Participants indicated their favorability toward the exercise class (1 = "I hated/disliked it" to 5 = "I enjoyed/liked it"; 1 = "I found it unpleasurable/harmful to my physical health/ineffective" to 5 = "I found it pleasurable/useful for my physical health/effective"; α_{Human} = .68, α_{Team} = .91; Čaić et al. 2020). Respondents next indicated their behavioral responses ("I will recommend this physical exercise class to other residents," "I will say positive things about this physical exercise class," "I complied with the instructions," "I followed the instructions," and "I carefully carried out the instructions given by the trainer"; α_{Human} = .76, α_{Team} = .96, Kashyap, Antia, and Frazier 2012; Zeithaml, Berry, and Parasuraman 1996).

Results

A series of paired tests revealed diminished favorability when the exercise class was led by a human–robot team rather than a human alone. Specifically, participants evaluated the physical exercise class less favorably (M_{Team} = 3.41, M_{Human} = 4.46; $F(1, 12) = 16.08$, $p < .01$, η^2

= .57) when it was led by a human–robot team. Another series of paired tests also revealed lower behavioral responses to exercise classes conducted by the cobotic team (M_{Team} = 3.63, M_{Human} = 4.37; $F(1, 12) = 5.42$, $p = .04$, $\eta^2 = .31$).

Discussion

This initial field experiment highlights that patients viewed the robot-led cobotic team less favorably than a human service provider and expressed diminished behavioral responses to that cobotic team. However, in the field study setting of an elder care facility, we were not able to test all our predictions about distinct role allocations. That is, this Pilot Study provides initial insights into how actual patients assess a cobotic team, relative to traditional services provided by human employees. But with Study 1, we test in more detail our predictions about whether robot-led (vs. human-led) cobotic teams are perceived differently.

Study 1: Live Encounter with a Robot–Human Team

Using in-person encounters with a cobotic team, we examine how consumers respond to such a team, as a function of whether the robot or the human leads it (H_1).

Method

Business undergraduate students (N = 97, M_{Age} = 20.78 years, 44 women) participated in this between-subjects study, which varied the team leader (doctor) as either a human or a robot. We alternated the identity of the team leader across sessions and ensured balanced cell sizes for the two conditions. During each session, the participants received a live, in-person nutritional counseling session from a human–robot team, with either the robot or the human as the doctor and the other as the assistant. Images of the in-person team are shown in Appendix. The nutrition information was obtained from the USDA website and outlined the importance of maintaining

proper nutrition. During each session, the doctor asked the assistant to perform two tasks, verifying nutrition information and confirming that brochures were organized, which the assistant completed. After the counseling session, the robot and human service providers exited the room, and participants then indicated their behavioral intentions (e.g., "I would recommend this doctor to my friends," "I would visit this doctor again"; adapted from Zeithaml, Berry, and Parasuraman 1996) and power relative to the assistant (e.g., "To what extent does the team leader have more power than the assistant?"; Lammers et al. 2016). Finally, participants completed a manipulation check (e.g., "To what extent do you believe that the doctor is machine-like?") and provided demographics.

Results

Manipulation check. In an analysis of variance (ANOVA) of the manipulation check, we find a significant main effect of doctor type ($M_{HumanDoctor} = 4.04$, $M_{RobotDoctor} = 5.99$; $F(1, 95) = 36.05$, $p < .001$), indicating that participants regarded the robot doctor as significantly more machine-like.

Main effects. ANOVA for behavioral intentions revealed a significant main effect of doctor type ($M_{HumanDoctor} = 4.39$, $M_{RobotDoctor} = 2.60$; $F(1, 95) = 30.22$, $p < .001$, $\eta^2 = .24$), which indicates support of H_1.

With ANOVAs, we find that when participants encounter a robotic (vs. human) doctor, they perceive this team leader as having power relative to the assistant ($M_{HumanDoctor} = 5.54$, $M_{RobotDoctor} = 4.50$; $F(1, 95) = 10.37$, $p = .002$, $\eta^2 = .10$).

Discussion

In a live cobotic team encounter, Study 1 provides support for H_1, because a robot-led (vs. human-led) cobotic team leads to diminished behavioral intentions. The converging

evidence across studies is consistent with the notion that power is a foundational factor in the physician–patient relationship (Goodyear-Smith and Buetow 2001). When a consumer encounters a cobotic health care team, multiple power dynamics are at work. For example, a physician's tenure (Graber, Pierre, and Charlton 2003; Passaperuma et al. 2008), gender (Burgoon, Birk, and Hall 1991; West 1984), and race (Laveist and Nuru-Jeter 2002) can alter how patients respond, such that when doctors seem to have less power, they evoke higher levels of anxiety in patients and lower adherence to medical treatment plans (Goodyear-Smith and Buetow 2001; Playle and Keeley 1998). Our studies confirm these effects in cobotic settings: When we vary whether the robot or the human serves as the physician (vs. the assistant), we demonstrate that people perceive a robotic physician as having less power and also report lower levels of behavioral intentions.

Study 2: The Moderating Role of Consumers' Power Distance Beliefs

Firms also would prefer to prevent negative consumer reactions, which they might do by targeting consumer segments that are less likely to react negatively to robot-led teams. In Study 2, we thus examine consumers' acceptance of cobotic teams depending on their views on power distance. Consumers vary in their power distance beliefs (PDB), or the degree to which they believe that instructions issued by entities in positions of power should be followed, with little questioning or a need for justification (Lalwani and Forcum 2016); that is, they differ in how they interpret and accept disparities in power (Zhang, Winterich, and Mittal 2010). Consumers with *lower* levels of PDB feel free to express different opinions, even if they might entail non-compliance with an authority figure (Hofstede 2001; Zhang, Winterich, and Mittal 2010). In contrast, consumers with *higher* levels of PDB believe that people should avoid behaviors that

deviate from the norm and tend to be more susceptible to social influences, relying on information provided by social hierarchies. When interacting with a cobotic team, consumers with higher PDB might be more likely to accept a hierarchal system and adhere to recommendations from the medical provider that leads the team, regardless of its type. In turn, we expect these consumers to be less affected by a robot in a leadership role. Among consumers with higher PDB, any diminished behavioral intentions in response to a robot-led (vs. human-led) team thus should be attenuated by their belief that instructions from an entity in a position of power should be followed, regardless of whether the leader is a robot or a human.

H_2: Power distance beliefs moderate consumer responses to a cobotic team, such that lower behavioral intentions in response to a team led by a robot (vs. human) physician are mitigated by high levels of PDB.

Method

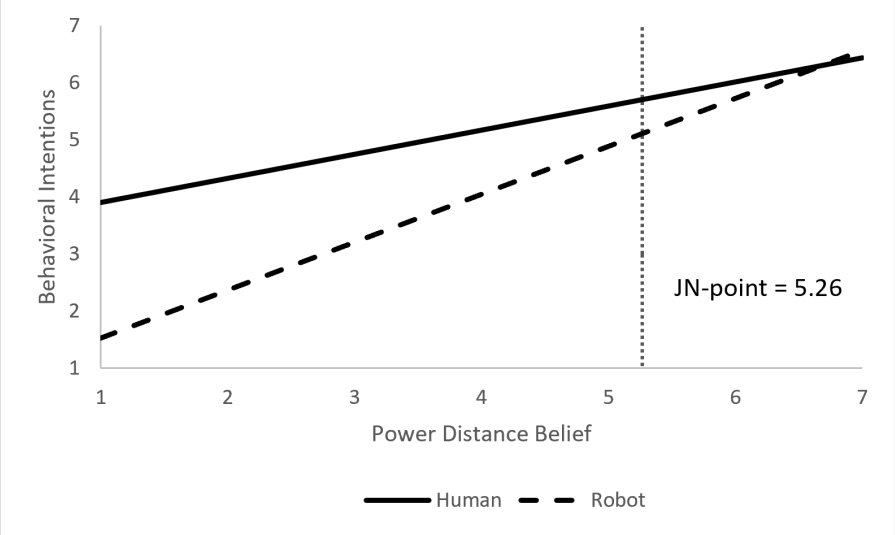
Online MTurk members (requested N = 200, received N = 201, M_{Age} = 34.80, 96 women) were randomly assigned to a 2 (team leader (i.e., doctor): human, robot) between-subjects × (measured: power distance belief) design. We measured PDB with ten items (e.g., "People in lower positions should not disagree with decisions made by people in higher positions," "People in higher positions should avoid social interactions with people in lower positions," α = .91, adopted from Han, Lalwani, and Duhachek 2017). The manipulation of the lead doctor used a video. Participants had to imagine visiting a doctor for a routine physical examination; they watched a video of a human–robot medical team, in which either the human or the robot served as the physician, while the other functioned as the assistant. An introduction indicated this role, and in each video, the robot or human in the physician role stated that the other entity (human or robot) would "assist me in the medical procedures we are doing today and will take some health

measurements." Participants answered questions about their behavioral intentions, the manipulation check, and demographic questions.

Results

In the analysis focused on behavioral intentions, we find a significant doctor × PDB interaction ($F(1, 197) = 7.23$, $p = .008$, $\eta^2 = .04$). The main effects of both doctor type ($M_{HumanDoctor} = 5.09$, $M_{RobotDoctor} = 4.01$; $F(1, 197) = 19.17$, $p < .001$, $\eta^2 = .09$) and PDB ($M_{LowPDB(-1SD)} = 3.68$, $M_{HighPDB(+1SD)} = 5.38$; $F(1, 197) = 65.73$, $p < .001$, $\eta^2 = .25$) are also significant. A floodlight analysis (Figure 1) (Spiller et al. 2013) displays a significant effect of doctor type on behavioral intentions when PDB values are below 5.26 ($B_{JN} = -.59$, SE = .30, $p = .05$), the effect is non-significant for those with higher PDB ratings in line with H_2.

Figure 1. Spotlight Analyses for Study 2



Discussion

Study 2 provides further evidence of diminished behavioral intentions toward a cobotic team when the robot (vs. the human) serves as the physician, as we predict in H_1. However, it

also establishes an important boundary condition: Consumers with lower PDB levels express lower behavioral intentions toward a robot doctor, but this effect is attenuated for consumers with higher PDB levels. This finding is not only interesting conceptually but also relevant managerially, in that organizations can measure their customers' PDB (e.g., as part of routine market research). Thus, firms can identify consumer segments that are less likely to react negatively to robot-led teams, due to their high levels of power distance beliefs.

Study 3: Consumer Power and the Choice to Opt Out

In Study 3 we examine the effects of consumers' choice to pay a premium to upgrade to a human–human team (i.e., by paying a premium, they gain the power to move from a cobotic to a human–human team). We expect that participants will express greater interest in upgrading and greater willingness to pay to do so when the robot is the physician, rather than when a human is the physician.

Method

Online members from MTurk (requested N = 120, received N = 121, M_{Age} = 35.02 years, 68 women) were randomly assigned to a 2 (team leader (i.e., doctor): human, robot) between-subjects design. The description of visiting a medical office for a routine physical examination included the information that the medical office includes robots in its medical team. Participants saw a picture of a cobotic team, in which the robot was either the physician or assistant, then they were told that they could upgrade their robot doctor/assistant to a human. They next indicated how interested they would be in moving to a human assistant/doctor (1 = "not at all interested," 7 = "very interested") and how much they would pay ("How much of a premium, as a percent increase on your total bill, would you be willing to pay for a human assistant/doctor?"

on a sliding scale from 0–100%). Participants then could choose a human–robot team or a human–human team. They also provided demographic information.

Results

A significantly greater proportion of participants chose to upgrade to a human–human team when the base offer included a robot as the physician rather than as the assistant (77.42% vs. 54.24%; z = 2.69, $p = .008$). Furthermore, when the robot was the physician, significantly more participants chose to upgrade their medical team rather than retaining the standard team (upgrade = 77.42%, standard = 22.58%; Wald $\chi^2 = 16.46$, $p < .001$). When the robot was the assistant, participants did not exhibit any differences in their choice of a standard or upgraded team (upgrade = 54.24%, standard = 45.76%; Wald $\chi^2 = .42$, $p = .52$).

In addition, an ANOVA revealed that participants were more interested in moving to a human–human team when the initial team had a robot in the role of a physician ($M_{RobotDoctor} = 5.48$, $M_{HumanDoctor} = 3.86$; $F(1, 119) = 21.14$, $p < .001$, $\eta^2 = .15$). They also indicated, according to another ANOVA, a higher willingness to pay for an upgraded medical team when the robot was the physician ($M_{RobotDoctor} = 30.35$, $M_{HumanDoctor} = 15.19$; $F(1, 119) = 14.39$, $p < .001$, $\eta^2 = .11$).

Discussion

With Study 3 we test the effect of providing consumers with the power to opt out of using a cobotic team. The results show that when the robot functions as the physician (vs. the assistant), consumers are more likely to exert their power and disengage from a cobotic team. Indeed, participants are 2.89 times as likely to upgrade to a human–human medical team when the robot is the physician. Notably, consumers also are willing to pay more to exert this power.

General Discussion

Four studies examine how consumers respond to cobotic service teams led by a robot (vs. a human) in health care settings. The findings contribute to understanding of how and why consumers respond to cobotic teams, with implications for marketing scholars and managers.

Theoretical Insights and Implications

Behavioral intentions toward cobotic service teams. Research on how consumers perceive and respond to sophisticated technology is a dynamic area, revealing both that consumers appreciate such technology (Logg, Minson, and Moore 2019) but also that they might have concerns and respond negatively to advanced technology, especially in service settings (e.g., Castelo, Bos, and Lehmann 2019; Dietvorst, Simmons, and Massey 2015; Leung, Paolacci, and Puntoni 2018; Mende et al. 2019, Wirtz et al. 2018). Expanding this line of research, we show that consumers respond negatively, in terms of WOM and re-patronage intentions, to the inclusion of robots in service teams, especially when robots are assigned a leading role. Thus, cobotic service teams may be a double-edged sword: On the one hand, they can increase efficiencies and decrease the burdens on human staff (Kruger, Lien, and Verl 2009), but on the other hand, cobotic teams might decrease customer behavioral intentions.

Decreased ratings of power. A robot (vs. a human) that leads a cobotic team is evaluated as having less power. Power is an integral feature of teams, and a member in a superordinate role inherently gains legitimate power. Conceptually then, a robot leading the cobotic team has legitimate power over its subordinates. However, an open question is whether humans recognize and accept power in robots in the same way they do for humans (e.g., Hou and Jung 2018). Some prior work indicates that consumers disregard information provided by algorithms and follow information from humans, even if it might be less accurate (Dietvorst, Simmons, and Massey 2015). Indeed, we find that consumers rate a robot (vs. human) leader of a cobotic team lower in

power. That is, our findings suggest that humans do *not* recognize power in robots by mere virtue of their hierarchical leadership position.

Moderating effects. We show that a consumer's (high, not low) power distance beliefs attenuates a decrease in behavioral intentions toward a robot-led team. Notably, a consumer's (high, not low) power distance beliefs have a similar mitigating effect.

Managerial Implications

Cobotic service teams might offer benefits to consumers and service firms. Robots can operate in conditions dangerous to humans, potentially protecting the well-being of human staff and consumers. For example, during the COVID-19 pandemic, robots are used to dispense medicine to patients, reducing human health care workers' exposure to the virus (Dujmovic 2020; Matthews 2020). Moreover, an ongoing concern for medical professionals is a lack of patient adherence to medical treatment plans (Atreja, Bellam, and Levy 2005; Martin et al. 2005). Solutions proposed by the medical industry, such as increased physician–patient communication (Atreja, Bellam, and Levy 2005; Martin et al. 2005), tend to require additional time, contacts, and communication between the patient and medical provider. Using cobotic teams might give human medical providers more time to engage in such conversations. Although cobotic teams have advantages, a first managerial insight from our work is an understanding why they can backfire (i.e., robot-led cobotic teams undermine consumer behavioral intentions). Therefore, companies need managerial interventions to introduce and promote cobotic teams in the marketplace effectively. This research provides marketing managers with insights into how to effectively leverage both a consumer's and a robot's power when introducing cobotic teams. Consumers with higher power distance beliefs also do not react aversively to a robot-led team, so health care organizations might screen their patients to identify them (e.g., using a short survey

in patient forms). Service firms can further segment consumers based on cultural backgrounds that emphasize power distance (Hofstede 2001). In addition, consumers who can choose between a human–robot team and a human–human team are likely to upgrade and pay a premium for a human–human team, with benefits for both consumers and service organizations. Consumers enjoy increased well-being and intend to return to the doctor; firms can anticipate increased revenue from consumers who are willing to pay to upgrade to human-human teams.

Further Research

Our studies point to multiple streams of future research, related to evolving theories on social perception of machines, human-machine teams, and the socially superior (or inferior) roles of robotic service providers. First, it is likely that customers will increasingly encounter cobotic service teams, and over time or in different service contexts, the presence of robots might evoke less anxiety. Studies show that ratings of stress of working with industrial robots decrease over time (Buchner et al. 2012). It is important to examine whether the same is true as consumers encounter cobotic teams with greater frequency. Thus, though we consider several service settings (elder care, routine medical exam, nutritional advice), investigating other domains, beyond health care, would be helpful. Even within the health care contexts that we study, further considerations are needed. For example, we focus on consumers' perceptions of the team-leading physician (robot or human), but additional studies might consider how they perceive the assistant, the overall team, or the organization that relies on such teams (e.g., the hospital).

Second, our tests of the hypotheses involve consumers who are aware they are being served by a cobotic team; however, in some cases, they might learn about the cobotic team structure later (e.g., after the completion of a medical procedure or surgery). In an exploratory study, we find that consumers experience greater anxiety and rate the team leader less favorably

when the cobotic team is led by a robot (vs. a human), *regardless* of when they learn about these roles. Perhaps not surprisingly, consumers also express a sense of betrayal when they learn of the cobotic team after (vs. before) a procedure, though betrayal does not mediate the findings of this preliminary model. Additional research could delve into other potential moderators of this effect, such as the risk level of the procedure.

Third, as an alternative path for future research, we also recognize a perspective that examines the extent to which humans perceive robots as social actors (Dautenhahn 1999, 2003) and, therefore, judge robots along social perception dimensions, such as those that humans use to assess other humans (van Doorn et al. 2017).

A final question relates to our finding that consumers are willing to pay (more) to be served by a human (vs. cobotic) team. From a managerial perspective, it is attractive to be able to offer consumers the option to pay a premium for a human–human medical team. Yet we note the ethical complexities related to this approach, similar to how prior work has highlighted linkages between emerging technologies and their potential impact on vulnerable consumer segments (e.g., Hoffman, Novak, and Schlosser 2000). We encourage further marketing research to examine this and related ethical questions for cobotic service teams.

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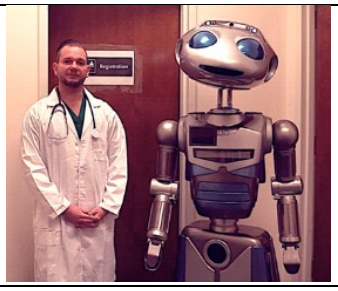
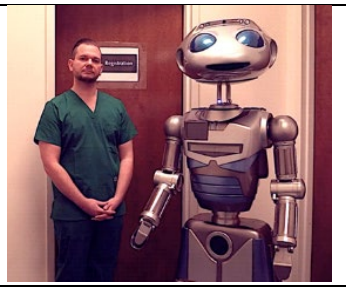
APPENDIX
VIDEO SCREEN CAPTURES AND PHOTOS OF THE STIMULI USED IN STUDIES

Study 1		**Study 2**	
Human-Led Team	Robot-Led Team	Human-Led Team	Robot-Led Team
			

Study 3

Human-Led Standard Team	Robot-Led Standard Team	Upgraded Human-Led Team	Upgraded Robot-Led Team