Article

AMERICAN MARKETING ASSOCIATION

Journal of Marketing Research
2019, Vol. 56(4) 535-556

DOI: 10.1177/0022243718822827
journals.sagepub.com/home/mrj
SAGE

Service Robots Rising: How Humanoid Robots Influence Service Experiences and Elicit Compensatory Consumer Responses

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

Abstract

Interactions between consumers and humanoid service robots (HSRs; i.e., robots with a human-like morphology such as a face, arms, and legs) will soon be part of routine marketplace experiences. It is unclear, however, whether these humanoid robots (compared with human employees) will trigger positive or negative consequences for consumers and companies. Seven experimental studies reveal that consumers display compensatory responses when they interact with an HSR rather than a human employee (e.g., they favor purchasing status goods, seek social affiliation, and order and eat more food). The authors investigate the underlying process driving these effects, and they find that HSRs elicit greater consumer discomfort (i.e., eeriness and a threat to human identity), which in turn results in the enhancement of compensatory consumption. Moreover, this research identifies boundary conditions of the effects such that the compensatory responses that HSRs elicit are (1) mitigated when consumer-perceived social belongingness is high, (2) attenuated when food is perceived as more healthful, and (3) buffered when the robot is machinized (rather than anthropomorphized).

Keywords

anthropomorphism, compensatory consumption, robots, service, technology

Online supplement: https://doi.org/10.1177/0022243718822827

Humanoid service robots are an emerging reality that will increasingly replace human service providers in numerous industries (Harris, Kimson, and Schwedel 2018). Accordingly, customer–humanoid encounters in the marketplace are not as futuristic as they might seem, and they represent a primary area for innovation in services and shopper marketing (Murphy, Hofacker, and Gretzel 2017; Van Doorn et al. 2017). Although technology continuously influences customer service experiences (e.g., Giebelhausen et al. 2014; Huang and Rust 2013; Meuter et al. 2005), the emergence of humanoid robots is among the most dramatic evolutions in the service realm, and it is already under way (see Table 1).

For example, more than 10,000 humanoid "Pepper" robots have been sold worldwide since their launch in 2014, representing sales and related services of $140 million (Tobe 2016). Pepper helps sell coffee machines at 1,000 Nescafé stores in Japan (Nestlé 2014) and has worked as a waiter at Pizza Hut in Asia (Curtis 2016) and in a restaurant at the Oakland International Airport, taking orders and interacting with customers (e.g., offering food recommendations; Heater 2017a).

The emergence of humanoid service robots (HSRs) reflects mantras in the business press about how companies can stay competitive by engaging customers through technology. For example, *Bloomberg* (2017) suggests that humanoid robots allow companies to create positive buzz because they are "easy to relate to thanks to their human-like mannerisms and emotions." In other words, HSRs critically differ from traditional self-service technologies (which are beyond the scope of this article) in that they can more meaningfully engage consumers on a social level (Van Doorn et al. 2017). However,

Martin Mende is Associate Professor of Marketing, College of Business, Florida State University, USA (email: mmende@business.fsu.edu). Maura L. Scott is Madeline Duncan Rolland Associate Professor of Business Administration, College of Business, Florida State University, USA (email: mlscott@business.fsu.edu). Jenny van Doorn is Associate Professor of Marketing at the Faculty of Business and Economics, University of Groningen, the Netherlands (email: j.van.doorn@rug.nl). Dhruv Grewal is Toyota Chair of Commerce and Electronic Business and Professor of Marketing, Marketing Division, Babson College, USA (email: dgrewal@babson.edu). Ilana Shanks is a doctoral candidate in Marketing, College of Business, Florida State University, USA (email: is15@my.fsu.edu).

Table 1. Use of Robots in the Marketplace.

Industry	Example	Scope and Investment	Companies Using the Technology	Robot Type	Source
Food Services / Restaurants	"Pepper" waiter taking orders and processing payments		Pizza Hut and Mastercard	Humanoid	Curtis (2016); Heater (2016)
	Robot waiter	Seven restaurants in China	Different restaurants	Humanoid	Nguyen (2016); Victor (2014)
	"DRU" pizza delivery robot	$17.2 million by Starship Technologies; will roll out in all 12,500 Domino's stores	Domino's	Nonhumanoid	Kahn (2017); Taylor (2016)
	Delivery robot that cooks pizza while driving	$48 million > 1,000 human employees in 2018	Zume Pizza	Nonhumanoid	Heater (2017b)
	Robot barista	$5 million	Café X Technologies	Nonhumanoid	Pierce (2017); Swartz (2017)
	Bionic bar	$2.2 million	Royal Caribbean	Nonhumanoid	Osborne (2015)
Retail	"Pepper" providing customer service for coffee machines	1,000 Nescafé stores	Nestlé	Humanoid	Nestlé (2014)
	LoweBot, OSHBot		Lowe's	Humanoid	Lowe's (2016)
	Greeter in shopping mall	2,000 SoftBank shops	SoftBank stores, Mitsukoshi department store, Carrefour	Humanoid	Carrefour (2017); Hu (2015)
	Hologram robot		Microsoft	Humanoid	Microsoft (2016)
Hospitality / Travel	Cupertino – robotic butler	$2 million	Aloft	Nonhumanoid	Robinson (2016); Solomon (2014)
	"Pepper" providing customer service in train stations and airports	Three train stations in France, Oakland airport	SNCF	Humanoid	Heater (2017a)
	Hotel staff		Henn-na Hotel, Hilton	Humanoid	Davis (2016); Rajesh (2015)
	Flight attendant			Humanoid	Kolodny (2016)
Health Care	Companion robot	Used at more than 80 institutions in United States	Hospitals and other health care facilities	Zoomorphic	www.parorobots.com/users.asp
	"Zora" bot for health and elderly care	Over 400 sold, worth $7 million	Hospitals and other health care facilities	Humanoid	Ulu (2017)
	daVinci surgical system	$6.1 million	Cincinnati VA Medical Center	Nonhumanoid	Monk and McKee (2016)
	Rehabilitation robots	$1 billion	Toyota	Nonhumanoid	Tajitsu (2017)
	Hospital sanitizers	$2 million	University of Michigan	Nonhumanoid	Holley (2017)

Table 2. Literature Review of Robots in Service Settings.

Source	Method and Participants	Robot Type	Findings
Dining Services			
Foster, Gaschler, and Giuliani (2017)	Experiment, employees	Nonhumanoid	Presents software strategies that allow a robot bartender to estimate the social states of humans in dynamic environments.
Hospitality / Travel			
Pan et al. (2015)	Field experiment, hotel guests	Humanoid	Direct verbal interaction with hotel guests (e.g., greeting or asking if any help is needed) works better for hotel assistive robots than if the robot recites information.
Pinillos et al. (2016)	Field experiment, hotel guests	Humanoid	Accompanying guests to an area of the hotel and providing news service (e.g., displaying news headlines) were the highest demanded services. Touchscreen was the most common way of requesting information. Guests were reluctant to talk to the robot.
Retail			
Gai, Jung, and Yi (2016)	Experiment, consumers	Nonhumanoid	A shopping cart service robot is feasible, resulting in accurate real-time localization of the multicart system.
Kanda et al. (2010)	Field experiment, consumers	Humanoid	A robot in a shopping mall increased visiting frequency and shopping frequency relative to an informational display.
Sabelli and Kanda (2016)	Qualitative, consumers	Humanoid	In a study of a robot in a shopping mall, trends among visitors included believing that the robot was aimed at children, feeling surprise that the robot had an operator, connecting the robot with its location, and assigning future roles to the robot.
Shiomi et al. (2013)	Field experiment, consumers	Humanoid	A study of coupon-giving robots in a shopping mall found that a small (vs. large) robot led to consumers printing coupons.
Health Care			
Baisch et al. (2017)	Experiment, elderly individuals	Nonhumanoid	In high functioning scenarios, elderly people with lower social support showed higher acceptance rates for a less intuitive social robot (that required instructions for use, named “Giraff”). In low functioning scenarios, low psychological well-being resulted in lower acceptance of Giraff. Lower life satisfaction was related to lower acceptance of the more intuitive (i.e., no instructions required) robot, “Paro.”
Čaić, Odekerken-Schröder, and Mahr (2018)	Qualitative, elderly individuals	Humanoid	Suggests that assistive robots could have three support roles in elder care: physical, psychosocial, and cognitive health. The robot’s support roles may contribute more to the individual (e.g., extended-self), the in/formal network of caretakers (replacement), or the individual and network (enabler, intruder).
Hebesberger et al. (2017)	Field experiment, older patients and hospital staff	Nonhumanoid	An examination of a long-term robot at a hospital demonstrated that staff and seniors were excited about the robot; however, the staff was reluctant to share their workspace with a robotic aid.
Hudson, Orviska, and Hunady (2017)	Secondary data, residents of EU member states	Not specified	Focused on attitudes toward robots caring for the elderly. Most people are against robotic care for the elderly; however, younger participants, males, and individuals who are more educated had more favorable attitudes.
Jayawardena et al. (2010)	Experiment, elderly at a living facility	Nonhumanoid	A robot is feasible to use for long time periods and is reliable in aiding the elderly. Elderly participants rated the robot positively overall.
Lee et al. (2017)	Experiment, patients	Humanoid	A study of robots in a healthcare setting showed that increased politeness negatively affects intention to comply and the amount of benefit patients perceived.
Liu et al. (2018)	Experiment, not specified	Nonhumanoid	An exoskeleton robot that can replicate human arm reaching movements did not accurately imitate the motion of the ESP joint but was able to execute five reaching movements similarly to a human arm.
Looije et al. (2016)	Experiment, children with diabetes	Humanoid	In a study investigating the influence of a social robot on the progress of self-management of children with diabetes, results found that the children and their caregivers built a relationship with the robot and experienced small increases in knowledge.
Piezzo and Suzuki (2017)	Experiment, elderly individuals	Humanoid	In a study examining the feasibility of a robot (Pepper) walking guide for the elderly, the walker trainer robot helped elderly individuals preserve or correct their gait.
Pulido et al. (2017)	Experiment, children age 5–7	Humanoid	Participants in a pediatric rehabilitation center enjoyed training with a robot called “NAO.” They were able to figure out how to train with the robot without help.

(continued)

Table 2. (continued)

Source	Method and Participants	Robot Type	Findings
Song et al. (2016)	Experiment, patients	Nonhumanoid	Results of a study on a telerehabilitation robot showed improved productivity of rehabilitation training, which may help with the lack of therapists.
Wada and Shibata (2007)	Field experiment, individuals in an elderly care house	Nonhumanoid (animal)	"Paro," designed to look like a seal, encouraged residents to communicate with each other and resulted in physiological improvements. Reactions of vital organs to stresses also improved.
Household			
Ferrús and Somonte (2016)	Qualitative, customers	Various	Consumers prefer a household robot that works independently in the home with low amounts of maintenance and intervention.
Vaussard et al. (2014)	Experiment/qualitative, households	Nonhumanoid	In an investigation of robotic vacuum cleaners in the home ecosystem, concerns of the participants included the amount of energy used. Six of the nine households stopped using the vacuum due to lack of functionality within the ecosystem.
Education			
Aziz et al. (2015)	Field experiment, autistic children	Humanoid	Showed that different interactions resulted in different emotions in children with autism. Singing and dancing resulted in the highest rating of emotional response.
Conti et al. (2017)	Experiment, students and educators	Humanoid	Examined professionals' acceptance of educational robots and found that only perceived helpfulness of the robot influenced intention to use.
Fernández-Llamas et al. (2017)	Experiment, children	Nonhumanoid	A study of the influence of a machine-like, industrial robot teacher versus a human teacher found that the type of teacher did not affect students' scores.
Kanda et al. (2007)	Field experiment, children	Humanoid	Elementary school children who treated the robot as a peer level friend created friendly relations and interacted with it the entire time. Children who did not consider the robot as a partner became bored with the robot after five to seven weeks.
Kanda et al. (2002)	Evaluation, students	Humanoid	Showed that people interacted with the robot in a similar style as they would interact with other humans (e.g., communicated with eye contact).
Reich-Stiebert and Eyssel (2015)	Survey, online participants	Humanoid	Gender, age, need for cognition, and technology commitment predicted attitude toward engaging in the learning process with educational robots.
Current Research			
	Experiments, students, MTurk participants	Four different humanoids	First to empirically show that consumers respond to HSRs with compensatory behavior, specifically: (1) status consumption, (2) increase in food consumption, and (3) increase in desire for social affiliation. Demonstrates that an increase in discomfort mediates the increase in compensatory behavior. Shows that social belongingness and healthy food moderate this effect. Shows that machinization alleviates the increase in food consumption, whereas anthropomorphism increases the effect.

companies that intend to use HSRs face a potential conundrum: Although creating robots that appear as much like humans as possible is the "holy grail" in robotics (Rubin 2003), there is a risk that consumers may find dealing with highly human-like robots uncomfortable. This is a phenomenon known in robotics as the "uncanny valley" (Mori, MacDorman, and Kageki 2012). To date, human reactions to robots have largely been studied in the robotics field (see Table 2). However, specific reactions to humanoid *versus* human service providers have not been widely examined. Furthermore, Table 2 shows that empirical studies of the uncanny valley concept from a consumer perspective in commercial service settings are scarce. It would also be important to understand what types of consumption-related behaviors would be evoked by HSRs.

Herein, we report the results of seven studies that use four distinct HSRs as stimuli. These studies collectively examine whether HSRs elicit compensatory consumer responses (e.g., status-oriented consumption, social affiliation, and increased food consumption) and whether such compensatory responses might be driven by consumers perceiving an HSR as eerie and as eliciting a threat to their human identity.

By addressing these questions, we make three contributions to the marketing literature. First, our research is among the first in marketing to examine the concept of the uncanny valley, testing how customers respond to HSRs. Consistent with the idea of the uncanny valley, we show that interacting with HSRs (vs. humans) both increases consumers' discomfort with the service provider and elicits compensatory consumption (e.g., food intake). We demonstrate the robustness of this compensation effect for four different HSRs and across various consumption categories (e.g., premium-priced products, multiple foods).

Second, we reveal important aspects of the process driving the compensatory effect. Consistent with the notion that a robot's highly human-like appearance can backfire, we find that HSRs trigger discomfort, which functions as a mediator linking HSRs and customers' responses (i.e., decreased favorability toward the robot but increased food intake).

Third, after demonstrating our basic effect, we investigate the moderating roles of (1) social belonging, (2) healthy food, and (3) machinizing the robot as boundary conditions of the adverse response to HSRs. Specifically, we show that the compensatory consumption effect is alleviated when customers experience high levels of social belongingness and when they perceive the focal food as healthy. Moreover, we find that the effects of HSRs on customers are related to the anthropomorphization (i.e., imbued with human-like characteristics) of the robot. Although anthropomorphization can elicit desirable marketing outcomes (Aggarwal and McGill 2007), we find the opposite, such that machinizing the robot (i.e., reminding consumers that it is merely a machine) mitigates customers' compensatory response. Taken together, these studies not only extend theoretical insights into the impact of technology on customer service experiences but also offer actionable managerial implications.

HSRs, Customer Discomfort, and Compensatory Responses

Firms may employ HSRs if they infer that customers will relate easily to the HSRs because of their human-like features (*Bloomberg* 2017). Although a review of the robotics literature is beyond the scope of our discussion (see Table 2 and Kanda and Ishiguro 2013), we note that robots with human-like features are designed with the goals of inspiring trust, being more sociable, and encouraging humans to bond with them (Broadbent et al. 2008; Li, Rau, and Li 2010). Thus, firms may deem it beneficial to use HSRs on their frontlines.

However, an alternative theoretical lens suggests that synthetic agents with highly human-like attributes are likely to elicit aversive responses in humans (Moosa and Ud-Dean 2010). Specifically, a humanoid robot that imitates but fails to attain humanness fully might trigger feelings of discomfort (e.g., eeriness), because people perceive a mismatch between the robot's anticipated human qualities and its actually imperfect, nonhuman qualities (i.e., the uncanny valley; Mori, MacDorman, and Kageki 2012). Notably, the empirical evidence of the uncanny valley in response to a variety of artificial agents (e.g., animated movie characters, gaming characters, or digitally created faces) is inconsistent (for a discussion of possible reasons for this inconsistency, see Kätsyri et al. 2015; Piwek, McKay, and Pollick 2014; Wang, Lilienfeld, and Rochat 2015). However, regarding human–robot encounters, more recent research supports the idea of the uncanny valley. Specifically, in a comprehensive investigation, Mathur and Reichling (2016) examined how humans responded to the faces of 80 real-world robots positioned on a continuum from highly mechanical to highly human-like. The authors show that humans found robotic faces more likeable as they became less mechanic and more human-like; however, as the robot faces appeared nearly human, the participants found them unlikeable.

The accounts for why humanoids cause discomfort typically draw on evolutionary mechanisms and can be unified by the idea that people feel threatened by humanoids (Gray and Wegner 2012). For example, MacDorman (2005) draws on terror management theory to propose that androids can elicit mortality salience by violating norms of human appearance and movement. Other research, consistent with the idea that eeriness is an instinct that protects people from danger (Mori, MacDorman, and Kageki 2012), posits that people associate robots with a threat to human identity related to fears of loss of control, job loss, robotic dysfunction, or scenarios in which intelligent robots overthrow humanity (Ray, Mondada, and Siegwart 2008).

In summary, the uncanny valley concept suggests that people respond to humanoids with "an undercurrent of apprehension or unease" (Gray and Wegner 2012, p. 125). Therefore, adopting a risk-sensitive approach to the employment of HSRs at organizational frontlines, we predict that consumers will experience discomfort—specifically, feelings of eeriness and a threat to their human identity—when dealing with HSRs.

If HSRs elicit discomfort, how might consumers cope? To address this question, we draw on the notion of compensatory consumption, which refers to consumption "motivated by a desire to offset or reduce a self-discrepancy" (Mandel et al. 2017, p. 134). A self-discrepancy is a threatening incongruity between one's ideal and one's perceived self (e.g., an identity threat related to one's sense of power, control, mortality, or social belonging; Higgins 1987; Mandel et al. 2017). Because self-discrepancies are typically psychologically aversive, people aim to reduce them. Notably, according to self-completion theory, people whose self is threatened are motivated to acquire symbols to offset the threat (Wicklund and Gollwitzer 1982). Relating these ideas more directly to the realm of marketing, the concept of compensatory consumption suggests that consumers can respond to threatening self-discrepancies by "acquiring, thinking about, and consuming products that are imbued with symbolic properties" (Lisjak et al. 2015, p. 1187). Empirical research has provided broad support for this idea and identified numerous compensatory consumer behaviors. For example, consumers have been shown to respond to self-threats related to their social standing with an elevated willingness to spend money on status-signaling products (e.g., premium products like a silk tie; Rucker and Galinsky 2008). Other research found that threats to peoples' social belonging motivate consumption behaviors that lead to social affiliation (e.g., signaling group membership and in-group loyalty; Mead et al. 2011). Finally, another major response to self-identity threats is the increased consumption of unhealthy food (e.g., "junk food" such as pizza, cakes, or cookies; Cornil and

Chandon 2013; Heatherton, Herman, and Polivy 1991). Drawing on these conceptual and empirical insights, we hypothesize:

> $\mathbf{H_1}$: Consumers who are served by an HSR (vs. a human employee) will be motivated to engage in compensatory behaviors (status signaling, social belonging, or increased food consumption).
>
> $\mathbf{H_2}$: There is a serial mediation such that consumers will respond to an HSR (vs. a human employee) with increased levels of eeriness and a perceived threat to their human identity, which drives their compensatory response.

Empirical Overview

We test our hypotheses in a series of seven experiments (see Table 3 for an overview). Studies 1a–1c provide an initial examination of how consumers respond to HSRs in different service settings (medical, educational, and dining) and in terms of three distinct compensatory behaviors. These studies, all of which include consequential choices or actual behavior, show that HSRs motivate consumers to engage in compensatory behavior such as spending their own money to purchase a premium (vs. nonpremium) product (Study 1a), choosing social affiliation (vs. not) (Study 1b), and engaging in compensatory eating (Study 1c). Then, Study 2 not only examines how an HSR influences consumers' food choices but also reveals serial mediation, establishing that the HSR elicits eeriness and a threat to consumers' human identity, which triggers compensatory consumption (in this case, increased caloric intake).

Our subsequent studies (3a, 3b, and 4) investigate the moderating roles of social belonging, healthy food type, and machinizing the robot, according to hypotheses that will be introduced in conjunction with these studies. Specifically, Study 3a sheds greater light on the role of compensatory social bonds (see also Study 1b) and tests the moderating effect of social belonging, which prior research suggests helps people cope with identity threats (e.g., Shnabel et al. 2013). Indeed, the analysis confirms that high levels of social belonging mitigate the compensatory food consumption that HSRs can elicit. Next, Study 3b shows the moderating role of food type such that the compensatory responses to HSRs (e.g., increased food consumption) are also attenuated when consumers perceive food to be positioned as relatively healthy. Then, Study 4 further draws on the uncanny valley concept to mitigate compensatory food consumption in response to HSRs. Specifically, reversing the concept of anthropomorphization, Study 4 shows that machinizing the HSR (i.e., highlighting its nature as a lifeless machine) alleviates the compensatory increase in food consumption. Finally, we include a within-paper meta-analysis to test the basic effect in aggregate across all studies. The within-paper meta-analysis confirms a robust effect of compensatory responses when consumers perceive an HSR (vs. a human provider) in the service context.

Study 1: Do HSRs Trigger Compensatory Consumer Behavior?

To test H_1, the first set of studies provides an initial examination of how consumers respond to HSRs across three compensatory behaviors. Each study employs a one-way between-subjects design, with two service provider levels (HSR and human). We filmed videos using an actual HSR (or human) to create three different service situations in which the provider gives instructions to consumers. Specifically, the video for Study 1a is set in a medical context, the video for Study 1b is in an educational context, and the video for Study 1c is in a dining context. In the field, robots are already being tested in all three contexts (e.g., Conti et al. 2017; Curtis 2016; Hoorn and Winter 2017). We examine whether consumers, in response to the HSR, engage in compensatory behavior when making consequential choices such as buying a premium (vs. nonpremium) product (Study 1a), choosing social affiliation (vs. not) (Study 1b), and engaging in compensatory eating (Study 1c). Moreover, to further generalize the results, these studies use different robots: Studies 1a and 1b use one humanoid robot, and Study 1c uses a different humanoid robot (see Figure 1, Panels A and B). In all our studies, we control for gender and age (Briers and Laporte 2013; McCrory et al. 1999; Romero and Craig 2017), factors that influence compensatory behaviors; we also control for the perceived novelty of the service experience to rule out mere novelty effects related to robots (Roehrich 2004).[1] As Web Appendix A details, the set of control variables used in our research is consistent with prior literature.

Study 1a: Video-Based Encounter with an HSR and Status Consumption

Eighty undergraduate students participated in the study for course credit ($M_{age} = 20.34$ years, 41 women). The study was implemented as two ostensibly different studies. Upon checking into the laboratory, each participant was given an envelope containing $2.00 as a "thank you" for participating. Several bottles of premium-priced Fiji water and generic bottled water were displayed at the check-in station in full view.

Next, participants were seated at a computer station and were randomly assigned to watch a video that featured a medical service encounter with either an HSR or a human provider (see Figure 1, Panel A). Specifically, participants were asked to imagine that they had an appointment for a routine medical visit and the (HSR or human) medical service provider came

[1] Study 1a (water choice) also controls for thirst, and Studies 1c–4 also control for dieting and hunger because the main dependent variable is food consumption (actual eating in Studies 1c and 4, consumption intentions in Studies 2 and 3a) (Briers and Laporte 2013). Studies 1c and 4 (actual food consumption studies) also control for time of day (Boland, Connell, and Vallen 2013) because these studies took place over multiple days. We report adjusted means in the body text; Web Appendix B provides adjusted means (standard errors) and raw means (standard deviations). Patterns hold with and without control variables (see Web Appendices C and D).

Table 3. Overview of Studies.

Study	Design and Stimuli	Response Type	Dependent Variable	Findings	Model Including Control Variables (Adjusted Mean and SE)
S1a	2 (HSR, human) between-subjects, video stimuli	Actual behavior	Status consumption: spending of own money to purchase a status product	Participants were more likely to choose the premium (vs. generic) product with an HSR (vs. a human).	HSR = 31.41% versus Human = 7.41%, H_1: Wald $X^2 = 5.01$, $p < .05$
S1b	2 (HSR, human) between-subjects, video stimuli	Actual behavior	Social affiliation: actual choice of working on task with a team or alone	Participants were more likely to choose a group (vs. individual) task with an HSR (vs. a human).	HSR = 37.63% versus Human = 25.87%, H_1: Wald $X^2 = 3.83$, $p < .1$
S1c	2 (HSR, human) between-subjects, video stimuli	Actual behavior	Compensatory food consumption: cheese eaten	Participants consumed more food with an HSR (vs. a human).	HSR = 7.35 (.47) versus Human = 5.99 (.48), H_1: $F(1, 196) = 4.03$, $p < .05$
S2	2 (employee: HSR, human) between-subjects, photo stimuli	Intentions	Compensatory food consumption intentions: calories / servings selected.	Participants served by the HSR (vs. a human) selected more food. Serial mediation via eeriness, human identity threat.	HSR = 1858.88 (142.22) versus Human = 1421.02 (148.70), H_1: $F(1, 93) = 4.07$, $p < .05$
S3a	2 (HSR, human) × 2 (control, social belongingness) between-subjects, video stimuli	Intentions	Compensatory food consumption intentions: chocolate cake	Participants in the control condition intended to eat more cake when served by the HSR (vs. a human). This is attenuated in the belongingness condition.	$HSR_{control} = 76.53$ (4.34), $Human_{control} = 64.36$ (4.48), $HSR_{belonging} = 62.51$ (5.60), $Human_{belonging} = 71.18$ (5.27) Interaction: $F(1, 171) = 4.43$, $p < .05$, H_1: $F(1, 171) = 3.79$, $p < .1$
S3b	2 (HSR, human) × 2 (food type: control, healthy) between-subjects, photo stimuli	Actual behavior	Compensatory food consumption: cheese eaten	With regular food, participants ate more with an HSR (vs. a human). When the food is positioned as healthy, the effect is attenuated.	$HSR_{control} = 8.28$ (.73), $Human_{control} = 5.88$ (.75), $HSR_{healthy\ food} = 6.77$ (.75), $Human_{healthy\ food} = 7.35$ (.72). Interaction: $F(1, 193) = 3.97$, $p < .05$ H_1: $F(1, 193) = 5.04$, $p < .05$
S4	3 ($human_{Alex}$, HSR_{Alex}, machinized HSR_{XT1000}) between-subjects, video stimuli	Actual behavior	Compensatory food consumption: Cheese eaten	Participants ate more food with the named HSR than the machinized HSR. No difference for human and machinized HSR.	HSR = 9.43 (.67), Human = 6.87 (.68), $HSR_{machinized} = 7.41$ (.66). H_1: HSR versus Human: $F(1, 218) = 7.18$, $p < .01$, H_3: HSR versus $HSR_{machinized}$: $F(1, 218) = 4.62$, $p < .05$

into the exam room. In the video, the service provider said, “Please have a seat so that I can take your temperature, pulse, and blood pressure.” After watching the video, participants briefly described what they imagined the experience to be like. As a manipulation check, they reported the extent to which the service provider seemed robotic (“The medical service

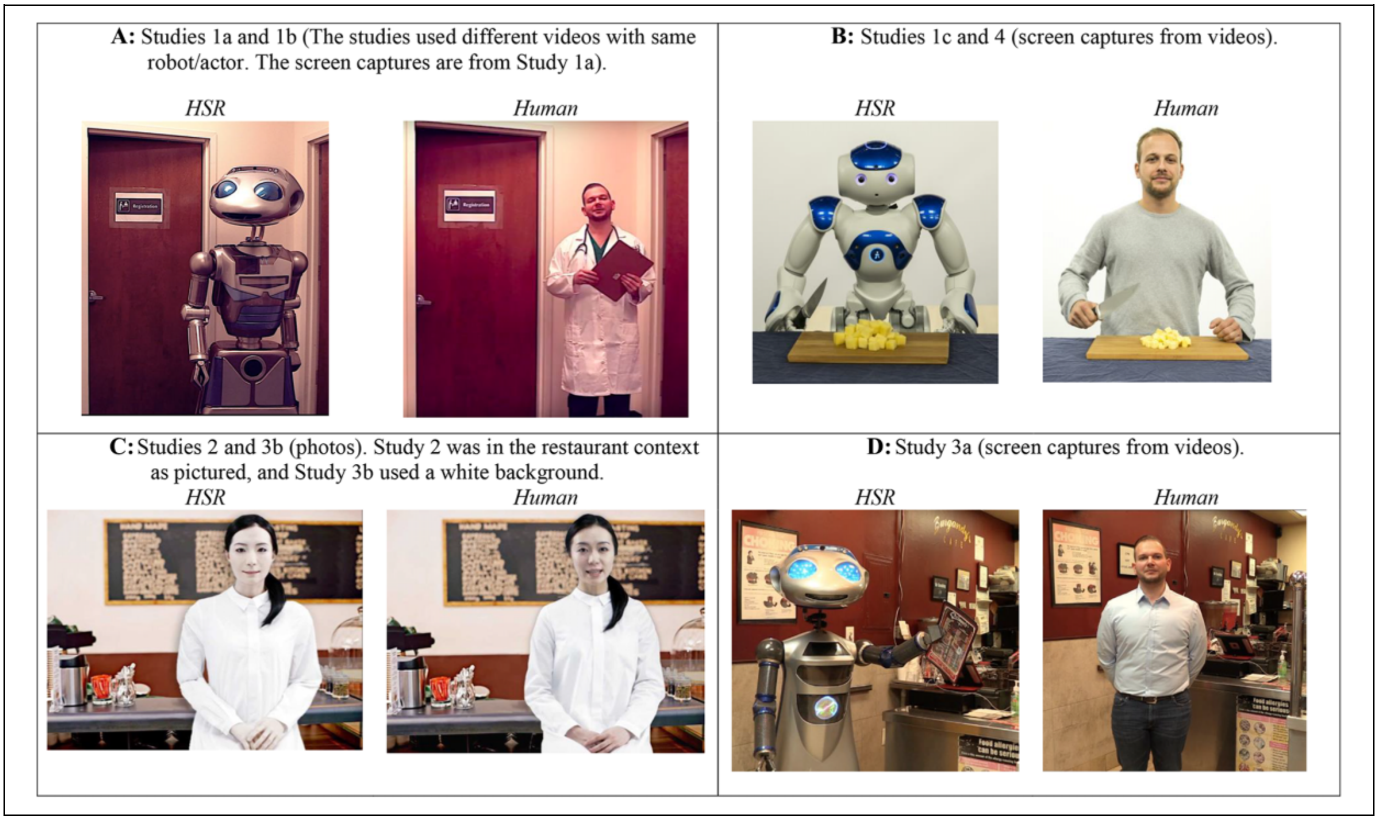

Figure 1. Illustrative video screen captures and photos of the four robots used across studies.

provider is like a person" [reverse coded]/"The medical service provider is machine-like"; 1 = "strongly disagree," and 7 = "strongly agree") and novel ("I have not been to a medical practice like this before" and "This medical practice is unusual," random presentation; 1 = "strongly disagree," and 7 = "strongly agree").

The second part of the study examined participants' compensatory consumption. Participants completed what appeared to be a different study about product choices related to the $2.00 they were given and the water they saw upon entering the lab. Following Romero and Craig's (2017) procedure, participants were shown a photo of a bottle of Fiji water for $1.50 and a bottle of generic water for $.95 and were asked to select one of the bottles to purchase using the $2.00 they received. After indicating which bottle of water they wanted to purchase, participants indicated their age and gender, their level of thirst (Crolic and Janiszewski 2016), and whether they had brought a beverage with them to the lab. At the end of the study, all participants were informed that they could simply keep the $2.00.

Results

Manipulation check. An analysis of variance (ANOVA) for the robot manipulation check revealed a main effect of service provider type ($M_{HSR} = 6.08$, $M_{human} = 2.75$; $F(1, 78) = 122.95$, $p < .001$). Thus, the manipulation was effective, as participants perceived the HSR as a robot.

Compensatory behavior: purchasing a status product.[2] A binary logistic regression controlling for age, gender, thirst, and novelty showed that participants chose the premium Fiji water more often when the medical provider was an HSR rather than a human ($M_{HSR} = 31.41\%$, $M_{human} = 7.41\%$; Wald $\chi^2 = 5.01$, $p < .05$, $\eta^2 = .09$). This choice behavior indicates that consumers in the HSR condition engaged in compensatory (status) consumption.

Study 1b: Video-Based Encounter with an HSR and Social Affiliation

Two hundred fifty-three undergraduate students participated in this study for course credit ($M_{age} = 21.07$ years, 130 women). As participants entered the lab, signs guided them to a room where they sat at a computer station and watched a video of a lab service employee (HSR or human; Figure 1, Panel A) greeting them and asking them to turn off their mobile phones, to read the informed consent form, and to sign it. They were asked to watch a second video of the same (HSR or human) lab employee saying, "We now invite you to participate in a task.

[2] Twenty-six participants had brought their own beverage with them to the study session and therefore would not need to purchase a beverage. We excluded them from the beverage choice analysis; 54 participants were included in the beverage choice analysis.

Please take this seriously and give it your best effort." Participants then completed the same unrelated tasks.

The second part of the study examined participants' compensatory behavior. To do this, we gave participants the following instructions: "For the next task, you can choose whether you prefer to do it by yourself or with a group." Our variable of interest was whether participants chose to work on the task with other people or alone. We theorized that in response to receiving instructions from the HSR, participants might compensate by seeking social affiliation (i.e., contact with others). After participants made their choice, they were informed that they would receive more information on this task later. They then answered additional questions about the extent to which the lab employee seemed robotic ("This lab employee is like a person [reverse coded]"; "This lab employee is machine-like") and novel ("This seems to me like a novel type of lab employee"). Participants also indicated their age and gender. Finally, we told participants that they would not need to perform the individual/group task. We removed four participants who reported encountering technical difficulties with the video.

Results

Manipulation check. An ANOVA for the robot manipulation check revealed a main effect of service provider type ($M_{HSR} = 6.00$, $M_{human} = 2.81$; $F(1, 247) = 429.13$, $p < .001$). Thus, the manipulation performed as intended.

Compensatory behavior: choosing a group task. A binary logistic regression controlling for age, gender, and novelty revealed that participants chose a group task more often with an HSR serving as the virtual lab employee than a human ($M_{HSR} = 37.63\%$, $M_{human} = 25.87\%$; Wald $\chi^2 = 3.83$, $p < .1$, $\eta^2 = .02$).

Study 1c: Video-Based Encounter with an HSR and Compensatory Eating Behavior

Two hundred fifteen undergraduate students participated in the study for course credit ($M_{age} = 21$ years, 114 women). We examined actual eating by inviting participants to a cheese taste test. They sat at individual computer stations, each with a box containing 20 uniformly cut cubes of Gouda cheese. Before they began eating, participants indicated their hunger level ("How hungry are you at this moment?" 1 = "not at all," and 7 = "very much").

We manipulated service provider type (HSR vs. human) by informing participants that they would taste a new type of cheese prepared in a test kitchen and that, "This cheese was prepared and sliced for you by this employee of our test kitchen as you can see in the video below." Participants then watched a video with either a humanoid robot or a human behind a table with a cutting board and cheese cubes, holding a knife (see Figure 1, Panel B). In the video, the service provider said, "Hello. Welcome to the test kitchen. This is cheese I prepared for you today. Please try a sample. You are welcome to eat as much of it as you would like." Then, participants watched a brief history video (unrelated to cheese or technology) and answered questions. The main dependent variable was the number of cheese cubes eaten by each participant. After participants left the lab, an assistant, blind to our hypotheses, documented the number of cheese pieces eaten by each participant. As a manipulation check, we used agreement measures to determine the extent to which the employee seemed robotic ("The kitchen staff member is like a person [reverse coded]; The kitchen staff member is machine-like"). We controlled for hunger, dieting status, age, gender, and novelty. Because the data collection sessions took place over multiple days, we also controlled for the time of day (Boland, Connell, and Vallen 2013). We removed five participants from the analysis: three who participated twice and two who did not eat any cheese for health reasons.

Results

Manipulation check. The ANOVA for the robot manipulation check revealed a main effect of service provider type ($M_{HSR} = 5.74$, $M_{human} = 2.26$; $F(1, 208) = 577.49$, $p < .001$). Thus, the manipulation performed as intended.

Quantity consumed. We conducted an analysis of covariance (ANCOVA) on the number of cheese cubes eaten as a function of provider type. Participants ate more when the cheese was prepared by an HSR rather than a human service provider ($M_{HSR} = 7.35$, $M_{human} = 5.99$; $F(1, 196) = 4.03$, $p < .05$, $\eta^2 = .02$).

Discussion

Studies 1a–1c suggest that encountering an HSR (vs. a human) causes consumers to engage in compensatory behavior, including a focus on status products (Study 1a), a desire for social affiliation (Study 1b), and compensatory eating (Study 1c). These findings support the idea that humanoids activate human defensive mechanisms (MacDorman 2005). Next, we deepen our empirical investigation of this phenomenon by examining its underlying process and by focusing on compensatory consumption of food (in line with Study 1c).

Whereas our initial three studies demonstrated a variety of compensatory behavior, our subsequent studies focus on food-related compensation for two important conceptual and managerial reasons. First, from a conceptual lens, research on compensatory behavior suggests that consumers often respond to aversive states by directing their attention elsewhere in an effort to distract themselves. This so-called escapism frequently manifests in people turning their attention to food when they experience a threat to their ego in order to, at least momentarily, "reduce the salience of any activated self-discrepancy" (Mandel et al. 2017, p. 139; also, Cornil and Chandon 2013). This explanation is consistent with emotional eating theory, which also conceptualizes eating as an instrumental behavior to reduce negative affect (Groesz et al. 2012).[3] In short, negative affect is linked to eating because food can shift attention away from an ego-threatening stimulus (Heatherton, Herman, and Polivy 1991; Wallis and Hetherington 2004).

Second, from a managerial lens, we note that HSRs are increasingly used in restaurants and food services (see Table 1). However, the robotics literature has not focused on this important service setting that is common in most consumers' lives (see Table 2). Therefore, we examine the effects of HSRs in a food context and expect that customers who are served by an HSR (vs. a human) will compensate by turning to food to offset their discomfort.

Study 2: The Effect of HSRs on Customer Food Consumption

Study 2 is set in a restaurant context and examines compensatory food consumption. It also investigates the mediating roles of eeriness toward the service provider and human identity threat, and it uses an HSR with a different appearance than those used in Studies 1a–1c to generalize the results. To examine whether interacting with an HSR (vs. a human) influences food choices (H_1) and customer eeriness and human identity threat (H_2), Study 2 employs a one-way between-subjects design, with two service provider levels (HSR vs. human). Consistent with the previous studies, we control for age, gender, and novelty. In the remaining studies, the main dependent variable pertains to food consumption (i.e., actual eating or eating intentions); thus, we control for hunger (Poor, Duhachek, and Krishnan 2013) and dieting (Briers and Laporte 2013; VanEpps, Downs, and Loewenstein 2016).

Study 2 adopts an HSR designed to look like its human counterpart, which helps rule out the appearance differences that were present in the previous studies as an explanation for the results (see Figure 1, Panel C). The focal HSR has already functioned as a service employee in real-world settings (e.g., receptionist and guide in a Tokyo museum; Demetriou 2014). The participants were 100 Amazon Mechanical Turk (MTurk) participants ($M_{age} = 34.37$ years, 54 women). We asked them to imagine going to dinner at a new all-you-can-eat restaurant. We manipulated the server type by presenting pictures of either a human or a humanoid server, described as either a woman or a humanoid robot, respectively. The server was pictured in the context of the restaurant.

The main dependent variable was the caloric intake selected. The all-you-can-eat restaurant format allowed patrons to indicate the amount of each food item they desired (selecting between zero and two servings of each food item). One serving of each entrée item was described as 5 ounces, and one serving of each side item was described as 3 ounces. Participants considered six entrée items (grilled chicken breast, broiled salmon, grilled steak, lasagna, bacon cheeseburger, and chicken tenders, in random order) and six side items (side salad, grilled asparagus, steamed broccoli, French fries, baked macaroni and cheese, and mozzarella sticks, in random order), and they could select as much or as little of each item as they wanted. Similar to Ailawadi, Ma, and Grewal (2018), we calculated the caloric content of the food using the website www.CalorieCount.com (accessed 2017). After making their food choices, participants indicated their sense of eeriness and identity threat. Eeriness was measured as: "This server is creepy/eerie/unnatural" (1 = "not at all," 7 = "very much so"). Building on prior literature on robot-induced threat to humans (Yogeeswaran et al. 2016; Zlotowski et al. 2017), participants indicated human identity threat by responding to the following items: "This service provider threatens my very existence," "This service provider makes me worry about my place in the world," "This service provider makes people like me less important," "This service provider makes me worry about my own job security," and "This service provider seems to lessen the value of my existence" (1 = "strongly disagree," 7 = "strongly agree"). They also answered the manipulation check as in the previous studies and indicated their hunger, age, gender, dieting, and novelty of the service experience.

Results

Manipulation check. An ANOVA of the manipulation check revealed the expected main effect of service provider type ($M_{HSR} = 5.85$, $M_{human} = 3.23$; $F(1, 98) = 55.61$, $p < .001$).

Eeriness of service provider. In support of H_2, an ANCOVA revealed that consumers felt greater eeriness ($\alpha = .96$) when interacting with the HSR rather than the human service provider ($M_{HSR} = 5.17$, $M_{human} = 3.21$; $F(1, 93) = 29.75$, $p < .001$, $\eta^2 = .24$).

Human identity threat. An ANCOVA revealed that consumers felt greater identity threat ($\alpha = .97$) when interacting with the HSR rather than the human service provider ($M_{HSR} = 4.21$, $M_{human} = 1.98$; $F(1, 93) = 40.91$, $p < .001$, $\eta^2 = .22$).

Food consumption intentions. An ANCOVA on the calories of the food selected from the menu indicated that consumers selected more calories when served by the HSR rather than the human ($M_{HSR} = 1858.88$, $M_{human} = 1421.02$; $F(1, 93) = 4.07$, $p < .05$, $\eta^2 = .04$), in support of H_1. To be complete, we also note that ANCOVA on the total number of servings selected showed that participants selected more servings with the HSR (vs. human) server ($M_{HSR} = 9.37$ vs. $M_{human} = 7.17$; $F(1,93) = 4.86$, $p < .05$).

Mediation analysis. We conducted a serial mediation analysis to examine whether eeriness and identity threat mediated the relationship between server type and caloric consumption (Hayes 2015, Model 6). The results revealed the expected serial

[3] Similar explanations conceptualize eating as a strategy to mask a stressor (Polivy and Herman 1999) or as a way to escape aversive self-awareness (Heatherton and Baumeister 1991). However, we also note that the link between negative affect and eating is complex and can be influenced by various factors (e.g., gender, dieting status, types of affect, type and intensity of a stressor, duration of exposure to a stressor, type of food, etc.; Greeno and Wing 1994; Groesz et al. 2012; Macht 1999, 2008; Wagner et al. 2012; Wallis and Hetherington 2004). For this reason, Study 3b further examines type of food as a meaningful moderator in our conceptual model.

mediational path (HSR → greater eeriness → increased identity threat → increased calories selected) at the 95% confidence interval (CI) (a × b = 84.80, 95% CI: 6.71, 280.82); furthermore, the mediators rendered the direct effect non-significant (a × b = 2.53, 95% CI: –525.82, 530.88). Thus, this suggests full mediation through consumer-perceived eeriness and human identity threat.

Discussion

In support of H_1 and H_2, Study 2 shows that an HSR (vs. a human) triggers greater feelings of eeriness and identity threat, which leads consumers to cope through selecting more calories. As such, Study 2 replicates the compensatory customer response and sheds light on the underlying process and the chain of effects that links HSRs and consumers' food choices.

Study 3: The Moderating Roles of Social Belonging and Food Type

As demonstrated, HSRs cause consumers to engage in compensatory behavior (Studies 1a–1c) and elicit feelings of eeriness and human identity threat (Study 2). This next set of studies examines how the consumption effects resulting from exposure to an HSR can be attenuated. First, Study 3a examines the moderating role of social belonging. Then, Study 3b investigates the moderating role of healthy food, which is a managerially relevant aspect because firms can design and position their offerings to be more focused on health benefits.

The Moderating Role of Social Belongingness

One effective way for people to buffer the impact of a stressor is to affirm the self (Cornil and Chandon 2013; Shnabel et al. 2013). Self-affirmation, the process by which people reinforce their self-integrity and image as effective and able, increases psychological resources for coping with a threat (Cohen and Garcia 2008); consequently, a focal threat becomes less psychologically dire, which leads a person "to acknowledge the threat without negative effects on psychological well-being" (Shnabel et al. 2013, p. 664).

Recent theoretical advances suggest that social belonging (i.e., feeling more connected with other people) is a crucial ingredient for self-affirmation in the face of an identity-related threat. Reflecting on social belonging can affirm the self, "because fitting into social groups is an important aspect of human adequacy" (Shnabel et al. 2013, p. 672). In short, reminding themselves of their meaningful social connections with others can bolster people's self-integrity, which in turn makes them more resilient in situations that may seem otherwise dire (Shnabel et al. 2013). Therefore, we expect that if an identity-related threat of an HSR drives the compensatory increase in consumption, social belonging will attenuate this outcome. In other words, affirming a consumer's sense of social belongingness may be an alternative means to face the threat elicited by an HSR, which should mitigate the need to cope through food.

Study 3a

Participants were 180 MTurk workers in the United States (M_{age} = 36.22 years, 108 women). The study employed a 2 (service provider: HSR, human) × 2 (social belongingness, control) between-subjects design.

We manipulated social belonging based on prior literature (DeWall, Baumeister, and Vohs 2008; Lambert et al. 2013). In the social belonging condition, we asked participants to "Describe in several sentences a time when you felt socially connected to another person or group of people. Describe the person/people you felt connected to. Why did you feel connected to them? How did this social connection make you feel?" In the control condition, we asked participants to "Describe in several sentences a television program you watched recently and what you remember about it. What was the television program? What do you remember most about it? Will you watch it again?" A pretest confirmed that the belonging manipulation elicits a greater sense of belongingness compared to the control condition (see Web Appendix D).

We next manipulated service provider type via a video of an actual robot (or person) in an actual restaurant (Figure 1, Panel D). We asked participants to imagine going to this restaurant and encountering the service provider. Participants watched a video that showed either an HSR or a human employee as the greeter in the focal restaurant. In the video, the HSR or human said, "Hello and welcome. Would you like a table or a booth? Please have a seat and look at the menu. Your server will be right over."

Our dependent variable was chocolate cake consumption intentions. Participants were asked to imagine ordering a cup of coffee and a piece of chocolate cake. Participants saw a photo of the chocolate cake and then indicated how much of the cake they would eat (on a sliding scale from 0% to 100%). Because we wanted to consider positive affect as an alternative explanation, participants also completed a corresponding ten-item measure (Watson, Clark, and Tellegen 1988). Finally, participants completed the manipulation check and control variables (age, gender, novelty, dieting, and hunger).

Study 3a Results and Discussion

Manipulation check. The ANOVA for the manipulation check index revealed a main effect of service provider type (M_{human} = 2.91, M_{HSR} = 6.15; $F(1, 176) = 215.44$, $p < .001$). The other effects were not significant. Thus, the provider type manipulation performed as intended.

Consumption intentions. We conducted an ANCOVA on the percentage of chocolate cake selected as a function of social belongingness, server type, and their interaction, while controlling for age, gender, hunger, dieting, and novelty. The analysis revealed the expected social belongingness × server interaction ($F(1, 171) = 4.43$, $p < .05$, $\eta^2 = .03$; Figure 2, Panel A). The belongingness and service provider type main effects (Fs < 1) were not significant.

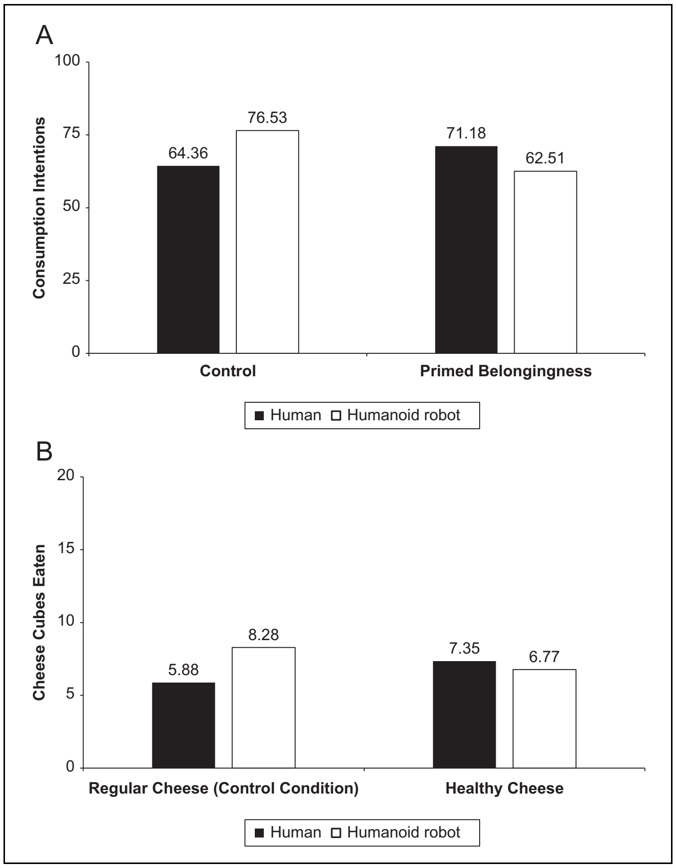

Figure 2. Study 3. Panel A: Study 3a: Consumption intentions (service provider type × social belongingness). Panel B: Study 3b: Cheese cubes eaten (service provider type x food healthfulness).

Contrasts showed that when the service provider was an HSR, consumption intentions decreased under high social belonging ($M_{control} = 76.53$, $M_{belonging} = 62.51$; $F(1, 171) = 3.88$, $p < .1$, $\eta^2 = .02$). However, with a human employee, social belonging had no effect on consumption intentions ($M_{control} = 64.36$, $M_{belonging} = 71.18$; $F < 1$). In other words, in the control condition, participants intended to consume *more* food from the HSR ($M_{HSR} = 76.53$, $M_{human} = 64.36$; $F(1, 171) = 3.79$, $p < .1$, $\eta^2 = .02$), which is consistent with H_1 and the previous studies. However, this effect was attenuated with higher social belonging ($M_{HSR} = 62.51$, $M_{human} = 71.18$; $F(1, 171) = 1.26$, $p > .25$), which is consistent with our theorizing.

Finally, in terms of exploring positive affect as an alternative explanation, an ANCOVA with positive affect as the dependent variable revealed no effects as a function of belonging, HSR, or the two-way interaction ($\alpha = .91$, ps $> .33$).

Discussion. In the control condition, participants had greater consumption intentions with an HSR (vs. a human), in support of H_1. Importantly, when participants had a greater sense of social belonging, the effect of the HSR on consumption was attenuated. Consistent with our theorizing, when participants encountered the HSR, inducing social belonging (vs. control condition) buffered the compensatory response, and their consumption intentions decreased significantly.

The Moderating Role of Perceived Healthfulness of Food

Whether eating more occurs as a way to cope with the discomfort elicited by HSRs may also depend on the type of food. Prior research suggests that identity-related threats increase eating, but not for food that is perceived as healthy (Cornil and Chandon 2013; Heatherton and Baumeister 1991). For example, Zellner et al. (2006) show that stress causes a shift in food choice away from healthy, low-calorie foods (e.g., fruits) to less healthy, high-calorie foods (e.g., chocolate), which is consistent with the idea that high-calorie "comfort foods" (relative to healthy foods) reduce discomfort and make consumers feel better. More broadly, escape theory (Heatherton and Baumeister 1991) suggests that high-calorie palatable food (rather than low-calorie healthy food) allows consumers to shift their attention away from the aversive self-appraisal triggered by an ego-threatening stimulus (Wallis and Hetherington 2009). Against this background, we propose that the effects of HSRs on compensatory food consumption may be mitigated when the food is perceived as more healthful; that is, we expect that healthy food attenuates consumers' use of increased caloric intake as a coping mechanism.

Study 3b

The study employed a 2 (service provider: HSR, human) × 2 (food type: regular, healthy) between-subjects design. Participants were 203 business students who took part in the study for course credit ($M_{age} = 21.06$ years, 78 women). We used organic food as the operationalization of healthy food because it is produced without artificial inputs such as pesticides, chemical fertilizers, or chemical food additives that may be harmful to one's health (Paul and Rana 2012). Therefore, consumers tend to strongly associate organic food with health benefits (Brantsæter et al. 2017; Magnusson et al. 2003; Schuldt and Schwarz 2010), and various studies have shown that good health "is the strongest motive for purchasing organic food" (Aertsens et al. 2009, p. 1143). Furthermore, consumers view organic foods as being higher in nutritional value and lower in calories than their conventional counterparts (Lee et al. 2013; Schuldt and Schwarz 2010).

We examined actual eating behavior by inviting participants to a cheese taste test. They sat at individual computer stations, and each station had a box containing 20 uniformly cut cubes of Gouda cheese. Before they began eating, participants indicated their hunger level ("How hungry are you at this moment?" 1 = "not at all," 7 = "very much").

We manipulated server type by informing participants that they would taste a new type of cheese and that "This cheese was prepared and sliced for you by the [humanoid robot/woman] pictured below" while showing the corresponding photo (Figure 1, Panel C). In the same description, we manipulated food type (healthy vs. regular) as described subsequently. A pretest confirmed that the food described as healthy was perceived as significantly healthier (see Web Appendix D).

> Healthy: "You will have the opportunity to taste a new type of organic cheese from local farms. This cheese is all-natural, calcium-rich, packed with vitamins and minerals. This cheese has a delicious natural flavor."
>
> Regular: "You will have the opportunity to taste a new type of cheese from local production facilities. This cheese is enriched with added calcium, vitamins, and minerals. This cheese is enhanced with natural and artificial ingredients for a delicious flavor."

After being exposed to the background and photo of the (HSR or human) service provider and reading the description of the cheese, the participants were invited to eat as much cheese as they wanted while watching a brief video (unrelated to cheese or technology). The dependent variable was the number of cheese cubes eaten. After participants left the lab, an assistant, blind to our hypothesis, documented the amount of cheese each participant ate. Participants also rated the novelty of the experience and provided demographics (age, gender, hunger, and dieting status) as control variables. One vegan participant was removed from the analysis.

Study 3b Results and Discussion

Quantity consumed. An ANCOVA on the number of cheese cubes eaten revealed the predicted server type × food type interaction ($F(1, 193) = 3.97$, $p < .05$, $\eta^2 = .02$; see Figure 2, Panel C). The main effects were not significant ($p > .22$). The contrasts revealed that with the regular cheese in the control condition, consumers ate significantly more cheese cubes if those cubes had been prepared by the HSR rather than the human ($M_{HSR} = 8.28$, $M_{human} = 5.88$; $F(1, 193) = 5.04$, $p < .05$, $\eta^2 = .03$), which is consistent with our previous findings. However, when the cheese was described as healthy, this effect was attenuated ($M_{HSR} = 6.77$, $M_{human} = 7.35$; $F < 1$). Thus, we find that food perceived as more healthful mitigates the increase in consumption that customers otherwise display when they are served by an HSR.

Discussion. Study 3b again replicates the compensatory effect with actual eating behavior and investigates another boundary condition—it shows that the perceived healthfulness of food functions as a moderator. When food is perceived as healthy (e.g., organic food), consumers do not eat more of it to deal with the discomfort elicited by an HSR. Although more nuanced distinctions could be considered in future work (e.g., whether food is healthy by nature or science; Andre, Chandon, and Haws 2019), our finding is in line with prior research that shows indulgent, unhealthy food serves as a relatively more effective coping mechanism (Cornil and Chandon 2013; Heatherton and Baumeister 1991).

Machinizing the Humanoid Robot to Maneuver the Uncanny Valley

Our results show that consumers do not respond favorably to HSRs as compared with human service providers. In parallel, the uncanny valley premise predicts a nonlinear effect of a robot's human-like appearance on how people respond to it; that is, a robot that approaches humanness but fails to fully attain it triggers discomfort because of the mismatch between the anticipated human qualities of the robot and its actually imperfect, nonhuman qualities (Mori, MacDorman, and Kageki 2012). Thus, we expect that consumers will respond more favorably to a service robot that seems *less* (vs. more) human-like. Our idea of making the HSR less human-like represents an antonym to the concept of anthropomorphization; specifically, we study the role of machinizing the robot, which refers to "the action or process of making into a machine (literal and figurative)" (www.oxforddictionaries.com/definition/machinization).

Humans have a deeply rooted tendency to anthropomorphize objects; they "imbue the real or imagined behavior of nonhuman agents with human-like characteristics, motivations, intentions, or emotions," which influences how they interact with those agents (Epley, Waytz, and Cacioppo 2007, p. 864). Anthropomorphization can affect how consumers respond to products (e.g., Aggarwal and McGill 2007). For example, anthropomorphizing products can elicit more positive emotional responses (e.g., products seem more endearing), which drives consumer preference for the offerings (Wan and Aggarwal 2015). These positive responses arise because attributing human-like qualities to a nonhuman entity helps make that entity seem more familiar, explainable, or predictable (Epley, Waytz, and Cacioppo 2007). Notably, developers of HSRs frequently use anthropomorphization such as giving robots human names rather than a model number (e.g., Aiko Chihira is the name of a robot that works in a Tokyo department store and looks like a 32-year-old woman dressed in a kimono; Hu 2015). Hanson Robotics Ltd. named one of its most advanced humanoids Sophia and systematically speaks about it as being "alive," being "born," and having feelings (hansonrobotics.com). Yet, in contrast with the positive outcomes often associated with anthropomorphization, the uncanny valley concept suggests that a robot endowed with such human cues can make consumers feel more uncomfortable than one that appears more machine-like. Accordingly, we propose that machinizing the robot (e.g., giving it a model number rather than a human name) reemphasizes that it is a lifeless object. Thus, when customers interact with such a machinized (vs. humanized) robot, we expect that the compensatory increase in food consumption will be attenuated.

> **H_3:** Consumers increase their food consumption when they are served by an HSR (vs. a human) service provider; machinizing the HSR mitigates this effect.

Study 4: The Effects of a Machinized HSR on Actual Food Consumption

Study 4 employed a 3 (service provider: human, HSR, machinized HSR) between-subjects design with 250 students who participated for course credit (M_{age} = 22 years, 127 women). As in Studies 1c and 3b, this study examines actual eating behavior by inviting participants to a cheese taste test. The manipulation of the service provider differed slightly from the other studies to include the three separate levels. Specifically, we began by providing the following introductions to participants in the three randomly assigned conditions:

> Human: "This cheese was prepared and sliced for you by this employee of our test kitchen. He is called Alex, as you can see in the video below."
>
> HSR: "This cheese was prepared and sliced for you by this employee of our test kitchen. He is called Alex, as you can see in the video below. Alex is a humanoid robot born and raised in [university city]. Alex looks and behaves like a human and enjoys preparing food, which he can do as well as humans do."
>
> Machinized HSR (XT 1000): "This cheese was prepared and sliced for you by this robot owned by our test kitchen. It is called XT 1000, as you can see in the video below. This humanoid robot was assembled in [university city]. XT 1000 is designed to look and behave like a human and can provide the same functions as humans when it comes to food preparation."

Next, participants watched the same videos as in Study 1c (Figure 1, Panel B). The service provider used the same script: "Hello. Welcome to the test kitchen. This is cheese I prepared for you today. Please try a sample. You are welcome to eat as much as you would like." A pretest confirmed that the manipulation performed as intended (see Web Appendix D). Again, the main dependent variable was the number of cheese cubes eaten, and an assistant, blind to our hypothesis, documented this variable. We removed 18 participants from the analysis because the video did not play; four participants indicated that they did not eat cheese for health reasons and were removed as well. Thus, 228 participants were included in the main study analyses.

Results

Quantity consumed. We conducted an ANCOVA on the number of cheese cubes eaten as a function of provider type, controlling for age, gender, hunger, dieting, novelty, and time of day. There was a main effect of server type ($M_{human} = 6.87$, $M_{HSR} = 9.43$, $M_{HSR\text{-}XT1000} = 7.41$; $F(2, 218) = 4.02$, $p < .05$, $\eta^2 = .04$). Participants ate more cheese prepared by the named HSR than by the machinized HSR (Model XT 1000) ($M_{HSR} = 9.43$ vs. $M_{HSR\text{-}XT1000} = 7.41$; $F(1, 218) = 4.62$, $p < .05$, $\eta^2 = .02$) or the human ($M_{HSR} = 9.43$ vs. $M_{human} = 6.87$; $F(1, 218) = 7.18$, $p < .01$, $\eta^2 = .03$). There were no differences in consumption between the machinized HSR_{XT1000} and the human ($M_{HSR\text{-}XT1000} = 7.41$ vs. $M_{human} = 6.87$; $F < 1$).

Discussion

In support of H_3, Study 4 shows that humanizing an HSR by giving it a name, speaking of it using personal pronouns, or giving it a birthplace aggravates rather than mitigates consumers' reactions to HSRs. Machinizing an HSR (i.e., emphasizing that it is merely a machine) mitigates compensatory consumption given our finding that food consumption does not differ significantly between a human and a machinized robotic service provider.

Meta-Analysis: Testing the Robustness of the Results Across Studies

To test the overall validity of H_1 (that consumers served by an HSR versus a human will engage in compensatory consumption), we performed a single paper meta-analysis (SPM; McShane and Böckenholt 2017) on the five studies that included continuous dependent variables, all of which involved food (Studies 1c–4). We standardized the dependent variables, and for Studies 3a, 3b, and 4, we only included the control condition (HSR vs. human), in which the effect was not attenuated by social belongingness, food type, or machinizing the robot (McShane and Böckenholt 2017). The SPM showed that across the five studies, consumers had greater actual consumption or consumption intentions when they were served by an HSR (vs. a human) (Estimate = .3244, SE = .0761; z = 4.26, $p < .0001$), in support of our theory.[4] This is a conservative test, as it does not include any of the (theory-based) control variables in the SPM.

General Discussion

This research examines how HSRs influence customer experiences. It is inspired by two insights: First, service robots are estimated to become a billion-dollar business by 2020 (*Business Insider* 2015), so service robots will soon be a new normal (Frey and Osborn 2013). Second, human-like robots are considered the "holy grail" in robotics (Diller 2011), which suggests that designers assume human-likeness encourages humans' adoption of robots. Against this backdrop, we offer

[4] We also performed a meta-analysis of the results for all seven studies (standard procedures reviewed by Grewal, Puccinelli, and Monroe 2018). The effect sizes were from the results not including control variables. The seven effect sizes from the seven studies were positive, as the HSR resulted in greater consumption (see Web Appendix B), were homogeneous ($\chi^2(6) = 3.81$, $p > .70$), and significant ($\eta = .15$, z = 4.72, $p < .001$). Rosenthal and Rubin's (1982) binomial effect size display (BESD), indicates that HSR would result in 36% greater likelihood of consumption behavior relative to human or control condition. Furthermore, the Rosenthal and Rosnow (2008) file drawer technique suggests that it would take over 55 null results to reduce the overall directional significance to the .05 level, further reinforcing the generalizability of the HSR effect. Web Appendix E provides a summary of four studies not included in this article. Including these four studies results in very similar results, and over 100 null studies would be needed to reduce the overall directional significance to the .05 level.

new theoretical and managerial implications as well as avenues for research.

Theoretical Insights

HSRs can elicit eeriness and human identity threats. Expanding research on technology-related consumer discomfort (e.g., Giebelhausen et al. 2014; Mick and Fournier 1998), we find that HSRs can elicit eeriness and a threat to human identity. Conceptually, this insight has implications for research on customer–employee interactions. Consumers make spontaneous inferences about frontline employees, often before any verbal exchange occurs (Ambady, Krabbenhoft, and Hogan 2006), which can affect customers' loyalty intentions (Scott, Mende, and Bolton 2013). Therefore, marketers need to further investigate when and why customers perceive HSRs to be eerie and with which consequences. On the latter point, we reveal initial insights, as discussed next.

HSRs can elicit compensatory behaviors. Our studies show that consumers cope with HSRs by choosing a status product, seeking social affiliation, and increasing their caloric intake. The compensatory effects of status and food consumption are noteworthy given the prevalence of households with debt and nearly 70% of U.S. consumers being overweight (Centers for Disease Control and Prevention 2014; Mende and Van Doorn 2015). HSRs might undermine efforts to help people control their spending or food consumption, such as requiring restaurants to include caloric data on their menus (e.g., Kozup, Creyer, and Burton 2003). In this sense, our findings are relevant from a consumer well-being perspective. However, in terms of financial performance (e.g., Mittal et al. 2005), our results suggest that HSRs benefit firms when customers purchase more expensive products and consume more.

Contextual cues influence how consumers respond to HSRs. Because firms should deliver positive customer experiences (Lemon and Verhoef 2016), marketers need to understand the circumstances in which consumers have adverse experiences with HSRs. We show that compensatory effects are moderated by social belongingness (Study 3a), the perceived healthfulness of food (Study 3b), and the extent to which HSRs are machinized (Study 4). As marketers venture into the realm of service robots, they need to account for the contexts in which HSRs are being used and consider contextual facets that drive or mitigate consumer responses.

Should robotics be pursuing the "holy grail" of human-like appearance? Supporting the idea of an uncanny valley (Mori, MacDorman, and Kageki 2012), we find that consumers respond more favorably to an HSR that is less (vs. more) human-like (Study 4). However, robots can deviate from human appearance and movement in many ways, some of which might seem more "uncanny" than others (MacDorman 2005). Although we cannot speak to the plethora of design features that could reduce consumer discomfort with HSRs (e.g., facial features, colors, sizes, voices), the "sophistication of humanoid robots has recently soared" (Feil-Seifer and Mataric 2015, p. 5). Marketing scholars, as they gain a deeper understanding of how consumers respond to HSRs, can provide valuable guidance to researchers in robotics and robot developers.

Managerial Implications for the Deployment of HSRs

Service employees, whether they are human or robotic, represent the organization and can affect the customer–firm relationship. Therefore, firms that use HSRs need to understand how customers evaluate and respond to service robots. Against this background, our findings have direct implications, and we suggest a set of guidelines for employing HSRs (Table 4).

First, because HSRs can trigger discomfort, which could undermine customer satisfaction and loyalty, managers should track consumer responses to HSRs through marketing research. Firms should also segment consumers on the basis of their recorded response to HSRs or broader measures such as technology readiness (Parasuraman and Colby 2015) or technology anxiety (Meuter et al. 2003). Companies might then assign human employees to customers who are more likely to fall into technophobe segments but offer HSRs to their technophile peers. More broadly, firms should avoid forcing consumers to interact with HSRs but allow consumers to self-select into being served by an HSR (e.g., Reinders, Dabholkar, and Frambach 2008).

Second, the implementation of HSRs should be guided by strategies that are based on an understanding of the context in which HSRs are employed and that are designed to reduce consumer discomfort. Our Studies 1b and 3a suggest that employing HSRs in settings in which they serve groups provides customers with a built-in coping mechanism.[5] In addition, from a consumer well-being perspective, pairing HSRs with healthy food settings could help prevent an increase in caloric intake (Study 3b). Study 4 cautions against the common approach of deliberately anthropomorphizing robots (e.g., giving them human names, using gender-specific personal pronouns) in order to reduce negative reactions.

Third, although we advocate a marketing approach that provides positive customer experiences (Lemon and Verhoef 2016), we note that HSRs can drive revenue. We found that HSRs nudge customers toward compensatory consumption (premium-priced Fiji water in Study 1a and increased food consumption in Studies 1c–4). As such, HSRs offer opportunities for upselling (e.g., in settings in which consumers choose between base and premium products).

[5] Notably, using HSRs in all-you-can-eat restaurants might not be beneficial because they likely increase customers' food consumption. However, considering the moderating role of social belongingness, HSRs might be an option in food settings that promote sociability (e.g., receptions, parties, happy hours, sports bars). Our research does not account for more nuanced contextual aspects, but the nature of the restaurant (e.g., fast-food drive-through vs. sit-down, fine-dining experience) is also likely to influence how customers respond.

Table 4. Managerial Guidelines Related to the Deployment of HSRs.

	Opportunities to Leverage Potential Benefits	Consideration of Potential Risks
Type of Customer	• Use HSRs for customer segments that have higher levels of affinity with technology (e.g., technology/robot readiness). Leverage existing customer segmentation insights (e.g., use consumer demographics as proxies for robot readiness). • Give customers a choice between humans and HSRs so that consumers who are uncomfortable with HSRs have the option to interact with a human service provider instead.	• Forcing customers to interact with HSRs (i.e., without an option for a human service provider) may lead to unintended consequences such as increased consumption levels. • Consumers with a high tendency to anthropomorphize (a trait variable) may tend to overconsume with humanoid robots to the extent that they anthropomorphize HSRs.
Service Setting	• Use HSRs in social service settings (e.g., receptions, parties, hotel lobbies, high-traffic areas in malls). Consumers tend to cope with exposure to an HSR by seeking out other people, and they may also feel greater belongingness while in the presence of other people. • Creating a sense of social belongingness for consumers in the service environment may help consumers cope with the experience of interacting with an HSR and enhance the experience for the customer.	• Service settings where compensatory consumption does not translate into additional sales or can even drive increased costs for the firm or harm consumers (e.g., all-you-can-eat restaurants). • In settings where consumers lack social belonging (e.g., elderly consumers living alone) or social belonging is not reinforced (in which consumers tend to consume a service alone), care should be taken with the use of HSRs.
Humanizing Service Robots	• Machinize robots as desired. Reminding consumers that the HSR is only a machine will help reduce compensatory consumption. • Anthropomorphizing HSRs (e.g., giving HSRs human names, attributing human emotions to them, increasing their human-like appearance) may lead to compensatory consumption.	• Anthropomorphizing HSRs can result in uncanny HSRs that create discomfort. When introducing such HSRs, reminding consumers that the HSR is a machine and that the consumer can connect to other humans may help alleviate unintended consequences.
Product or Service Type	• Utilize HSRs in the sale of status products, as consumers cope with the experience of an HSR by purchasing status products. • When consumers choose to consume unhealthy food products (e.g., burgers, cake), the use of an HSR may increase sales. • Highlighting a product's/service's health benefits (e.g., focusing on health functions or healthy ingredients) and positioning the product around such benefits reduces compensatory consumption.	• Pairing HSRs with unhealthy products such as food perceived to be unhealthy results in increased consumption, which may undermine consumer health and well-being. • Using an HSR to sell status products may cause consumers to overspend, potentially decreasing consumer financial well-being.

Limitations and Further Research

Limitations of our work open avenues for further research. First, we used scenarios and videos as stimuli because access to fully programmed HSRs is still limited. However, as more robots enter the marketplace, researchers could examine actual customer–HSR encounters. Second, while we find that consumers respond to HSRs with an increased desire for food, some research suggests the opposite stress–eating link (e.g., reduced food intake or a general avoidance of the stressor; Macht 2008; Moschis 2007). Because leaving a restaurant might be more viable than leaving our studies was for our participants, we recognize that consumers might choose other coping reactions than the ones shown in this research. Third, we recognize the need for a more nuanced examination of mediators. For example, further research could examine fine-grained differences in self-discrepancies and related consumer affect in customer–HSR encounters (e.g., Will distinct forms of discomfort emerge, such as anxiety, mortality salience, loss of control, fear of job loss, or reactance to cost-cutting in companies? When and why might social emotions [e.g., embarrassment, shame, guilt, jealousy] occur in consumer–HSR encounters? Are consumers distracted by HSRs, which might undermine self-control and result in suboptimal choices?). Research should also explore additional forms of compensatory consumption driven by customer–HSR encounters (e.g., Mandel et al. 2017) such as a preference for familiar (vs. less familiar) brands. We also note that our data do not address the effects for a company or brand (e.g., repurchase, word of mouth). Although consumer inferences about frontline staff affect the organization (Matta and Folkes 2005), brand personality might moderate this effect (Aaker 1997). Fourth, future studies could explore design-related effects by comparing robots that have distinct features with each other. For example, customer (dis)comfort with service robots might depend on a robot's relative height (Hiroi et al. 2012) or its cuteness (Nenkov and Scott 2014). Such research should also take into account different service settings (e.g., medical vs. security services) and corresponding stereotypes about such service providers. For example, people perceive a male-looking robot as more agentic than a female-looking robot, but they view the female-looking robot as more communal. These appearance-based inferences extend to the robot's task because people believe stereotypically male tasks are a better fit for male rather than female robots, and vice versa (Eyssel and Hegel 2012). Such insights raise the thought-provoking question of whether and which human-related stereotypes (e.g., regarding gender or age) influence how customers respond to HSRs. Finally, we study first-time customer–robot encounters; we do not capture whether our effects persist over multiple encounters with an HSR. Although empirical work in this area is scarce (Dziergwa et al. 2018), examining customer–robot interactions over time (e.g., service relationships) is important.

Acknowledgments

The authors thank Team BORG of the Robotics Lab at the University of Groningen, Frank Beke, and Christopher Roth for their support with producing the video stimuli. The authors are grateful to the three anonymous reviewers for their valuable feedback on this article.

Author Contributions

The first three authors contributed equally and share first authorship.

Associate Editor

Vikas Mittal served as associate editor for this article.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The authors gratefully acknowledge a Customer Experience Research Grant from the Marketing Science Institute, which helped support this research.

References

Aaker, Jennifer L. (1997), "Dimensions of Brand Personality," *Journal of Marketing Research*, 34 (3), 347–56.

Aertsens, Joris, Wim Verbeke, Koen Mondelaers, and Guido Van Huylenbroeck (2009), "Personal Determinants of Organic Food Consumption: A Review," *British Food Journal*, 111 (10), 1140–67.

Aggarwal, Pankaj, and Ann J. McGill (2007), "Is That Car Smiling at Me? Schema Congruity as a Basis for Evaluating Anthropomorphized Products," *Journal of Consumer Research*, 34 (4), 468–79.

Ailawadi, Kusum L., Yu Ma, and Dhruv Grewal (2018), "The Club Store Effect: Impact of Shopping in Warehouse Club Stores on Consumers' Packaged Food Purchases," *Journal of Marketing Research*, 55 (2), 193–207.

Ambady, Nalini, Mary Anne Krabbenhoft, and Daniel Hogan (2006), "The 30-Sec Sale: Using Thin Slice Judgments to Evaluate Sales Effectiveness," *Journal of Consumer Psychology*, 16 (1), 4–13.

Andre, Quentin, Pierre Chandon, and Kelly L. Haws (2019), "Healthy Through Presence or Absence, Nature or Science? A Framework for Understanding Front-of-Package Food Claims," *Journal of Public Policy and Marketing*, 38 (2), 172–91.

Aziz, Azhar Abdul, Fateen Faiqa, Mislan Moganan, Afiza Ismail, and Anitawati Mohd Lokman (2015), "Autistic Children's Kansei Responses Towards Humanoid-Robot as Teaching Mediator," *Procedia Computer Science*, 76 (January), 488–93.

Baisch, Stefanie, Thorsten Kolling, Arthur Schall, Saskia Rühl, Stefanie Selic, Ziyon Kim, et al. (2017), "Acceptance of Social Robots by Elder People: Does Psychosocial Functioning Matter?" *International Journal of Social Robotics*, 9 (2), 293–307.

Bloomberg (2017), "Creating Consumer Buzz with Human-Like Robots," (accessed July 8, 2017), https://www.bloomberg.com/news/videos/2017-03-30/creating-consumer-buzz-with-human-like-robots-video.

Boland, Wendy A., Paul M. Connell, and Beth Vallen (2013), "Time of Day Effects on the Regulation of Food Consumption After Activation of Health Goals," *Appetite*, 70, 47–52.

Brantsæter, Anne Lise, Trond A. Ydersbond, Jane A. Hoppin, Margaretha Haugen, and Helle Margrete Meltzer (2017), "Organic Food in the Diet: Exposure and Health Implications," *Annual Review of Public Health*, 38, 295–313.

Briers, Barbara, and Sandra Laporte (2013), "A Wallet Full of Calories: The Effect of Financial Dissatisfaction on the Desire for Food Energy," *Journal of Marketing Research*, 50 (6), 767–81.

Broadbent, Elizabeth, Vinayak Kuman, Xingyan Li, John Sollers, Rebecca Q. Stafford, Bruce A. MacDonald, et al. (2008), "Robots with Display Screens: A Robot with a More Human-Like Face Display Is Perceived to Have More Mind and a Better Personality," *PLOS ONE*, 8 (8), e72589.

Business Insider (2015), "The Robotics Market Report: The Fast-Multiplying Opportunities in Consumer, Industrial, and Office Robots" (accessed March 6, 2016), http://uk.businessinsider.com/growth-statistics-for-robots-market-2015-2?r=US&IR=T.

Čaić, Martina, Gaby Odekerken-Schröder, and Dominik Mahr (2018), "Service Robots: Value Cocreation and Codestruction in Elderly Care Networks," *Journal of Service Management*, 29 (2), 178–205.

Carrefour (2017), "Customers Will Be Able to Have Fun with Pepper the Robot!" (accessed January 6, 2018), http://www.carrefour.com/current-news/customers-will-be-able-to-have-fun-with-pepper-the-robot.

Centers for Disease Control and Prevention (2014), "Obesity and Overweight" (accessed December 19, 2015), http://www.cdc.gov/nchs/fastats/obesity-overweight.htm.

Cohen, Geoffrey L., and Julio Garcia (2008), "Identity, Belonging, and Achievement: A Model, Interventions, Implications," *Current Directions in Psychological Science*, 17 (6), 365–69.

Conti, Daniela, Santo Di Nuovo, Serafino Buono, and Alessandro Di Nuovo (2017), "Robots in Education and Care of Children with Developmental Disabilities: A Study on Acceptance by Experienced and Future Professionals," *International Journal of Social Robotics*, 9 (1), 51–62.

Cornil, Yann, and Pierre Chandon (2013), "From Fan to Fat? Vicarious Losing Increases Unhealthy Eating, but Self-Affirmation Is an Effective Remedy," *Psychological Science* 24 (10), 1936–46.

Crolic, Cammy, and Chris Janiszewski (2016), "Hedonic Escalation: When Food Just Tastes Better and Better," *Journal of Consumer Research*, 43 (3), 388–406.

Curtis, Sophie (2016), "Pizza Hut Hires Robot Waiters to Take Orders and Process Payments at Its Fast-Food Restaurants," *Mirror* (May 25), http://www.mirror.co.uk/tech/pizza-hut-hires-robot-waiters-8045172.

Davis, Lisa Kay (2016), "Hilton and IBM Pilot 'Connie,' The World's First Watson-Enabled Hotel Concierge Robot" (accessed January 7, 2018), https://www.ibm.com/blogs/watson/2016/03/watson-connie/.

Demetriou, Danielle (2014), "Humanoid Robots Join Staff at Tokyo Science Museum," *Telegraph* (June 25), http://www.telegraph.co.uk/news/worldnews/asia/japan/10924594/Humanoid-robots-join-staff-at-Tokyo-science-museum.html.

DeWall, C. Nathan, Roy F. Baumeister, and Kathleen D. Vohs (2008), "Satiated with Belongingness? Effects of Acceptance, Rejection, and Task Framing on Self-Regulatory Performance," *Journal of Personality and Social Psychology*, 95 (6), 1367–82.

Diller, Antoni (2011), *How to Detect an Android*. Birmingham, AL: School of Computer Science, University of Birmingham.

Dziergwa, Michał, Mirela Kaczmarek, Paweł Kaczmarek, Jan Kędzierski, and Karolina Wadas-Szydłowska (2018), "Long-Term Cohabitation with a Social Robot: A Case Study of the Influence of Human Attachment Patterns," *International Journal of Social Robotics*, 10 (1), 163–76.

Epley, Nicholas, Adam Waytz, and John T. Cacioppo (2007), "On Seeing Human: A Three-Factor Theory of Anthropomorphism," *Psychological Review*, 114 (4), 864–86.

Eyssel, Friedericke, and Frank Hegel (2012), "(S)he's Got the Look: Gender Stereotyping of Robots," *Journal of Applied Social Psychology*, 42 (9), 2213–30.

Feil-Seifer, David, and Maja Mataric (2015), "Human Robot Interaction," white paper (accessed 06/14/2015), http://robotics.usc.edu/publications/media/uploads/pubs/585.pdf.

Fernández-Llamas, Camino, Miguel Ángel Conde, Francisco J. Rodríguez-Sedano, Francisco J. Rodríguez-Lera, and Vicente Matellán-Olivera (2017), "Analyzing the Computational Competences Acquired by K-12 Students When Lectured by Robotic and Human Teachers," *International Journal of Social Robotics* (published electronically November 9), doi:10.1007/s12369-017-0440-9.

Ferrús, Rafael Mateo, and Manuel Domínguez Somonte (2016), "Design in Robotics Based in the Voice of the Customer of Household Robots," *Robotics and Autonomous Systems*, 79 (May), 99–107.

Foster, Mary Ellen, Andre Gaschler, and Manuel Giuliani (2017), "Automatically Classifying User Engagement for Dynamic Multi-party Human–Robot Interaction," *International Journal of Social Robotics*, 9 (5), 659–74.

Frey, Carl Benedikt, and Michael A. Osborne (2013), "The Future of Employment: How Susceptible Are Jobs to Computerization," working paper, Oxford Martin School, University of Oxford.

Gai, Shengnan, Eui-Jung Jung, and Byung-Ju Yi (2016), "Multigroup Localization Problem of Service Robots Based on Hybrid External Localization Algorithm with Application to Shopping Mall Environment," *Intelligent Service Robotics*, 9 (3), 257–75.

Giebelhausen, Michael, Stacey G. Robinson, Nancy J. Sirianni, and Michael K. Brady (2014), "Touch Versus Tech: When Technology Functions as a Barrier or a Benefit to Service Encounters," *Journal of Marketing*, 78 (4), 113–24.

Gray, Kurt, and Daniel M. Wegner (2012), "Feeling Robots and Human Zombies: Mind Perception and the Uncanny Valley," *Cognition*, 125 (1), 125–30.

Greeno, Catherine G., and Rena R. Wing (1994), "Stress-Induced Eating," *Psychological Bulletin*, 115 (3), 444–64.

Grewal, Dhruv, Nancy Puccinelli, and Kent B. Monroe (2018), "Meta-Analysis: Integrating Accumulating Knowledge," *Journal of Academy of Marketing Science*, 46 (1), 9–30.

Groesz, Lisa M., Shannon McCoy, Jenna Carl, Laura Saslow, Judith Stewart, Nancy Adler, et al. (2012), "What Is Eating You? Stress and the Drive to Eat," *Appetite*, 58 (2), 717–21.

Harris, Karen, Austin Kimson, and Andrew Schwedel (2018), "Why the Automation Boom Could Be Followed by a Bust," *Harvard Business Review* (March 13), https://hbr.org/2018/03/why-the-automation-boom-could-be-followed-by-a-bust.

Hayes, Andrew F. (2015), "An Index and Test of Linear Moderated Mediation," *Multivariate Behavioral Research*, 50 (1), 1–22.

Heater, Brian (2016), "Pepper the Robot's Next Job is Pizza Hut Cashier" (accessed January 7, 2018), https://techcrunch.com/2016/05/24/pepperoni-pizza/.

Heater, Brian (2017a), "Pepper the Robot Gets a Gig at the Oakland Airport" (accessed April 19, 2017), https://techcrunch.com/2017/01/25/pepper-robot.

Heater, Brian (2017b), "Zume Scores $48 Million in Funding to Expand Its Robotic Pizza Empire" (accessed November 20, 2017), https://techcrunch.com/2017/10/09/zume-scores-48-million-in-funding-to-expand-its-robotic-pizza-empire/.

Heatherton, Todd F., and Roy F. Baumeister (1991), "Binge Eating as Escape from Self-Awareness," *Psychological Bulletin*, 110 (1), 86–108.

Heatherton, Todd F., C. Peter Herman, and Janet Polivy (1991), "Effects of Physical Threat and Ego Threat on Eating Behavior," *Journal of Personality and Social Psychology*, 60 (1), 138–43.

Hebesberger, Denise, Tobias Koertner, Christoph Gisinger, and Jürgen Pripfl (2017), "A Long-Term Autonomous Robot at a Care Hospital: A Mixed Methods Study on Social Acceptance and Experiences of Staff and Older Adults," *International Journal of Social Robotics*, 9 (3), 417–29.

Higgins, E. Tory (1987), "Self-Discrepancy: A Theory Relating Self and Affect," *Psychological Review*, 94 (3), 319–40.

Hiroi, Yutaka, Takayuki Nakayama, Hisanori Kuroda, Shinji Miyake, and Akinori Ito (2012), "Effect of Robot Height on Comfortableness of Spoken Dialog," in *Human System Interactions (HSI), 2012 5th International Conference*, 29–34.

Holley, David (2017), "Xconomy: U-M Gets $2 M to Study Xenex Robots' Ability to Sanitize Hospitals" (accessed January 22, 2018), https://www.xconomy.com/texas/2017/01/12/u-m-gets-2m-to-study-xenex-robots-ability-to-sanitize-hospitals/.

Hoorn, Johan F., and Sonja D. Winter (2017), "Here Comes the Bad News: Doctor Robot Taking Over," *International Journal of Social Robotics*, December (published electronically December 13, 2017), doi:10.1007/s12369-017-0455-2.

Hu, Elise (2015), "She's Almost Real: The New Humanoid on Customer Service Duty in Tokyo" (accessed May 5, 2018), http://www.npr.org/sections/alltechconsidered/2015/05/14/403498509/shes-almost-real-the-new-humanoid-on-customer-service-duty-in-tokyo.

Huang, Ming-Hui, and Roland T. Rust (2013), "IT-Related Service: A Multidisciplinary Perspective," *Journal of Service Research*, 16 (3), 251–58.

Hudson, John, Marta Orviska, and Jan Hunady (2017), "People's Attitudes to Robots in Caring for the Elderly," *International Journal of Social Robotics*, 9 (2), 199–210.

Jayawardena, C., I. H. Kuo, U. Unger, A. Igic, R. Wong, C. I. Watson, et al. (2010), "Deployment of a Service Robot to Help Older People," in *Intelligent Robots and Systems (IROS), 2010 IEEE/RSJ International Conference*, 5990–95.

Kahn, Jeremy (2017), "Domino's Will Begin Using Robots to Deliver Pizzas in Europe," *Bloomberg* (March 29), https://www.bloomberg.com/news/articles/2017-03-29/domino-s-will-begin-using-robots-to-deliver-pizzas-in-europe.

Kanda, Takayuki, and Hiroshi Ishiguro (2013), *Human–Robot Interaction in Social Robotic*. Boca Raton, FL: CRC Press.

Kanda, Takayuki, Hiroshi Ishiguro, Tetsuo Ono, Michita Imai, and Ryohei Nakatsu (2002), "Development and Evaluation of an Interactive Humanoid Robot 'Robovie,'" in *Robotics and Automation, 2002. Proceedings. ICRA'02. IEEE International Conference*, 1848–55.

Kanda, Takayuki, Rumi Sato, Naoki Saiwaki, and Hiroshi Ishiguro (2007), "A Two-Month Field Trial in an Elementary School for Long-Term Human–Robot Interaction," *IEEE Transactions on Robotics*, 23 (5), 962–71.

Kanda, Takayuki, Mashahiro Shiomi, Zenta Miyashita, Hiroshi Ishiguro, and Norihiro Hagita (2010), "A Communication Robot in a Shopping Mall," *IEEE Transaction on Robotics*, 26 (5), 897–913.

Kätsyri, Jari, Klaus Förger, Meeri Mäkäräinen, and Tapio Takala (2015), "A Review of Empirical Evidence on Different Uncanny Valley Hypotheses: Support for Perceptual Mismatch as One Road to the Valley of Eeriness," *Frontiers in Psychology*, 6 (April), 390.

Kolodny, Lora (2016), "Pepper the Inflight Service Bot Is a Multilingual Flight Attendant Who Doesn't Hate Picking Up Your Garbage" (accessed April 3, 2018), https://techcrunch.com/2016/09/11/pepper-the-inflight-service-bot-is-a-multi-lingual-flight-attendant-who-doesnt-hate-picking-up-your-garbage/.

Kozup, John C., Elizabeth H. Creyer, and Scot Burton (2003), "Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items," *Journal of Marketing*, 67 (2), 19–34.

Lambert, Nathaniel M., Tyler F. Stillman, Joshua A. Hicks, Shanmukh Kamble, Roy F. Baumeister, and Frank D. Fincham, (2013) "To Belong Is to Matter: Sense of Belonging Enhances Meaning in Life," *Personality and Social Psychology Bulletin*, 39 (11), 1418–27.

Lee, Namyeon, Jeonghun Kim, Eunji Kim, and Ohbyung Kwon (2017), "The Influence of Politeness Behavior on User Compliance with Social Robots in a Healthcare Service Setting," *International Journal of Social Robotics*, 9 (5), 727–43.

Lee, Wan-chen Jenny, Mitsuru Shimizu, Kevin M. Kniffin, and Brian Wansink (2013), "You Taste What You See: Do Organic Labels Bias Taste Perceptions?" *Food Quality and Preference*, 29 (1), 33–39.

Lemon, Katherine N., and Peter C. Verhoef (2016), "Understanding Customer Experience Throughout the Customer Journey," *Journal of Marketing*, 80 (6), 69–96.

Li, Dingjun, P. L. Patrick Rau, and Ye Li (2010), "A Cross-Cultural Study: Effect of Robot Appearance and Task," *International Journal of Social Robotics*, 2 (2), 175–86.

Lisjak, Monika, Andrea Bonezzi, Soo Kim, and Derek D. Rucker (2015), "Perils of Compensatory Consumption: Within-Domain Compensation Undermines Subsequent Self-Regulation," *Journal of Consumer Research*, 41 (5), 1186–203.

Liu, Kai, Cai-Hua Xiong, Lei He, Wen-Bin Chen, and Xiao-Lin Huang (2018), "Postural Synergy Based Design of Exoskeleton Robot Replicating Human Arm Reaching Movements," *Robotics and Autonomous Systems*, 99 (January), 84–96.

Looije, Rosemarijn, Mark A. Neerincx, Johanna K. Peters, and Olivier A. Blanson Henkemans (2016), "Integrating Robot Support Functions Into Varied Activities at Returning Hospital Visits: Supporting Child's Self-Management of Diabetes," *International Journal of Social Robotics*, 8 (4), 483–97.

Lowe's (2016), "Lowe's Introduces LoweBot – The Next Generation Robot to Enhance the Home Imporvement Shopping Expiernece in the Bay Area" (accessed April 3, 2018), https://newsroom.lowes.com/news-releases/lowesintroduceslowebot-thenextgenerationrobottoenhancethehomeimprovementshoppingexperienceinthebayarea-2/.

MacDorman, Karl F. (2005), "Mortality Salience and the Uncanny Valley," in *Humanoid Robots, 2005 5th IEEE-RAS International Conference*, 399–405.

Macht, Michael (1999), "Characteristics of Eating in Anger, Fear, Sadness, and Joy," *Appetite*, 33 (1), 129–39.

Macht, Michael (2008), "How Emotions Affect Eating: A Five-Way Model," *Appetite*, 50 (1), 1–11.

Magnusson, Maria K., Anne Arvola, Ulla-Kaisa Koivisto Hursti, Lars Åberg, and Per-Olow Sjödén (2003), "Choice of Organic Foods is Related to Perceived Consequences for Human Health and to Environmentally Friendly Behavior," *Appetite*, 40 (2), 109–17.

Mandel, Naomi, Derek D. Rucker, Jonathan Levav, and Adam D. Galinsky (2017), "The Compensatory Consumer Behavior Model: How Self-Discrepancies Drive Consumer Behavior," *Journal of Consumer Psychology*, 27 (1), 133–46.

Mathur, Maya B., and David B. Reichling (2016), "Navigating a Social World with Robot Partners: A Quantitative Cartography of the Uncanny Valley," *Cognition*, 146 (January), 22–32.

Matta, Shashi, and Valerie S. Folkes (2005), "Inferences About the Brand from Counter-Stereotypical Service Providers," *Journal of Consumer Research*, 32 (2), 196–206.

McCrory, Megan A., Paul J. Fuss, Nicholas P. Hays, Angela G. Vinken, Andrew S. Greenberg, and Susan B. Roberts (1999), "Overeating in America: Association Between Restaurant Food Consumption and Body Fatness in Healthy Adult Men and Women Ages 19 to 80," *Obesity Research*, 7 (6), 564–71.

McShane, Blakeley B., and Ulf Böckenholt (2017) "Single-Paper Meta-Analysis: Benefits for Study Summary, Theory Testing, and Replicability," *Journal of Consumer Research*, 43 (6), 1048–63.

Mead, Nicole L., Roy F. Baumeister, Tyler F. Stillman, Catherine D. Rawn, and Kathleen D. Vohs (2011), "Social Exclusion Causes People to Spend and Consume Strategically in the Service of Affiliation," *Journal of Consumer Research*, 37 (5), 902–19.

Mende, Martin, and Jenny van Doorn (2015), "Coproduction of Transformative Services as a Pathway to Improved Consumer Well-Being: Findings from a Longitudinal Study on Financial Counseling," *Journal of Service Research*, 18 (3), 351–68.

Meuter, Matthew L., Mary Jo Bitner, Amy L. Ostrom, and Stephen W. Brown (2005), "Choosing Among Alternative Service Delivery Modes: An Investigation of Customer Trial of Self-Service Technologies," *Journal of Marketing*, 69 (2), 61–83.

Meuter, Matthew L., Amy L. Ostrom, Mary Jo Bitner, and Robert Roundtree (2003), "The Influence of Technology Anxiety on Consumer Use and Experiences with Self-Service Technologies," *Journal of Business Research*, 56 (11), 899–906.

Mick, David Glen, and Susan Fournier (1998), "Paradoxes of Technology: Consumer Cognizance, Emotions, and Coping Strategies," *Journal of Consumer Research*, 25 (2), 123–43.

Microsoft (2016), "Why HoloLens" (accessed April 3, 2018), https://www.microsoft.com/en-us/hololens/why-hololens.

Mittal, Vikas, Eugene W. Anderson, Akin Sayrak, and Pandu Tadikamalla (2005), "Dual Emphasis and the Long-Term Financial Impact of Customer Satisfaction," *Marketing Science*, 24 (4), 544–55.

Monk, Dan, and Craig McKee (2016), "Surgical Robot Use Scrutinized at Cincinnati VA Medical Center" (accessed January 22, 2018), https://www.wcpo.com/news/insider/surgical-robot-use-scrutinized-at-cincinnati-va-medical-center?page=2.

Moosa, Mahdi Muhammad, and S. M. Minhaz Ud-Dean (2010), "Danger Avoidance: An Evolutionary Explanation of the Uncanny Valley," *Biological Theory*, 5 (1), 12–14.

Mori, Masahiro (2012), "The Uncanny Valley," *Robotics & Automation Magazine, IEEE*, 19 (2), Karl F. MacDorman and Norri Kageki, trans. 98–100.

Moschis, George P. (2007), "Stress and Consumer Behavior," *Journal of the Academy of Marketing Science*, 35 (3), 430–44.

Murphy, Jamie, Charles Hofacker, and Ulrike Gretzel (2017), "Dawning of the Age of Robots in Hospitality and Tourism: Challenges for Teaching and Research," *European Journal of Tourism Research*, 15, 104–11.

Nenkov, Gergana Y., and Maura L. Scott (2014), "'So Cute I Could Eat It Up': Priming Effects of Cute Products on Indulgent Consumption," *Journal of Consumer Research*, 41 (2), 326–41.

Nestlé (2014), "Nestlé to Use Humanoid Robot to Sell Nescafé in Japan" (accessed January 6, 2018), https://www.nestle.com/media/news/nestle-humanoid-robot-nescafe-japan.

Nguyen, Clinton (2016), "Restaurants in China Replacing Waiters with Robots" (accessed December 17, 2017), http://www.businessinsider.com/chinese-restaurant-robot-waiters-2016-7/? international=true&r=US&IR=T.

Osborne, Charlie (2015), "Meet the Robot Bartenders Serving on Smart Ships" (accessed January 9, 2017), http://www.zdnet.com/article/meet-the-robot-bartenders-serving-on-smart-ships/.

Pan, Yadong, Haruka Okada, Toshiaki Uchiyama, and Kenji Suzuki (2015), "On the Reaction to Robot's Speech in a Hotel Public Space," *International Journal of Social Robotics*, 7 (5), 911–20.

Parasuraman, A., and Charles L. Colby (2015), "An Updated and Streamlined Technology Readiness Index TRI 2.0," *Journal of Service Research*, 18 (1), 59–74.

Paul, Justin, and Jyoti Rana (2012), "Consumer Behavior and Purchase Intention for Organic Food," *Journal of Consumer Marketing*, 29 (6), 412–22.

Pierce, David (2017), "This Robot Barista Makes a Dang Good Latte" (accessed November 20, 2017), https://www.wired.com/2017/01/cafe-x-robot-barista/.

Piezzo, Chiara, and Kenji Suzuki (2017), "Feasibility Study of a Socially Assistive Humanoid Robot for Guiding Elderly Individuals During Walking," *Future Internet*, 9 (3), 30–46.

Pinillos, Roberto, Samuel Marcos, Raul Feliz, Edurado Zalama, and Jaime Gomez-Garcia-Bermejo (2016), "Long-Term Assessment of a Service Robot in a Hotel Environment," *Robotics and Autonomous Systems*, 79 (May), 40–57.

Piwek, Lukasz, Lawrie S. McKay, and Frank E. Pollick (2014), "Empirical Evaluation of the Uncanny Valley Hypothesis Fails to Confirm the Predicted Effect of Motion," *Cognition*, 130 (3), 271–77.

Polivy, Janet, and C. Peter Herman (1999), "Distress and Eating: Why Do Dieters Overeat?" *International Journal of Eating Disorders*, 26 (2), 153–64.

Poor, Morgan, Adam Duhachek, and H. Shanker Krishnan (2013), "How Images of Other Consumers Influence Subsequent Taste Perceptions," *Journal of Marketing*, 77 (6), 124–39.

Pulido, José Carlos, José Carlos González, Cristina Suárez-Mejías, Antonio Bandera, Pablo Bustos, and Fernando Fernández (2017), "Evaluating the Child–Robot Interaction of the NAOTherapist Platform in Pediatric Rehabilitation," *International Journal of Social Robotics*, 9 (3), 343–58.

Rajesh, Monish (2015), "Inside Japan's First Robot-Staffed Hotel" (accessed May 10, 2018), https://www.theguardian.com/travel/2015/aug/14/japan-henn-na-hotel-staffed-by-robots.

Ray, Céline, Francesco Mondada, and Roland Siegwart (2008), "What Do People Expect from Robots?" *IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS* (September 22), 3816–21.

Reich-Stiebert, Natalia, and Friederike Eyssel (2015), "Learning with Educational Companion Robots? Toward Attitudes on Education Robots, Predictors of Attitudes, and Application Potentials for Education Robots," *International Journal of Social Robotics*, 7 (5), 875–88.

Reinders, Machiel J., Pratibha A. Dabholkar, and Ruud T. Frambach (2008), "Consequences of Forcing Consumers to Use Technology-Based Self-Service," *Journal of Service Research*, 11 (2), 107–23.

Robinson, Melia (2016), "Meet the Robot that Delivers Fresh Towels and Coffee at Hotels Across Silicon Valley" (accessed November 20, 2017), http://www.businessinsider.com/savioke-robot-hotel-cupertino-2016-8/#this-is-botlr-its-an-autonomous-robot-capable-of-delivering-towels-toothbrushes-morning-coffee-and-more-to-guests-rooms-in-select-california-hotels-1.

Roehrich, Gilles (2004), "Consumer Innovativeness: Concepts and Measurements," *Journal of Business Research*, 57 (6), 671–77.

Romero, Marisabel, and Adam W. Craig (2017), "Costly Curves: How Human-Like Shapes Can Increase Spending," *Journal of Consumer Research*, 44 (1), 80–98.

Rosenthal, Robert, and David Rubin (1982), "A Simple, General Purpose Display of Magnitude of Experimental Effect," *Journal of Educational Psychology*, 74 (2), 166–69.

Rosenthal, Robert, and Ralph Rosnow (2008), *Essentials of Behavioral Research: Methods and Data Analysis*, 3rd ed. Boston: McGraw-Hill.

Rubin, Charles T. (2003), "Artificial Intelligence and Human Nature," *The New Atlantis*, (1), 88–100.

Rucker, Derek D., and Adam D. Galinsky (2008), "Desire to Acquire: Powerlessness and Compensatory Consumption," *Journal of Consumer Research*, 35 (2), 257–67.

Sabelli, Alessandra Maria, and Takayuki Kanda (2016), "Robovie as a Mascot: A Qualitative Study for Long-Term Presence of Robots in a Shopping Mall," *International Journal of Social Robotics*, 8 (2), 211–21.

Schuldt, Jonathon P., and Norbert Schwarz (2010), "The 'Organic' Path to Obesity? Organic Claims Influence Calorie Judgments and Exercise Recommendations," *Judgment and Decision Making*, 5 (3), 144–50.

Scott, Maura L., Martin Mende, and Lisa E. Bolton (2013), "Judging the Book by Its Cover? How Consumers Decode Conspicuous Consumption Cues in Buyer–Seller Relationships," *Journal of Marketing Research*, 50 (3), 334–47.

Shiomi, Masahiro, Kazuhiko Shinozawa, Yoshifumi Nakagawa, Takahiro Miyashita, Toshio Sakamoto, Toshimitsu Terakubo, et al. (2013), "Recommendation Effects of a Social Robot for Advertisement-Use Context in a Shopping Mall," *International Journal of Social Robotics*, 5 (2), 251–62.

Shnabel, Nurit, Valerie Purdie-Vaughns, Jonathan E. Cook, Julio Garcia, and Geoffrey L. Cohen, (2013), "Demystifying Values-Affirmation Interventions: Writing About Social Belonging Is a Key to Buffering Against Identity Threat," *Personality and Social Psychology Bulletin*, 39 (5), 663–76.

Solomon, Justin (2014), "Robots 'Invade' Starwood Hotel" (accessed December 4, 2017), https://www.cnbc.com/2014/08/12/robots-invade-starwood-hotels.html.

Song, Aiguo, Changcheng Wu, Dejing Ni, Huijun Li, and Hongyun Qin (2016), "One-Therapist to Three-Patient Telerehabilitation Robot System for the Upper Limb After Stroke," *International Journal of Social Robotics*, 8 (2), 319–29.

Swartz, Jon (2017), "A Robotic Barista Is Now Serving — Really Fast" (accessed December 4, 2017), http://www.tallahassee.com/story/tech/2017/01/30/robotic-barista-now-serving-really-fast/95888780/.

Tajitsu, Naomi (2017), "Japan Automakers Look to Robots to Keep Elderly on the Move" (accessed January 22, 2018), https://www.reuters.com/article/us-toyota-robots/japan-automakers-look-to-robots-to-keep-elderly-on-the-move-idUSKBN17E0C8.

Taylor, Bill (2016), "How Domino's Pizza Reinvested Itself," *Harvard Business Review* (November 28), https://hbr.org/2016/11/how-dominos-pizza-reinvented-itself.

Tobe, Frank (2016), "How Is Pepper, Softbank's Emotional Robot, Doing?" (accessed May 10, 2018), https://www.therobotreport.com/how-is-pepper-softbanks-emotional-robot-doing/.

Ulu, Mustafa (2017), "ZoraBots, The Worldwide Leader of Humanoid Robots in Healthcare, Sets Up in the United States" (accessed January 06, 2018), https://www.musttechnews.com/zorabots-humanoid-robots-healthcare-united-states/.

Van Doorn, Jenny, Martin Mende, Stephanie M. Noble, John Hulland, Amy L. Ostrom, and Dhruv Grewal, et al. (2017), "Domo Arigato Mr. Roboto: Emergence of Automated Social Presence in Organizational Frontlines and Customers' Service Experiences," *Journal of Service Research*, 20 (1), 43–58.

VanEpps, Eric M., Julie S. Downs, and George Loewenstein (2016), "Advance Ordering for Healthier Eating? Field Experiments on the Relationship Between the Meal Order–Consumption Time Delay and Meal Content," *Journal of Marketing Research*, 53 (3), 369–80.

Vaussard, Florian, Julia Fink, Valerie Bauwens, Philippe Retornaz, David Hamel, and Pierre Dillenbourg, et al. (2014), "Lessons Learned from Robotic Vacuum Cleaners Entering the Home Ecosystem," *Robotics & Autonomous Systems*, 62 (3), 376–91.

Victor, Anucyia (2014), "Restaurant Employs £6,000 Robots to Replace Waiters and Save Money on Staff Costs . . . But Don't Expect Service with a Smile," *Daily Mail* (November 26), http://www.dailymail.co.uk/femail/food/article-2850186/Restaurant-employs-6-000-ROBOTS-replace-waiters-save-money-staff-costs.html.

Wada, Kazuyoshi, and Takanori Shibata (2007), "Living with Seal Robot: Its Sociopsychological and Physiological Influences on the Elderly at a Care House," *IEEE Transactions on Robotics*, 23 (5), 972–80.

Wagner, Dylan D., Rebecca G. Boswell, William M. Kelley, and Todd F. Heatherton (2012), "Inducing Negative Affect Increases the Reward Value of Appetizing Foods in Dieters," *Journal of Cognitive Neuroscience*, 24 (7), 1625–33.

Wallis, Deborah J., and Marion M. Hetherington (2004), "Stress and Eating: The Effects of Ego-Threat and Cognitive Demand on Food Intake in Restrained and Emotional Eaters," *Appetite*, 43 (1), 39–46.

Wallis, Deborah J., and Marion M. Hetherington (2009), "Emotions and Eating. Self-Reported and Experimentally Induced Changes in Food Intake Under Stress," *Appetite*, 52 (2), 355–62.

Wan, Jing, and Pankaj Aggarwal (2015), "Befriending Mr. Clean: The Role of Anthropomorphism in Consumer–Brand Relationships," in *Strong Brands, Strong Relationships*, S. Fournier, M. Breazeale and J. Avery, eds. Abingdon, England: Routledge, 119–34.

Wang, Shensheng, Scott O. Lilienfeld, and Philippe Rochat (2015), "The Uncanny Valley: Existence and Explanations," *Review of General Psychology*, 19 (4), 393–407.

Watson, David, Lee Anna Clark, and Auke Tellegen (1988), “Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales,” *Journal of Personality and Social Psychology*, 54 (6), 1063–70.

Wicklund, Robert A., and Peter M. Gollwitzer (1982), *Symbolic Self-Completion*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Yogeeswaran, Kumar, Jakub Złotowski, Megan Livingstone, Christoph Bartneck, Hidenobu Sumioka, and Hiroshi Ishiguro (2016), “The Interactive Effects of Robot Anthropomorphism and Robot Ability on Perceived Threat and Support for Robotics Research,” *Journal of Human–Robot Interaction*, 5 (2), 29–47.

Zellner, Debra A., Susan Loaiza, Zuleyma Gonzalez, Jaclyn Pita, Janira Morales, and Deanna Pecora, et al. (2006), “Food Selection Changes Under Stress,” *Physiology & Behavior*, 87 (4), 789–93.

Zlotowski, Jakub Aleksander, Kumar Yogeeswaran, and Christoph Bartneck (2017), “Can We Control It? Autonomous Robots Threaten Human Identity, Uniqueness, Safety, and Resources,” *International Journal of Human–Computer Studies*, 100 (April), 48–54.