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The Impact of Hotel Service Robot Appearance and Service Attributes on Customer Experience

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DEDICATION

This dissertation is dedicated to my husband, my mom, my academic adviser, and my committee members without whom it was almost impossible to complete.

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ABSTRACT

In the past decade, an increasing discussion has taken place regarding the employment of hotel service robots. One critical issue is the impact service robots exhibit on customer experience. However, most of the existing studies focus on service robots' technical functions or customer's adoption behavior instead of customers' psychological or attitudinal reactions toward the robot. Meanwhile, the emergence of humanoid robots has raised great attention from both researchers and industry practitioners. Humanlike features (e.g. facial expressions, emotions, and motions) inherently affect customer experience in a hotel environment. Nevertheless, limited literature exists in incorporating service robots' anthropomorphism and service attributes into customer experience and perceived brand equity. Not many studies have included both the service robots' traits and customers' personality traits when assessing customer experience. Therefore, the purpose of the current study is to explore and understand the impact of service robots' appearance, service efficiency, and service customization on customer experience interacting with the service robot in the context of a hotel front desk check-in service. Customers' personality traits such as robot anxiety, technology readiness, and self-image congruity are also taken into consideration. This study also examines the influence of service robots' appearance and service attributes on hotel customers' perceptions toward the hotel brand equity.

The current study used experiments and online surveys to test the theoretical model and the perception changes toward the hotel brand equity. Two samples of 220 and

161 hotel customers who have completed the check-in services in person in the past 12 months were recruited for Study 1 and Study 2, respectively. Pilot studies were conducted, and hypothetical scenarios were embedded in the online surveys. The results showed that hotel service robots' appearance (extremely humanoid vs. humanoid vs. non-humanoid) did not lead to different customers' experiences interacting with the service robot. Service efficiency was a significant factor while service customization was not in affecting customer experiences. Customers' levels of technology readiness and self-image congruity exerted significant impacts on customer experiences. Moreover, customers did not show obvious perception changes before and after interacting with the hypothetical service robot. Theoretical and practical contributions were discussed.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Over the past few years, the world has witnessed a rapid development of artificial intelligence (AI). AI is defined as "any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals" (Poole, Mackworth, & Goebel, 1998, p. 1). AI was introduced as an independent academic discipline in the late 1950s (Crevier, 1993). It has also been applied to multiple fields such as healthcare, economics, and automotive industry. Among various forms of AI, robotics is regarded as one of the most essential forms because AI calls for machines that mimics human cognitive functions (Russell & Norvig, 2009). Robotics refers to the use of robots and computer systems for their sensory feedback and information processing to accomplish learning and problem-solving tasks (Nocks, 2007). Studies about robotics have been conducted in various social science disciplines, including service marketing, sociology, and psychology (e.g. Jamone et al., 2016; Meister, 2014; Wirtz et al., 2018).

As a rapidly developed social science, the hospitality discipline has also started to adopt robots to deliver basic services in place of hotel staff. Such robots are called "hotel service robots". The Aloft Hotel in California, a stylish and boutique hotel brand of Marriott International, for example, is one of the hotels that adopts a service robot ("Butler") to deliver room service to hotel guests. Another well-known example is Henn na Hotel in Japan, which uses service robots as its hotel employees, mainly providing

front desk services in the hotel lobby. Despite the rapid development and adoption of service robots in the hotel industry, little empirical research has been documented to understand hotel customers' experiences interacting with service robots. Therefore, it is critical for the hotel industry to evaluate the contributions of service robots to hotel operations by examining the effect of robot attributes on customers' overall experiences interacting with service robots.

Debates are unavoidable when new innovations and technologies are introduced to the current business environment. Researchers (e.g. Morgan, 2017; Onibalusi, 2017) question whether robots only make things look "cooler", but their ability to deliver services is not special or superior, compared to human beings. In other words, the added value from employing robots is not obvious. On the contrary, other researchers argue that service robots can provide more personalized, speedy, and consistent services that enhance customers' unique experiences, which are not always guaranteed by human employees (Weiss et al., 2009). According to the Travel Weekly Report (2019), hotels have been using service robots in various areas such as front desk, housekeeping, concierge, and room services to enhance customers' experiences and reduce operating costs (Latif, 2018). Due to the controversial debates on the employment of service robots and the prevalence of employing service robots in hotels, researchers' immediate attention has been provoked to uncover customers' psychological, attitudinal, and behavioral reactions toward service robots as their service counterparts (Primawati, 2018).

In the early stages of robotics research, most researchers mainly focus on the operational challenges or technical functions of service robots (Forlizze & DiSalvo, 2006;

Luo & Cai, 2012; Pinillos et al., 2016). As more and more service robots are designed with social features such as expressing emotions and creating conversations, researchers have shown keen interest in understanding hotel customers' experiences about their personal interactions with service robots (Ezer, Fisk, & Rogers, 2009; Hall et al., 2017; Kuo et al., 2009). The concept of "human-robot interaction" (HRI) (Dautenhahn, 2007) has been gradually discussed in the current hospitality discipline as a marketing tool to establish a unique hotel brand image (Zalama et al., 2014). Even though researchers have conducted many studies on service robots (López et al. (2013; Pinillos et al., 2016), they were either descriptive or fragmented, resulting in a lack of generalizability. As suggested in the study by Heerink et al. (2011), this study focuses more on scientifically explicit examinations of service robots through a comprehensive and empirical analysis of customers' robot interaction experiences.

1.2 STATEMENT OF THE PROBLEM

The emergence of "humanoid" service robots has raised concern regarding the importance of their appearance design (Levy, 2009). Humanoid robots feature a human-like appearance, motion, and personality. As a strategy for successfully integrating service robots into social environments (Duffy, 2003), the appearance design of service robots has been widely discussed in social psychology (Salem et al., 2013) and information technology (Matsuda, Hiraki, & Ishiguro, 2016). Service robots differ from other technologies in that they have humanlike characteristics embedded, which could lead to different customer experiences interacting with this innovative technology. The "design" of socially interactive robotics has recently gained much attention from researchers as well as industry practitioners (Fong et al., 2003; Sundar et al., 2017) and

has driven social robotics research to facilitate the gradual integration of robots into the real world (Zalama et al., 2014).

There are different opinions toward the effect of service robot appearance on customer experience. For example, Goetz, Kiesler, and Power (2003) state that humanlike features of robots provide cues that positively influence people's perceptions of the robot's propensities and acceptance intentions, whereas Solon (2011) claims that "there is no point making robots look and act like humans" because what affects consumers' experiences is the function, not the appearance. Furthermore, Mori (1970) proposes the Uncanny Valley Theory and posits that while initial increases in humanlike appearance can enhance people's evaluations of robots, extremely humanlike robot appearance seem to cause feelings of uneasiness because the imitation of a human being is never perfect. Therefore, research questions in recent studies have focused on whether and how a humanoid design of service robots would affect customers' experiences.

Although humanoid robots have started to appear in the lodging industry (Pinillos et al., 2016), research on hotel humanoid robots and customers' experiences is still at its infancy. Zhong and Verma's (2009) study reveals that customers expect hotel service robots to be able to handle check-in and check-out services, indicating that the front desk service area is the key area that would leave a critical first impression, and consequently shape customers' experiences. However, little is known about such interaction experiences with the "humanoid" or "non-humanoid" hotel service robots for check-in and check-out services (Tussyadiah & Park, 2018). A recent study shows that the adoption of "humanoid" service robots changes the nature of hotel service experience as service encounters are redefined by HRI (Tussyadiah & Park, 2018). It is also found that

the hotel's use of humanoid service robots generates customers' anxiety and excitement at the same time (Burgin, 2017). Due to the inconsistent findings and lack of research in this field (Hashim & Yussof, 2017; Solon, 2011), it is necessary to conduct empirical studies regarding the relationship between the service robot appearance and customers' experiences interacting with the robot. Considering the trend of adopting "humanoid" robots in hotel businesses, it is of great importance to understand customers' experiences with service robots that possess humanlike features, which consequently helps evaluate whether the hotel's investment in a "humanoid" design is value-added. The current study followed along the research idea from the study conducted by Van Doorn et al. (2016) and the following study from the same group of researchers Mende et al. (2019), which focused on the discussion of the humanoid feature of service robots in service industry.

In addition to the appearance design of the service robots, the functional design of service robots serves as a key influential driver of customers' experiences as well. As an essential dimension of service quality (Parasuraman, Zeithaml, & Berry, 1985), service efficiency is found to affect customer satisfaction and experience in the hospitality industry through technologies (Huang, Huang, & Wu, 1996; Nield, Kozak, & LeGrys, 2000). Zalama et al. (2014) claim that compared to an on-site human agent, the service efficiency provided by service robots is low when the task is complex. However, more studies are needed to assess the impact of service efficiency provided by service robots on customers' experiences. Moreover, how service efficiency interplays with robot appearance remains under researched.

In addition, the social feature of service robots – the ability to provide customized service - is also important in examining customers' experiences. Robots are different

from other technologies in that they possess social features such as empathy and emotions (Fong, Nourbakhsh, & Dautenhahn, 2003), which allow them to provide personalized services to customers by memorizing their names or preferences. The impact of customized service on customers' experiences is found to be enhanced by adopting advanced technologies (Wu & Li, 2011); however, there is a lack of empirical studies focusing on the impact of customized service provided by humanoid service robots on hotel customers' experiences interacting with the service robot.

According to Mori's (1970) Uncanny Valley Theory, "user anxiety or eeriness" is a critical concept that relates to service robot appearance. This concept can be explained by "technology anxiety", which is developed later by Parasuraman (2000), referring to a propensity to embrace technology and expectation to influence the predisposition to use new technologies. The role of technology anxiety is versatile; it serves as an antecedent of technology use (e.g. Kim, Mejia, & Connolly, 2017), a moderator (e.g. Kim & Qu, 2014), or a mediator (e.g. Wang et al., 2015) in social studies. Extending this concept to robotics, anxiety that prevents humans from interacting with robots in daily life is named "robot anxiety" (Nomura & Kanda, 2003). Similar to "technology anxiety", "robot anxiety" exhibits influence on customer perception toward using the robot (Fridin & Belokopytov, 2014). Considering hotel customers' potential levels of anxiety toward humanoid service robots as their service encounter, this study incorporates this concept in the theoretical model.

Recent studies in hotel service robots have used the Technology Readiness Index (TRI) to assess the robot's performance and customers' use intentions (Lu, Cai, & Gursoy, 2019). Moreover, different levels of Technology Readiness (TR) result in

different user evaluations (Wang & Sparks, 2014). TR has been used as a moderator in the relationship between the features of a technology (e.g. service robot) and its users' responses in social science studies (Shin & Perdue, 2019). As a main stream of technology-related research, TR is recommended to be incorporated into studies that emphasize customer experience in service encounters (Morosanand DeFranco, 2014).

Additionally, studies have expanded the Uncanny Valley Theory by adding the concept of "self-image congruity". It is claimed to be a key variable that leads to users' anthropomorphistic thinking (Epley et al., 2007) and affects their evaluations of advanced technologies (Kang, Hong, & Lee, 2009). Due to the tendency to seek consistency in their beliefs and behaviors, people with different levels of self-image congruity with technology would demonstrate different attitudes and behaviors toward hotel service robots (Su, Mariadoss, & Reynolds, 2015). However, not many studies have systematically examined the role of self-image congruity in affecting hotel customers' experiences. A research gap exists in terms of the effect of self-image congruity in hotel service robot studies (Murphy, Gretzel, & Pesonen, 2019).

Lastly, the construct "service brand equity" has been formed since customer experience became the centerpiece of business marketing (Berry, 2000). "Hotel brand equity" has emerged along with the development of the hospitality industry. Researchers have found the significant impact of technology on customers' perceived brand equity (Šeric, Gil-Saura, & Mollá-Descals, 2016), but few studies have explored whether and how humanoid service robots would affect customers' perceptions toward the hotel brand equity. There is an argument that the exposure to humanoid service robots will not change customers' perceived brand equity toward their preferred hotels because the

impact of having a service robot in front desk area is negligent; however, some researchers (e.g. Wirts et al., 2018) defend that customers' perceived images and service quality would change as the employment of a service robot is an addition to the tangible assets to the hotel. As the conclusions remain debatable, it is necessary to examine how service robots could affect hotel customers' perceptions toward the hotel brand that they normally choose while traveling. Based on the discussion above, this study raises the following research questions:

1) How will the hotel service robot appearance and efficiency/customization affect customers' perceived experiences interacting with the service robot?

2) Will customers' levels of robot anxiety affect the relationship between the hotel service robot appearance and customers' experiences interacting with the service robot?

3) Will customers' technology readiness and self-image congruity influence their perceived experiences interacting with the service robot that have different levels of appearance and efficiency/customization?

4) Will customers' perceived brand equity toward their preferred hotel exhibit significant differences before and after interacting with the service robot that have different levels of appearance and efficiency/customization?

1.3 PURPOSE OF THE STUDY

Based on the research gaps discussed above, the main purpose of this study is twofold. First, the current research seeks to examine the effect of hotel service robot appearance on customers' experiences interacting with the service robot. Specifically, this study proposes that the presence or absence of humanoid appearance of a hotel service robot would affect customers' experiences interacting with the service robot for

front desk check-in services. Two experimental studies are conducted to achieve the research goals. Study 1 incorporates the service robot efficiency with appearance and assesses both the main effect and interaction effects of the treatments on customers' experiences, whereas Study 2 takes the robot's capability of providing customized services into consideration and assesses its interplay with the service robot appearance on customers' experiences. In both studies, robot anxiety is proposed as a moderator that might potentially affect the relationship between robot appearance and customers' experiences. In addition, customers' perceived experiences interacting with the hotel service robot is predicted to be influenced by their levels of self-image congruity and technology readiness. Second, this study proposes to compare customers' perceived brand equity before and after being exposed to the hypothetical hotel service robot to identify whether the employment of service robots would change their perceived quality, brand image, brand awareness, and brand loyalty toward their preferred hotels. Overall, the goal of this research is to develop a better understanding toward the impact of robot design attribute (appearance), functional attribute (efficiency), social attribute (customization), and customers' personal attributes (level of anxiety, level of self-image congruity, and level of technology readiness) on customers' experiences interacting with service robots and to explore whether the presence of service robots with certain attributes would change hotel customers' perceptions toward a particular hotel's brand equity.

1.4 SIGNIFICANCE OF THE STUDY

Technology adoption has been examined numerous times in the hospitality literature, yet there remains a need to examine user experience of service robots in a hotel

environment. This study synthesizes concepts from anthropomorphism, technology anxiety, self-congruity theory, technology readiness, and customer experience in the theoretical model, incorporating robot, hotel, and customer attributes to provide a better understanding of service robot interaction experience.

The current study is one of the very first studies that focuses on the impact of hotel service robot appearance, an important feature of service robots (Waters et al., 2008), on customers' experiences interacting with the service robot. While the existing studies about hotel service robot appearance remains mostly conceptual (Murphy, Gretzel, & Pesonen, 2019), this study enriches the findings from a systematic and empirical perspective. Meanwhile, service efficiency and customization, two essential features that are important in the service industry and differentiate robots from other technologies are taken into consideration, advancing the knowledge of service robotics in the hospitality field. Methodologically, the current study adopts experiments along with online surveys to provide a solid and comprehensive understanding of customers' reactions in different hypothetical scenarios, supplementing the existing literature with a more direct research method. In general, the existing literature on hotel service robots is either too broad, focusing on general IT applications, or too specific, focusing on one type of robot and limiting the generalizability of the research findings. More empirical studies in humanoid service robots should be conducted to supplement the current literature from the perspective of customer experience. This study is innovative in that it extends the literature of service robot to the scope of the hotel environment.

Additionally, it is of great importance for hoteliers to understand whether they should invest in the design of a service robot and what design attributes can enhance

customer experience. Understanding customers' needs and preferences toward hotel service robots is critical in improving hotel performance. For hoteliers who plan to join the robotic market to gain competitive advantages, results from this study can potentially help them gain a better understanding on what the robot should look like, what services the robot should provide, and how to attract customers with different personal characteristics. Since the appearance of robots makes a big difference in the cost of a robot (Negi et al., 2008), this study can potentially guide hoteliers with a smarter direction to optimize their existing resources. For hoteliers who are reluctant to employ service robots, tracking customers' perceived brand equity changes can give them a better idea on whether it is worthwhile to follow the trend. The findings of this study offer directions for future research, focusing on the value of robotics in hospitality and tourism from the perspectives of two key stakeholders, hotel customers and hotel managers.

CHAPTER 2

LITERATURE REVIEW

2.1 THE DEVELOPMENT OF ROBOTICS

Recently, "robot" has become one of the most revolutionary forms of technology used in the current business environment. Originally, robot is defined as "a machine operated in a manufacturing setting only" (International Organization for Standardization, 1994). In 2012, ISO (2012) defines robots as devices that apply to both manufacturing and non-manufacturing settings and classifies them into two categories: industrial robots and service robots. The official definition of robot is "a machine - especially one programmable by a computer - capable of carrying out a complex series of actions automatically" (Oxford Dictionary, 2016). Robotics appears as an interdisciplinary subject of science and engineering, and mainly deals with the use of robots and computer systems (Siciliano et al., 2010).

Robots are designed to assist humans in various purposes and fields. They can help individuals with special needs (Tapus & Mataric, 2008), improve the operational proficiency at work as well as accomplish tasks or goals that humans cannot easily achieve (Round et al., 2008), and provide convenience and fun in people's daily life (Lu, Cai, & Gursoy, 2019). Warwick (2013) classifies robots into six categories: industrial robots (e.g. assembly robot), mobile robots (e.g. automatic guided vehicle), service robots (e.g. disability robot), educational robots (e.g. learning-assistive robot), modular robot

(e.g. cleaning robot), and collaborative robots (e.g. iRobot). Along with the technology advances, robotics has been applied not only in manufacturing but also in agriculture, domestics, hospitals, military, and household (Tsarouchi, Makris, & Chryssolouris, 2016). As robots' roles and services are diversified in current business environment, researchers and industry practitioners have started to pay their attention to robots, in particular, customers' experiences interacting with robots.

Rapidly developing AI and machine learning have become better, cheaper, and smarter and will virtually transform all service sectors and influence customer experience (Wirtz & Zeithaml, 2018). The infusion of robots in the service industry has drawn significant attention from practitioners (Lelieveld & Wolswinkel, 2017; Manyika *et al.*, 2017; Microsoft, 2018) and researchers (Huang & Rust, 2018; Marinova *et al.*, 2017; Čaić *et al.*, 2018; van Doorn *et al.*, 2017). In a frontline service setting, service robots represent the interaction counterpart of a customer and are viewed as "social robots" that accommodate customers' needs and requests. In the context of social interaction, service robots create some degree of automated social presence (ASP) during the service encounter, referring to the ability to make consumers feel that they are in the company of another social entity (van Doorn et al., 2017).

Technology in the service encounter has been studied from different aspects. The mainstream of technology research in social studies lies mainly in the impact of technology adoption on customer experience (e.g. Hua et al., 2015; Zhu et al., 2013) and customer motivation to adopt technology (e.g. Lee et al., 2012). Unique features of robotics have been discussed in recent studies. The first unique feature is related to service robots' presence and embodiment (Dautenhahn, 1999; Tung & Law, 2017).

Presence refers to social presence (e.g. users' mental reactions as if the robots were actual humans) (Nass & Moon, 2000) and physical presence (e.g. appearance) (Lee et al., 2006), while embodiment involves robots' verbal and non-verbal behaviors and dynamic interactions with human beings to create face-to-face experiences (Cassell, 2000; Ziemke, 2003). Another unique feature that service robots possess are functional features that differentiate them from human customer-contact employees. In a service encounter, customer-contact employees are directly responsible for providing "functional" quality, which is to cater to customers' needs properly (Bitner, 1990). For service robots, the unique "functional" feature refers to the ability to gather customer information and reduce time of service delivery. Lastly, the capability to provide great personalization is a unique social feature of service robots that would affect customer experience in hotels (Le et al., 2017; Ohlan, 2018). The current study focuses on the main attributes of a hotel service robot from its design feature (humanoid appearance), functional feature (efficiency), and social feature (personalization) and the impact they exert on customer experience.

2.1.1 Service Robots in Non-hospitality Fields

Recently, service robots have been introduced to the service industry, exhibiting social characteristics (Rodriguez-Lizundia et al., 2015). The International Federation of Robotics (IFR, 2016) defines a service robot as "a robot that performs useful tasks for humans or equipment excluding industrial automation application". Social and practical objectives of service robots include providing information or assisting users in social environments (Zalama et al., 2014). Human-robot interaction (HRI) has been a concept that is widely used to emphasize the social aspects of service robots (Mutlu & Forlizzi,

2017). Dautenhahn (2007b) defines HRI as "Robotiquette", meaning the "social rules for robot behavior (a ‘robotiquette’) that is comfortable and acceptable to humans". The concept of HRI has dominated robotics research ever since researchers started to increasingly include it in service robot studies (Jordan et al., 2013).

In the past decades, research on robotics has been dramatically increased and has experienced a paradigm shift in non-hospitality fields. At an early stage, most studies about robotics are conducted in the fields of engineering and information technology (IT), focusing on the technical aspects of robotic design, architecture, and performance (Gosselin & Angeles, 1991). Since the late 2000s, a paradigm shift has occurred from the rigid operational robots to more service-oriented robots in the fields of healthcare, marketing, home/assistive service, education, and sociology/social psychology (Tung & Law, 2017). Table 2.1 summarizes the major studies on the progress of robotics in non-hospitality fields, along with key findings, contributions, and limitations. A mainstream of robotics study is to identify users’ perceptions and acceptance toward service robots by using the unified theory of acceptance and use of technology (UTAUT) (Alaiad, Zhou, & Koru, 2014; Heerink et al., 2006). Researchers (e.g. Broadbenst, Stafford, & MacDonald, 2009); Heerink et al., 2011), for example, identify different perceptions of service robots by users’ demographic profile; younger male adults have more positive attitudes toward service robots than older female adults.

Table 2.1 Service Robot Research in Non-Hospitality Fields

Field	Author(s)	Key Findings	Major Contributions	Methodology	Limitations
Healthcare	Broadbent, Stafford, & MacDonald (2009)	Individual factors (age, gender, experience, cognitive ability, education, culture, anxiety, attitudes) and robot factors (appearance, humanness, size, gender, personality, adaptability) affect users' robot acceptance.	Summarizes variables in the literature that influence responses to healthcare robots.	Review paper	Users' expectations and specific needs are overlooked in this study.
	Kuo et al. (2009)	Significant gender effect (male had more positive attitude toward the robot than female); Age is not found significant.	Adopts "attitudes toward healthcare robots scale" (ATHR) and robot attitudes scale (RAS).	Survey	Lacks a measurement of HRI.
	BenMessaoud, Kharrazi, & MacDorman (2001)	The three main barriers to adoption for both users and nonusers were Perceived Ease of Use and Complexity, Perceived Usefulness, and Perceived Behavioral Control.	Contextualized and supplemented constructs of UTAUT in robotic-assisted surgery.	Interview	Uses UTAUT constructs in a qualitative way; context dependent.
	Hall et al. (2017)	Age matters in the perception of usefulness or robots (younger people prefer assistive robots more).	Specifically compares three age groups and addresses differences among these groups in acceptance of robots.	Experiment	Purposive sampling limits generalizability.
Marketing	Barnett et al. (2014)	Consumer value perceptions of robots in a retail service environment are of a	Adopts a "Value-Dominant Logic" approach that provide a means of user-	Conceptual	No quantitative data is collected.

		paradoxical nature where behavioral and social norms are expected of the robot, yet not for the user.	centric methodology in multidisciplinary collaborations.		
	Glende et al. (2016)	Stakeholders consider functionality, usability, safety, cost, and ethical aspects influential factors in their acceptance behavior of robots.	Develops a framework based on McCarthy's (1960) Marketing Mix (4Ps) using user-centered design (qual & quan).	Conceptual	Only European stakeholders; needs scale development.
Home/ Assistive service	Forlizze & DiSalvo (2004,2006, 2007)	The aesthetic, symbolic and emotional responses to the "Roomba" were driven by social associations. "Roomba"s novelty, autonomy, and ease of use triggers emotional responses and users' evaluations of the robot.	Adopts a qualitative ethnographic approach (social ecology theory) to have a grounded understanding of the actual use of domestic service robots that considers the material, social, and cultural details of robot (Lauria et al., 2001) in home context.	Ethnographic	Exploratory; needs empirical tests on the adaptation of robotic products in the domestic environments.
	Ezer, Fisk, & Rogers (2009)	Individuals see robots as performance-directed machines, less so as social devices, and least as unproductive entities. Younger and older adults with comparable technology experience have similar expectations of robots as performance-oriented machines.	Examines attitudinal acceptance of domestic robots using Technology Acceptance Model and Robot characteristics among younger and older users. Confirms that TAM (Davis, 1989) is robust.	Survey	There is no specific definition or scope of domestic robots measured; sample size is small.

	Klamer & Allouch (2010)	Social factors and intrinsic motivations are significant in affecting robot acceptance.	Conducts interviews and develops an original measuring questionnaire.	Conceptual	Needs empirical studies; small sample size.
	Fridin & Belokopytov (2014)	Perceives sociability significantly affects perceived enjoyment; anxiety and perceived adaptability significantly affect perceived usefulness; attitudes and perceived usefulness affect acceptance intentions.	UTAUT is modified to the education context; a first attempt to investigate teachers' acceptance of a social assistive robot.	Survey	Small sample size; personal, institutional, technological, factors should be considered.
	Alaiad, Zhou, & Koru (2013, 2014)	Perceives security is also a significant factor of use intention, but effort expectancy is not.	Extends UTAUT by adding perceived security. Enables robot designers and service providers to understand what influence stakeholders' adoption decisions.	Survey	User characteristics are not considered.
Sociology; Social Psychology	DiSalvo et al. (2002)	The presence of certain features, the dimensions of the head, and the total number of facial features heavily influence the perception of humanness in robot heads	Provides an initial understanding of what features and dimensions of a humanoid robot's face most dramatically contribute to people's perception of its humanness.	Survey	Small sample size. Focuses on the humanlike design not its use intention.
	Severinson-Eklundh, K., Green, A., & Hüttenrauch (2003)	Addresses only the primary user in service robotics is unsatisfactory, and that the focus should be on the setting, activities and social interactions of the group of	First time focuses on personality of a robot and paradigm of communication at a workplace.	Experiment	Limited setting with only analytical results. Focuses on the robot

		people where the robot is to be used.			design not the user experience.
	Sabanovic (2006, 2010)	Social and cultural factors influence the way robots are designed, used, and evaluated. Robots significantly affect the construction of social values and meanings. In social robotics, quantitative metrics (e.g. the time it takes the robot to complete its task) are less relevant than its ability to engage with users.	Combined technical (push) and social (pull) contexts to provide an alternative framework for developing social applications of robots, using a qualitative approach. Proposed to evaluate robot acceptance outside the laboratory.	Observation	Lacks participatory and contextually situated design methodology; lacks explicit exploration of the feedback from users.
	Bartneck et al. (2009)	There was a significant effect of all factors—speed, task, and type of planning strategy. Strong correlation coefficients were obtained between speed and reported levels of Anxiety, Agitation and Surprise	Scale development based on a literature review of five dimensions of HRI: Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety using semantic scales.	Survey	Only 7 subjects used.
	Heerink et al. (2006, 2008, 2010a, 2010b, 2011)	Good acceptance of iCAT; depends on social qualities of the robot; gender differences. Social presence influences acceptance; enjoyment does not depend on ease of use but has a strong impact on intention to use. Age and	UTAUT Expanded UTAUT questionnaire (Tanaka et al., 2006).	Survey	Focuses on one particular robot iCAT, which has only been available for five days and only ten participants

		education negatively relate to use intention.			are fully involved.
	Mubin et al. (2010); Diaz et al. (2011)	Different levels of acceptance of the robot from the initial attraction to long-term social engagement.	Develops game experience survey questions that measure users' satisfaction and perception about robots.	Survey	Constrains to game on child-robot relationship.
	Salem et al. Kim et al. (2013)	Humanoid robots' gestures affect users' perception of likability of the robot and use intentions; incongruent gesture positively affects participants' evaluation of the robot. Humanoid robots with gestures increase users' perceived social interactions and enjoyment; familiarity positively affects perceptions.	Applied social psychological research on the humanization of social groups and adopted measures of anthropomorphism. Using 3-week experiments to specifically examine the effect of familiarity and robot gesture on user acceptance.	Experiments	Non-humanoid robots are not considered. There are demographic factors that need to be controlled.
	De Graaf & Allouch (2013)	Usefulness, adaptability, enjoyment, sociability, companionship and perceived behavioral control are important evaluating the user acceptance of social robots.	Extends a literature review on motivation theory, TAM, and TPB with user characteristics. Examines social robot acceptance by considering utilitarian and hedonic variables and user characteristics.	Survey	Limited context, limited robot type, and limited user groups.
	Jörling, Böhm, & Paluch, (2019)	It is important for service customers to perceive control over the technology rather than to feel controlled by it.	One of the first investigations of service customers' perceptions of service robots, and attributions of responsibility for obtained outcomes.	Experiment	Did not examine different levels of interaction with service robots.

2.1.2 Service Robots in the Hospitality Field

Various types of service robots have been adopted in different areas of hotel operations such as front desk, concierge, room-service, and housekeeping (Ivanov, Webster, & Berezina, 2017). Like other hotel technologies, the adoption of humanoid service robots potentially changes the hotel's physical layout, ambience, and service quality (Ivanov et al., 2019). Meanwhile, the motive for hoteliers to employ robots is to provide convenience and unique experience to customers and improve operational efficiency at a lower cost (Ivanov & Webster, 2017). In academia, Tung and Law (2017) summarize six research streams regarding robots in the hospitality and tourism discipline: 1) customers' experience with robots, 2) robots' influence on tourists' decision-making processes, 3) robots' influence on the types of tourist experience, 4) the increased use of qualitative methods in social settings, 5) recommendation of using cloud robots in hospitality and tourism (Hu et al., 2012), and 6) the ability of robotic navigation features to transform tourists' experience in different settings. "Robotics" is introduced into the field of hospitality and tourism management later than other service disciplines, which results in scant scientific research and grows researchers' interests in hotel service robots (Zalama et al., 2014).

Table 2.2 summarizes studies on hospitality service robots. Although most studies still focus on the implementation of a hotel service robot (Ashhad et al., 2015), recent studies have attempted to identify customers' attitudes and experiences toward service robots in the hospitality and tourism field (Kim & Banchs, 2014; Stock & Merkle, 2017). Lu et al. (2019), for example, examine the key dimensions that characterize consumers' long-term willingness to integrate service robots into regular service transactions.

Moreover, Tussyadiah and Park (2018) focus on consumers' evaluations of hotel service robots from different HRI dimensions (e.g. anthropomorphism, animacy, perceived intelligence, and perceived safety). They conclude that when the design of service robots shows humanlike features (e.g. facial expressions, motions, etc.), customers can have fun interacting with them and receive customized service, forming a unique and memorable experience throughout their stay at the hotel. However, even though various analytic or descriptive approaches have been used to delve into core research issues related to service robots, more rigorous and systemic research methods should be implemented regarding the research topic of hotel service robots.

Table 2.2 Service Robot Research in Hospitality Fields

Author(s)	Key Findings	Major Contributions	Methodology	Limitations
López et al. (2013)	Robotic technologies have made their way into the hospitality industry by affecting various areas of hotel operations.	Brings up the attention from researchers on hotel service robots.	Conceptual	A descriptive paper focusing on the system of service robots.
Zalama et al. (2014)	The hardware, architecture, and applications levels should be improved for a hotel service robot.	First describes three levels of the development of a particular hotel service robot.	Conceptual	A pure evaluation of the robot from its design without considering user attitudes or acceptance.
Kortsha (2014)	Millennials (25-34) are currently the population segment most excited about hotel service robots, followed by GZs (18-24). This technology provides opportunities for efficiency benefits, as staff spend less time delivering items and more time interacting with guests. Males are more comfortable and excited with robot services. Most respondents prefer a delivery robot. 56% percent of respondents are interested in utilizing robotic room service.	A holistic questionnaire in the hotel setting with a big sample size.	Survey	Industry report; the measurements lack validity and reliability check. Only compares differences of simple questions based on age and gender.
Rodriguez-Lizundia et al. (2015)	Age correlates with intention to use; The level of a robot's presence affects social interaction with the robot in terms of proxemics, duration of the interaction and	Extends the service robot literature to the scope of a hotel environment.	Experiment	Focused on one specific hotel robot ("Sacarino"); only observations were used.

	the type of interaction; Active-looking robots better attract hotel users' attentions.			
Rodriguez-Lizundia et al. (2015)	Users tend to maintain a personal distance when interacting with an embodied robot and that embodiment engages users in maintaining longer interactions. Including a greeting model in a robot is useful in engaging users to maintain longer interactions, and that an active-looking robot is more attractive to the participants, producing longer interactions than in the case of a passive-looking robot. The level of a robot's presence affects social interaction with the robot.	Focuses on the influence over the proxemics, duration and effectiveness of the interaction, considering three dichotomous factors related with the robot design and behavior: robot embodiment, status of the robot (awake/asleep) and who starts communication (robot/user).	Experiment	One particular robot; didn't take into consideration of user characteristics.
Pan et al. (2013, 2015)	People are more likely to be interested in dual robots' greeting and conversation than single robot's greeting and soliloquy. robot's speech is the main factor that affects people's response in a hotel setting.	Helps understand the practical effectiveness of robot's speech in a public space, inspire the design of hotel-assistive robots.	Experiment	Age and gender are not controlled but they are possible confounding variables.
Pinillos et al. (2014, 2016)	The bellboy robot "Sacarino" lacks robot autonomy, low speech recognition, lack of interface simplicity. It can be improved from hardware level (developed automatic battery charging system), architecture level (added touch-to-listen button), and application level (designed intuitive menus).	Provides a long-term (3-stage) assessment (qualitative and quantitative) of a service robot ("Sacarino") using Technology Readiness Level methodology (TRL) in a real hotel environment.	Observation, survey	Focuses on the operation of the robot; lacks a connection between robot usability and user experience/satisfaction of hotel guests and staff.
Van Doorn et al., 2016	The framework and related propositions emerge from consideration of the advances in technology that enable an infusion of	Focuses on the interaction between consumers and	Conceptual	Conceptual. Practical issues (e.g., different research approaches

	ASP into the service frontline will serve as a catalyst for important service research.	such humanlike service technologies.		and obtaining approval from institutional review boards).
Tung & Law (2017)	Robotic navigation is necessary for hoteliers and tourism practitioners.	One of the early papers that reviewed recent work in the robotics literature and provided future opportunities for tourist experience research in human-robot interactions (HRI). The literature on presence and embodiment that applies to the physical world is considered relevant for real-world environments in tourism and hospitality.	Review paper	Abstract and conceptual. Suggestions for future studies: conduct interviews with managers in hospitality and tourism industries to explore practitioners' views toward robotics.
Stock & Merkle (2017)	Informativeness of interaction, benevolence, and user satisfaction are significantly different among groups with human and groups with robots.	Expanded TAM to robot-acceptance-model (RAM) in a hotel setting.	Survey	Comparative study; lacks the test of impacts of perceptions on behavioral intentions.
Ivanov, Webster, & Berezina; (2017) Ivanov & Webster (2017)	There is a big gap of research on robots in hospitality and tourism. Robot-friendliness of facilities would be a new source of competitive advantage for hospitality companies in the future.	A periodic review of robot adoption in hospitality and tourism sectors with a discussion of challenges. The hospitality industry should consider what space and design issues it will have to dedicate to the	Review paper	Not very comprehensive as some studies are left out. Descriptive.

	Investigates how hospitality firms need to design their facilities in order to make them accessible for robots	robots that will increasingly inhabit their hotels, restaurants, airport lounges, either as service robots to guests or as entities working to clean the physical environment.		
Osawa et al. (2017)	Human work is divided into task units, and that robot actions affect human emotional control.	A mixed method from both managers and employees to evaluate service robots in Henn-na hotel. A discussion of risks and benefit working with robots in a hotel setting.	Interview	No theoretical support and the sample size limit the generalizability of the results, which are not even discussed in the paper.
Tussyadiah& Park (2018)	Customer evaluations toward hotel service robots. consumer intention to adopt hotel service robots is influenced by human-robot interaction dimensions of anthropomorphism, perceived intelligence, and perceived security.	Holistically measured customers' evaluations toward robots using HRI measurement items; provided strong theoretical support for similar studies.	Experiments	Not based on actual experiences; other important factors such as attitudes and trust are not measured; comparisons are not done due to the limited function of the robot in this study.
Lu, Cai, & Gursoy (2019)	Drawing on a five-stage scale development procedure, a 36-item six-dimensional SRIW scale was developed, which includes performance efficacy, intrinsic motivation, anthropomorphism, social influence, facilitating condition, and emotions.	The SRIW scale demonstrates rigorous psychometric properties per findings across four service industries (e.g., hotels, restaurants, airlines, and retail stores).	Scale development	Did not consider cultural differences or user demographic

Murphy, Gretzel, & Pesonen (2019)	The paper proposes eleven robot capabilities that influence anthropomorphism and consequently shape HRI, three Uncanny Valley marketing outcomes, theoretical concepts, and a rich future research agenda.	It advances rService research by drawing on services marketing, Human Robot Interaction (HRI) and the Uncanny Valley Theory to explore anthropomorphic characteristics' range, role and impact on rService experiences.	Review	Conceptual
Fan, Wu, Miao, & Mattila, (2019)	consumers show varying levels of dissatisfaction with a service failure caused by an anthropomorphic (vs. non-anthropomorphic) self-service machine depending on their levels of interdependent self-construal (high vs. low) and technology self-efficacy (high vs. low)	This study contributes to the anthropomorphism research and empirically tests how consumers respond to humanoid technology in a self-service failure context. The current study further investigates the underlying mechanism of self-blame that leads to the varying levels of dissatisfaction among consumers with low technology self-efficacy.	Experiment	Generalizing the current findings to an actual service environment should be made with caution.
Zhong, Sun, Law & Zhang (2020)	The purchase intention of the group who watched a video about robot hotel service was significantly higher than those who watched traditional hotel service video.	Exploratory study that applied TAM to hotel service robot and customer's behavioral intention.	Experiment	The effects of socio-demographics on the purchase intention of consumers was not examined. Participants in the study watched the robot hotel service video instead of actual experience.

2.2 THE UNCANNY VALLEY THEORY

The "Uncanny Valley Theory" is proposed by Mori (1970), focusing on robot appearance and user experience. This theory argues that user reaction differs by the design of robot appearance – whether it is humanlike or machinelike. Specifically, the Uncanny Valley Theory posits that an initial increase in anthropomorphism can enhance people's evaluations of robots, but extremely humanlike robot appearance can cause feelings of uneasiness, because the imitation of a human is not always perfect. In a later study, Mori et al., (2012) supplements the theory by suggesting that a robot's degree of human likeness relates to the level of users' comfortable feelings with the robot. Rather than a linear relationship, the feelings become eerie as the robots almost resemble humans, and the interaction between the robot appearance and human eeriness results in more negative attitude toward using the robot. Relevant studies point out conflicting arguments of the existence of this theory and emphasize its importance in understanding user reaction when other conditions are taken into consideration (Grey & Wegner, 2012; Seyama & Nagayama, 2007). For example, Walters et al. (2008) apply the Uncanny Valley Theory and big five personalities in a robot appearance study and find that participants tend to prefer the humanoid appearance and attributes of the robots, but individual personality is a salient factor that results in different evaluations and preferences toward humanlike/machinelike service robots. Therefore, the findings from the Uncanny Valley Theory cannot be simply applied to all studies without considering other confounding factors. Overall, although the Uncanny Valley Theory has been widely cited in computer graphics and virtual reality community, there is a lack of empirical studies focusing on robot appearance in the hospitality and tourism field.

2.2.1 Robot Appearance

According to the Uncanny Valley Theory, anthropomorphism refers to humanlike characteristics of an object (Caporael, 1990). More specifically, this theory addresses the role of anthropomorphism in affecting user reaction. On one hand, it appears that robots with an anthropomorphic appearance elicit positive user responses; on the other hand, extreme human-like robots are more likely to be evaluated negatively by users (Robins et al., 2004; Sundar et al., 2016). Users may expect humanlike experiences if a robot is inspired with anthropomorphic features and users may have higher expectations from highly anthropomorphic robots than those with lower anthropomorphism (Nowak & Biocca, 2003). However, an individual's reaction to a humanoid robot could abruptly shift from empathy to revulsion due to the robot possessing not-quite-perfect lifelike appearance (Mori et al., 2012). In other words, the relationship between anthropomorphism and user reaction is complicated.

Anthropomorphism has received increasing attention in marketing because it can influence how consumers respond to brands, products, and services (Aggarwal & McGill 2007; Kim, Chen & Zhang 2016; Puzakova, Kwak, & Rocereto 2013). Anthropomorphism attributes human characteristics to inanimate objects and anthropomorphic/humanoid robots, seeking to facilitate HRI by mimicking humanlike forms (Duffy, 2003). HRI, the common theme related to service robots across various research areas, also includes anthropomorphic features (Belk, 2016). Anthropomorphism provides cues that influence users' perceptions and evaluations of the robot's propensities (Goetz, Kiesler, & Power, 2003); human-like personality makes people treat social robots as a real person (Dautenhahn & Billard 2002, Fong et al. 2002, Duffy 2003). The existing

investigations suggest that an anthropomorphic appearance of a service robot affects users' attitudes, evaluations, and behaviors toward the robot (Hameed et al., 2016; Waters, 2008a; 2008b). For example, Katz and Halpern (2014) have confirmed a positive relationship between the use of humanoid robots and user recognition of human-likeness attributes (e.g. appearance).

Robot appearance is a main construct derived from the concept anthropomorphism and measured by the Uncanny Valley Theory (Mori, 1970; 2012). Service robots can be designed as humanoid robot simulating a human appearance (e.g. Sophia) or as a non-humanoid robot like the cleaning robot "Roomba" (Wirtz et al., 2018). Recently, humanoid robots have started to advance the research in HRI, addressing the importance of robot appearance in customer experience (Haring et al., 2015). Humanoid service robots feature a human-like appearance, motion, and personality. Such service robots have mostly emerged in social psychology (Salem et al., 2013) and information technology (Matsuda, Hiraki, & Ishiguro, 2016). From a robotics design perspective, service robots need to deliver human-centered experiences, including communication skills, gentleness, and adaptability toward human partners, as well as ease of use, behavior, and humanoid appearance (Riener et al., 2006). For example, Sacarino is a humanoid robot that provides guests with hotel service information in the hotel lobby (Zalama et al., 2014). Service robots are mainly designed for human interaction and assistance, which inherently requires friendly and comfortable impressions. Therefore, investigating the relationship between the robot appearance and its effect on human experience has theoretical and practical value. The humanoid robot study is still at its infancy and can be related to a wide examination of anthropomorphism (DiSalvo et al.,

2002). Few studies have examined the relationship between the appearance of robots and customers' experiences interacting with them, while most are about users' subjective impressions of robot appearance (Kanda et al., 2008).

Prior research in robotics has assessed the effect of robot appearance (e.g. humanoid or non-humanoid) on customers' acceptance of the service robot (Hameet et al., 2016). Goet et al., (2003) find that an anthropomorphic appearance leads to more positive evaluations than a machine-like robot. They further conclude that the nature of a humanoid robot's appearance and demeanor should mediate people's acceptance intentions and responses to them. According to Branyon and Pak (2015), the appearance of a service robot influences the levels of trust, attribution, and perceived capabilities of robots. In addition, Young (2008) stresses that users' cultural and demographic characteristics affect their attitudes toward robot's anthropomorphic appearance; different evaluations occur toward humanlike and machinelike robots.

In the hospitality field, although humanoid robots have been employed, such as the extremely humanlike front desk staff at Henn-na hotel in Japan, research on humanoid robots and customer experience is far from being completely studied and has not emerged until recently (Murphy, Gretzel, & Pesonen, 2019; Pinillos et al., 2016; Van Doorn et al., 2017). For example, Rodriguez-Lizundia et al. (2015) find that the hotel bellboy robot's physical presence significantly affects customers' interaction experiences with it. In Tussyadiah and Park's (2018) study, they claim that anthropomorphism is significant in inducing use intention of hotel robot for check-in services, which is consistent with the findings in a recent study conducted by Lu, Cai, and Gursoy (2019) who develop a multi-dimensional Service Robot Integration Willingness (SRIW) Scale to

examine customer experience with anthropomorphic robot. To assess customer reaction toward anthropomorphic and non-anthropomorphic robots, Fan, Wu, and Mattila (2019) conduct experiments and contend there is a significant difference between customers' satisfaction with anthropomorphic and non-anthropomorphic service robots. Moreover, a recent hospitality and tourism study suggests several robotic research areas, including customer acceptance of robots, customer experience with robots, and robotic design (Murphy, Hofacker, & Gretzel, 2017). Nevertheless, the relationship between hotel service robots' appearance and customers' experiences remains under explored and there is an urgent need of academic research to advance the understanding of the relationship (Murphy et al., 2017).

2.2.2 Service Efficiency

In addition to the service robot appearance, which is the most important construct extracted from the Uncanny Valley Theory, there are other attributes of service robots that might potentially affect users' experiences interacting with the service robots. In other words, aside from the design aspect, the functionality aspect of a hotel service robot is also essential in affecting customers' experiences at service encounters. Customer service encounters are defined as the lasting personal impressions that customers receive upon first encountering a product, service, and/or company, which they hopefully will take with them and communicate to others (Pine & Gilmore, 1998, 1999; Poulsson & Kale, 2004). Moreover, in the SERVQUAL model (Parasuraman, Zeithaml, & Berry, 1985), responsiveness is proposed as an important factor that affects customer perception toward service performance, emphasizing the "promptness" of service delivery. Efficiency value, which is a main dimension of customer experiential value at service

encounters, measures the speed of service and affects customers' behavioral intentions (Keng et al., 2007). Efficiency value reflects the utilitarian aspects of services and describes active investment in temporal resources that may yield positive returns (Wu & Liang, 2008).

New technologies such as self-service technology, mobile, and digital technologies (e.g. augmented reality, virtual reality, & IoTs) are found useful in enhancing service quality (Reid & Sandler, 1992; Bitner *et al.*, 2000) in a way that they improve service efficiency, effectiveness, productivity, and convenience (Quinn, 1996; Nykiel, 2001; Zemke & Connellan, 2001). The adoption of service robots makes customer experience faster and smoother than other self-service technologies (Wirtz et al., 2018). With prompt technology-empowered frontline interactions, new technologies significantly improve consumer satisfaction and experience (Cobos et al., 2016; Marinova et al., 2017). In Lu et al.'s (2019) study, one measurement item of "facilitating conditions" phrased as "time spent to interact with the robot in order to complete the task" is claimed to be a significant factor that affects customers' experiences interacting with the service robot. Moreover, according to the Technology Acceptance Model (Davis, 1989), a customer's intention to use a new technology depends on the cognitive evaluation of its perceived usefulness and ease of use; whether the tasks can be done in a timely and effective way is a significant measurement of customers' perceptions toward new innovations. It appears reasonable to assume that consumers' experiences with service robots depends on how well robots can provide the functional and social assistance to meet customers' needs (Wirtz et al., 2018).

Service robots as the most recent hotel technologies are different from human agents in different service areas by providing different customer experiences (Wu et al., 2015). In most hotel service encounters, the front desk serves as the main liaison with hotel guests (Hartline & Jones, 1996). The speed of service has been discussed in the hospitality context as a way to assess the service performance and it is found to affect customer satisfaction with the service (e.g. Huang, Huang, & Wu, 1996; Nield, Kozak, & LeGrys, 2000). In Wu et al.'s (2015) study that investigates the wearable technology's impact on customer evaluation, the service outcome is measured by whether the check-in procedure is completed within 2 minutes or more than 10 minutes. Their findings show that people tend to evaluate human beings more favorably than objects when performance is good; however, when performance is poor, people tend to evaluate human beings less favorably than objects (Campbell, 2007; Kwak et al., 2015; Moon & Conlon, 2002; Scherer et al., 2015). Due to the importance of service efficiency, which is the main reason why service robots are developed (Jyh-Hwa & Kuo, 2008), there is an urgent need to examine how humanoid or non-humanoid service robots would affect hotel customers' experiences via different levels of service efficiency.

2.2.3 Service Customization

In addition to efficient services, service robots are also designed to provide customized services in many fields such as healthcare (Datta, 2012) and marketing (Kim & Lee, 2014). The growth of interest in one-to-one marketing (Peppers & Rogers, 1993) has brought the topic of personalization of services and communications to an increasingly prominent position in the service industry (Ball, Coelho, & Vilares, 2006). According to Lee et al. (2012), as compared with the service alone, adding personalized

service improves rapport, engagement, and cooperation with the robot during service encounters. Furthermore, customized service affects customers' experiences to a great extent (Piccoli, Lui, & Grün, 2017). It requires flexibility so that the process can be tailored to individual customer's needs and demands (Shostack, 1987). In addition, as a main component of experiential marketing, customized service is found to create long-lasting memories, consequently affecting customers' overall experiences (Addis & Holbrook, 2001; de Farias, Aguiar, & Melo, 2014).

Service robots are different from other machines in that they also possess social features such as empathy and emotions (Fong, Nourbakhsh, & Dautenhahn, 2003). As the appearance and movements continue to become less distinguishable from those of a human being, the emotional response of robots becomes positive and approaches human-human empathy levels (Tussyadiah & Park, 2018). As one of the dimensions in SERVQUAL, "empathy" refers to giving caring and individualized attention to customers (Parasuraman et al., 1988). Employees with a right attitude to provide quality service also show empathy—demonstrating concern for customers' needs and offering conscientious, individualized services (Lin, 1999; Larsen & Bastiansen, 1991; Tsa, 1994). Combined with biometrics (e.g. facial and voice recognition systems), a service robot will be able to identify a customer and provide highly personalized service at a negligible marginal cost (Wirtz et al., 2018). Glas et al. (2013) have discussed an interactive service robot which provides personal greetings to customers, using a machine-learning approach based on observations of a customer's appearance or behavior from on-board or environmental sensors. Customized service has become a basic requirement to service robot designers.

Customized service is extremely important in the hospitality industry due to the customer-oriented nature of the industry. Hotel services should be customized by purpose of visit and/or origin of guest (Teare, 1993). Personalized service has been discussed in the early customer relationship management studies (Keeney, 1999); it has been redeemed extremely important in the hospitality and tourism industry (Wu & Li, 2011). Recently, customizing the service experience for hotel guests is a means of service innovation (Victorino et al., 2005). Customer relationship management databases, online big data and AI enable robots to know customers better than any humans and utilize the knowledge to create relationships that could potentially increase customer commitment toward a hotel during the service delivery process (Murphy, Gretzel, & Pesonen, 2019). For instance, room service delivery robots can greet customers with their names, speed up the check-in/out processes, personalize the room décors, and ask whether certain service preferences should be added to their profiles. In the hospitality industry, customized service plays a key role in affecting customers' overall experiences, therefore, such a skill of hotel service robots needs to be systematically studied.

2.2.4 User Anxiety

The concept of "user anxiety or eeriness" has been discussed in the Uncanny Valley Theory as a key construct to evaluate robots (Mori, 1970). Technology anxiety has attracted researchers' attention in consumer behavior studies related to robotics. Built upon the concept of computer anxiety (Hirata, 1990), which is characterized by "excessive timidity in using computers, negative comments against computers and information science, attempts to reduce the amount of time spent using computers, and even the avoidance of computers in the place where they are located" (Doronina, 1995),

Johnson and Verdicchio (2017) extend the concept to "AI anxiety", referring to users' uneasiness interacting with AI, including robots.

According to the Social Cognitive Theory (Bandura, 1986), "user anxiety" is proposed as a core psychological reaction toward aggressive technologies. Studies have demonstrated similar psychological reactions individuals would give to the advanced computer – robots (e.g. Kanda & Ishiguro, 2016; Rani et al., 2004). Furthermore, technology anxiety, or robotics anxiety, reflects individual personality and innovativeness. Meuter et al., (2003) state that consumer anxiety about using technology specifically focuses on the individual consumer's state of mind regarding his/her ability and willingness to use technology-related tools. For example, a high level of anxiety for using technology-mediated services could reduce consumers' behavioral intentions to use the technology services (e.g., Hoffman & Novak 1996; Meuter et al. 2003). The importance of "user anxiety" toward new innovations has been widely discussed in the hospitality and tourism industry (Kim & Qu, 2014; Winata & Mia, 2005).

Researchers are debating on whether an anthropomorphic appearance elicits more positive psychological reactions and less anxiety than non-humanoid robots (Riek et al., 2009; Robins et al., 2004). Prior studies show that human-like appearance would reduce anxiety, consequently increasing adoption intention (Dautenhahn et al., 2009; Sundar et al., 2016); however, Goetz et al., (2003) claim that the effect of humanoid robot appearance varies by tasks and contexts. The relationship between a robot's anthropomorphic features and emotional responses to that robot seems nonlinear (Belk, 2016; Broadbent, 2017; Mori, 1970). Humans exhibit negative social and emotional responses as well as decreased trust toward robots that closely, but imperfectly, resemble

humans. Furthermore, customers show reluctance to accept social behaviors from robots (de Graaf et al., 2019). However, recent research in telepresence robots has established that mimicking human body postures and expressive gestures has made the robots likeable and engaging in a remote setting, and the interplay of the humanlike features and user likeliness leads to higher user acceptance of the robot (Adalgeirsson et al., 2010).

Moreover, anthropomorphism relates positively with feelings of psychological ownership and responsibility for robot actions (Van Doorn et al., 2017). Generally, robot appearance could bring human anxiety and eeriness, and in turn, human anxiety and eeriness could affect relationship between robot appearance and human reaction toward the service robot. For example, Nomura et al., (2008) use two psychological scales: negative attitudes toward robot scale (NARS) and robot anxiety scale (RAS) to examine user reaction in the human-robot interactions and find that user anxiety increases when the robot possesses overwhelming humanlike attributes. Moreover, research has shown that users' attitudes, evaluations and social responses towards robots are moderated by their feelings of social presence during their interaction with robots (Lee et al., 2006). A recent study shows that humanoid service robots would elicit greater consumer discomfort such as eeriness, which in turn results in the enhancement of compensatory consumption (Mende et al., 2019). van Pinxteren et al. (2019) contend that the interaction comfort moderates the effect of robot's gaze cues on anthropomorphism, which means gaze cues increase anthropomorphism when the comfort level is low and decrease it when the comfort level is high, and they together drive users' intentions to use the robot. Overall, there is a lack of systematic examination about the interplay of robot appearance and users' robot anxiety in the context of hotel customer experience.

2.3 CUSTOMER EXPERIENCE

Customer experience has become the centerpiece for many social studies. Back in 1982, Holbrook and Hirschmann (1982) theorize that consumption has experiential aspect and Schmitt (1999) brought up the concept of experiential marketing. Customer experience refers to a customer's interaction with a product or service that leads to his/her reaction toward the business (Gentile et al., 2007); such personal experience indicates the customer's involvement with the business at different levels (e.g. rational, spiritual, sensorial, physical, and emotional levels). There are various definitions of customer experience in social studies. Meyer and Schwager (2007) define customer experience as customers' subjective responses toward direct or indirect interactions with a company. According to Shaw (2005, p.51), "customer experience is an interaction between an organization and a customer. It is a blend of an organization's physical performance, the senses stimulated, and emotions evoked, each intuitively measured against customer expectations across all moments of contact." Customer experience plays as a subjective perception felt from within and relies on specific consumption context and it reflects customer satisfaction and attitudes (Walls, 2013). Interactions with physical elements are important in shaping customer experience (Ren et al., 2016). A seminal study by Berry, Carbone, and Haeckel (2002) suggests that companies need to understand what factors would affect consumers satisfactory experience in the buying process. Another seminal study conducted by Verhoef et al., (2008) discusses the determinants of customer experience by conceptualizing the concept in a model that contains social environment, service interface, retail atmosphere, assortment, and price and promotions. Overall, customer experience has become an essential concept discussed in social science studies.

Hedonic experience and cognitive experience are two major directions that researchers focus on regarding customer experience studies (Verleye, 2015). In comparison to human service employees, the level of co-creation between service customers and service robots is arguably higher (Jörling, Böhm, & Paluch, 2019). In value co-creation studies, drawing from the uses and gratification framework, Nambisan and Baron (2009) state that customers expect hedonic benefits (e.g. pleasurable experiences) and cognitive benefits (e.g. knowledge about products, services, and technologies). Füller (2010) confirms that customers expect first, intrinsic playful tasks (e.g. hedonic benefits), and second, opportunities to keep up with new ideas and develop skills (e.g. cognitive benefits). Specifically, hedonic experience refers to having pleasurable experiences, and cognitive experience refers to acquiring new knowledge/skills (Verleye, 2015). In line with calls for developing multidimensional customer experience scales (e.g. Verhoef et al., 2009), Verleye (2015) develops a scale that reflects the degree to which customers get hedonic and cognitive benefits. Previous research has shown that interactional quality between customers and service providers affects the social and hedonic experience (Downie et al., 2008), therefore, an empirical study extended to the interaction between hotel customers and hotel service robots and its impact on customers' experiences needs to be conducted.

Customer experience has been widely applied to hotel settings in a way to assess the key drivers of customer satisfaction, delight, or perception (e.g. Torres et al., 2014; Walls, 2013; Xiang et al., 2015). Researchers have made great efforts to identify the dimensions of customer experience. For example, Knutson et al. (2009) identify four dimensions of customer experience in a hotel setting, namely, environment, accessibility,

driving benefit, and incentive which are used to develop the four-factor Hotel Experience Index (HEI) (Knutson et al., 2009). Walls (2013) presents two broad dimensions, physical environment and human interaction, of hotel customer experience. The customer experience should be considered as the primary guideline of the quality of customer value, hence hotel managers must be attuned to "listening to the customer" (Coyle & Dale, 1993). Recent studies have focused on customer experience in terms of service quality across different hotel types (Hemmington, 2007; Ren et al., 2016); however, whether hotels equipped with technological innovations would shape unique customers' experiences is under-researched and calls for more empirical studies (Neuhofer, Buhalis, & Ladkin, 2015).

Technological innovations are found to greatly enhance customer experience (Sharma, 2016). User experience of technology potentially affects customers' brand experiences such as cognitions, sensations, feelings, and behavioral responses (Brakus et al., 2009), which in turn influence customers' experiences, including emotional and behavioral outcomes as well as brand-related decisions (Hwang & Seo, 2016). Customers' reactions toward hotel service robots can be mainly seen via their psychological and attitudinal evaluations after interacting with the service robots (Jaiswal & Niraj, 2011).

From a robotics' design perspective, service robots need to convey human-centered experiences, including humanoid appearance and behavior (Riener *et al.*, 2006). Studies have shown that hotel customers prefer more convenient and customized services, and more interesting experiences with robots (Tung & Au, 2018). Weiss et al. (2009) propose five dimensions to evaluate users' experiences within the usability, social

acceptance, user experience, and societal impact (USUS) framework: embodiment, emotion, human-oriented perception, feeling of security and co-experience with robots. Such framework is used in Tung and Au's (2018) study that discusses customers' experiences with robotics in hospitality in general. According to Young et al., (2011), users' experiences with robots could be different from that of other technologies, such as computers and smartphones, due to the potential social and emotional characteristics that rise from HRIs.

Based on the discussion above, this study proposes the following hypotheses:

H1: Different levels of service robots' anthropomorphic appearance lead to different customers' perceived experiences interacting with the hotel service robot.

H2: Different levels of service robots' efficiency lead to different customers' perceived experiences interacting with the hotel service robot.

H3: Different levels of service robot's appearance, service efficiency, and customers' robot anxiety jointly influence customers' perceived experiences interacting with the hotel service robot.

H3a: Among the customers with high robot anxiety, the interaction effect between service robot's appearance and service efficiency is attenuated.

H3b: Among the customers with low robot anxiety, service efficiency moderates the impact of service robot's appearance on customers' perceived experiences interacting with the hotel service robot.

H4: Different levels of service robots' customization lead to customers' perceived experiences interacting with the hotel service robot.

H5: Different levels of service robot's appearance, service customization, and customers' robot anxiety jointly influence customers' perceived experiences interacting with the hotel service robot.

H5a: Among the customers with high robot anxiety, the interaction effect between service robot's appearance and service customization is attenuated.

H5b: Among the customers with low robot anxiety, service customization moderates the impact of service robot's appearance on customers' perceived experiences interacting with the hotel service robot.

2.4 TECHNOLOGY READINESS

Technology readiness (TR) has become a critical concept in social studies that involve technology acceptance. It is a personality trait defined as "the propensity to embrace and use new technologies for accomplishing goals" and it is expected to influence the predisposition to use new technologies (Parasuraman 2000, p. 308). The Technology Readiness Index (TRI) is a multi-item scale that measures this personality trait from one positive dimension (optimism, innovativeness) and one negative dimension (discomfort, insecurity) (Parasuraman, 2000). Specifically, optimism refers to a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives; innovativeness measures a tendency to be a technology pioneer and thought leader; discomfort indicates a perceived lack of control over technology and a feeling of being overwhelmed by it; and insecurity means distrust of technology and skepticism about its ability to work properly.

A mainstream of research highlights consumers' readiness to use technology in service encounters (Mattila and Mount, 2003; Morosanand DeFranco, 2014) and

considerable research on TR has been conducted in a hotel setting (Sunny, Patrick, & Rob, 2019; Kim & Qu, 2014). Studies have used the concept of TR to explain the preferences of customers for either using or not using SST (Liljander et al., 2006). Specifically, TRI is found to be a useful segmentation tool as it allows managers to form cohesive customer segments, each with a particular attitude toward technology and each with its own demographic characteristics and usage patterns (Victorino et al., 2009). Customers with high TR would perceive the technology more useful and weigh the technology-related aspects more heavily in their experience evaluation (Wang & Sparks, 2014). 2014). TR has been used as a moderator in a way that optimism and innovativeness moderate relationships between perceived quality of technology-enabled services and overall satisfaction; such relationships are enhanced with higher TR travelers (Wang, So, & Sparks, 2017).

TR has also been discussed in research related to hotel service robots. For example, Pinillos et al. (2016) provides a long-term (3-stage) assessment (qualitative and quantitative) of a service robot ("Sacarino") using TRI and it identifies the weakness of the robot; however, this study only focuses on the operation of the robot and lacks a connection between robot usability and user experience measurement. A recent study conducted by Lu, Cai, and Gursoy (2019) combined TRI into the "service robot integration willingness scale" and confirm the significant impact of TR on user experience. Since the segmenting role of TR has been validated in the general business field but there is a lack of studies to emphasize its moderating role between customers' interaction with hotel service robots and their interacting experiences, this study proposes that:

H6: Given a particular combination of appearance and efficiency/customization (e.g. extremely humanoid and high efficiency), customers' levels of technology readiness significantly affect their perceived experiences interacting with the hotel service robot.

2.5 SELF-IMAGE CONGRUITY

Developing the self-image congruity model from the self-concept theory, self-image congruity has been discussed in many consumer behaviors studies, referring to the relationship between how individuals perceive themselves to be and how they perceive the image of a product or service (Sirgy, 1982). Self-image congruity is found to affect customer behavioral intentions to a great extent (Onkvisit & Shaw, 1987; Sirgy, 1985). For example, Landon Jr (1974) suggests that the relationship between self-concept and product preferences may vary depending on different forms of the self (actual vs. ideal) and product categories. Higher self-congruity is experienced when consumers feel that the product-user image matches their own images, while low self-congruity is experienced when the product-user image does not match the consumer's perceived self-image (Cowart, Fox, & Wilson, 2008). Prior research indicates that self-image congruence affects customers' brand preferences and purchase intentions (Ericksen 1996; Mehta 1999), facilitates positive behavior and attitudes toward brands (Ericksen 1996; Sirgy 1982, 1985; Sirgy et al. 1997), and positively influences customers' product evaluations (Graeff, 1996).

In tourism studies, the term "destination image congruity" (Chon, 1992) has been widely used, and it has been eventually applied to the hospitality field. Examples include studies regarding hotel online brand equity (Callarisat et al., 2012). Specifically, self-image congruity and online–offline brand image congruity both significantly influence

customers' online brand experiences (Lee & Jeong, 2014). Back (2005)'s study demonstrates that the ideal social image congruence has significant direct effects on customer satisfaction and indirect effects on attitudinal brand loyalty. Moreover, self-image congruity has been used as a moderator (Aguirre-Rodriguez, Bosnjak, & Sirgy, 2012) in assessing customer reactions toward new products and has been applied to technology-related research such as online shopping, mobile apps, and self-service technologies (SSTs) to categorize customer groups (Jamal, 2004; Antón, Camarero, & Rodríguez, 2013; Kang, Hong, & Lee, 2009). For instance, Su and Reynolds (2017) claim that the hotel brand–consumer relationships are influenced through self-congruity. Consumers are more likely to adopt innovations that match their own values, beliefs (Rogers, 1983), and lifestyles (Kleijnen, Ruyter, & Wetzels, 2004); while low self-congruity would result in technology resistance (Antón et al., 2013). The saliency of self-image congruity is demonstrated in the adoption process of mobile services (Kleijnen et al., 2005). This recent study may imply the important role of self-image congruity in continued consumer-oriented online service usage behavior.

With the development of virtual reality and robotics, researchers have started to consider the role of self-image congruity in this specific context. Unal, Dalgic, and Akar (2018) assess how avatars help enhance self-image congruence and confirm that there is a different self-image congruence between brands and persons' self-image perceptions. Furthermore, self-congruity is found as a key variable leading to anthropomorphistic thinking, meaning that the tendency to anthropomorphize is based on the ability to elicit "knowledge about humans when making inferences about nonhuman agents" (Epley et al., 2007). Such statement stands in line with Eyssel and Reich (2013), who are able to

observe an increase in respondents' tendency to anthropomorphize a robot after deliberately putting them in an emotional condition. Relevant studies support that self-image congruity plays a role in user reaction toward robotics. For instance, social influence such as what others think you should behave is found to affect users' behavioral intentions toward robots (Lu et al., 2019). In addition to that, the level of personal innovativeness also has a strong impact on customer experience interacting with robots (Hur, Yoo, & Chung, 2012). Although these studies do not measure self-image congruity directly, they emphasize the function of a match between individuals' self-awareness and the product's image. Customers' level of self-image congruity is proposed as an influential factor in this study. To fill the research gap in this field, the following hypothesis is given by this study:

H7: Given a particular combination of appearance and efficiency/customization (e.g. extremely humanoid and high efficiency), customers' levels of self-image congruity significantly affect their perceived experiences interacting with the hotel service robot.

Based on the discussion above, two theoretical models were proposed to incorporate all the constructs and they were depicted in Figure 2.1 and Figure 2.2.

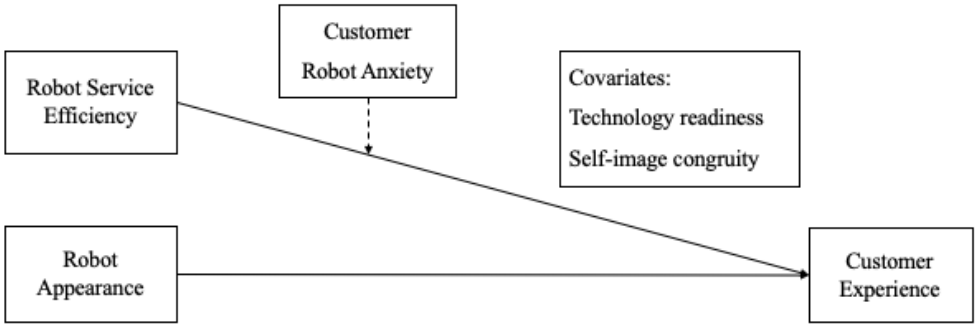

Figure 2.1 Theoretical Model for Study 1 – "Appearance" and "Efficiency"

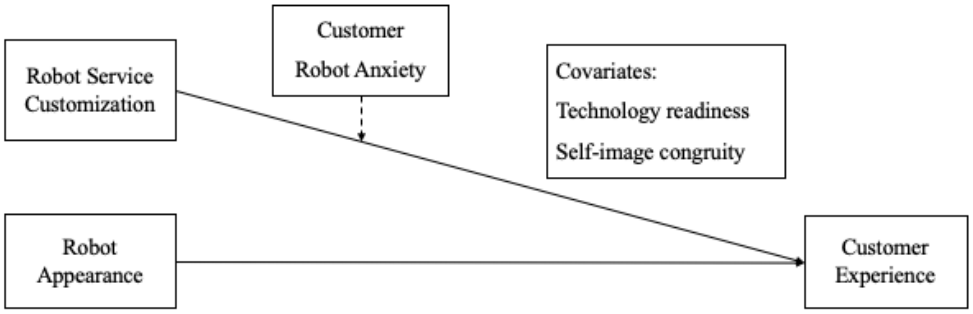

Figure 2.2 Theoretical Model for Study 2 – "Appearance" and "Customization"

2.6 BRAND EQUITY

The issue of brand equity has emerged as one of the most critical areas for marketing management in the 1990s (Cobb-Walgren, Ruble, & Donthu, 1995). Brand equity is seen as a very important concept in business practice and in academic research because marketers can gain competitive advantages through successful branding images (Lassar, Mittal, & Sharma, 1995). In general, brand equity refers to the differential effect of brand knowledge on consumer response to the marketing of the brand (Kamakura &

Russell, 1991). Most of the studies today adopt the four dimensions of brand equity brought up by Aaker (1991), which include brand awareness, brand association, perceived quality, and brand loyalty. Aaker (1996) further tests brand equity across products and markets and the importance of service brand equity has been proposed by Berry (2000). Brand equity is important because it improves marketing productivity and financial efficiency (Keller, 1993). It has been found to affect customer purchase intention (Jalilvand, Samiei, & Mahdavini, 2011), customer satisfaction (Nam, Ekinci, & Whyatt, 2011). Most notably, brand equity and customer experience reinforce one another over time (Verhoef et al., 2009).

The term "service brand equity" has been formed since customer experience becomes the centerpiece of business marketing (Berry, 2000). Berry's (2000) study presents a service-branding model that underscores the salient role of customers' service experiences in brand formation, which builds the theoretical foundation for similar social studies in the service industry. The particular definition of "hotel brand equity" has also been developed over time. Prasad and Dev (2000, pp.23-24) define hotel brand equity as the "favorable or unfavorable attitudes and perceptions that are formed and influence a customer to book at a hotel brand represent the brand equity". According to Bailey and Ball (2006, p.34), hotel brand equity refers to "the value that consumers and hotel property owners associate with a hotel brand, and the impacts of these associations on their behavior". Kim and Kim (2004) modify the items from Aaker's (1991) study in a hotel setting and find that brand loyalty, perceived quality, and brand image are important components of customer-based brand equity and positively affect luxury hotels' performance. Moreover, using Berry's service-branding model as a conceptual framework

(2000), So and King (2010) conclude that customers' service experiences with the hotel enhances brand meaning, which, in turn, improves brand equity; the effect of brand awareness on brand equity is, however, not significant. According to the statistical results from Kayaman and Arasli's (2007) study, brand awareness is not a significant dimension of hotel brand equity for five-star hotels.

The rise of advanced technology has dramatically intervened marketing communication planning in general and service brand equity, in particular (Peltier et al., 2003). Lee et al. (2003) state that, according to hotel managers' opinions and beliefs, technology can also enhance the quality of service and contribute to lifting the overall image of the hotel, which is the main component of brand equity. Šerić, Gil-Saura, and Ruiz-Molina' (2014) study show that hotels perceived by guests as high technology hotels exhibit stronger links between integrated marketing communication and brand equity dimensions. In a later study, Šeric et al. (2016) further conclude that advanced hotel technology directly influences perceived quality and image toward the hotel brand. Although a great number of studies have been conducted regarding hotel brand equity, there is a lack of research that examines hotel customers' perception changes toward hotel brand equity when there is a service robot present in the hotel front desk. Whether customers would perceive the hotel theme and image differently (e.g. the hotel looks more innovative and futuristic, the hotel looks more modern, etc.) remains unknown. Therefore, it is proposed in the current study that:

H8: Customers' perceived brand equity toward the hotel before and after their interaction with the hotel service robot is affected by the service robot's appearance and efficiency/customization

CHAPTER 3

METHODOLOGY

3.1 GENERAL RSEARCH DESIGN AND SETTING

This chapter illustrates the research design, sampling, data collection, and statistical techniques used for data analysis. This study conducted two field experiments to evaluate 1) how hotel service robots' appearance and level of efficiency affected customers' perceived experiences interacting with the service robot (Study 1); 2) how hotel service robots' appearance and level of customization affected customers' perceived experiences interacting with the service robot (Study 2). After developing hypothetical scenarios for each study, pilot studies were launched prior to actual studies, in order to assure the validity and reliability of the measurement items, confirm the clarity and accuracy of the manipulation checks, and modify and improve the scenarios based on the pilot test results. To achieve the objectives of the research, Study 1 used a 3 x 2 between-subjects factorial design to examine the influence of hotel service robot's appearance (extremely humanlike vs. humanlike vs. non-humanlike) and its service efficiency (high vs. low) on customers' perceived experiences interacting with the service robot. Using a 3 x 2 between-subjects design, Study 2 evaluated the impact of service robot's appearance (extremely humanlike vs. humanlike vs. non-humanlike) and its customization (high vs. low) on customers' perceived experiences interacting with the service robot. Hypothetical scenarios were designed to instruct participants to imagine an interaction with a hotel service robot for front desk check-in service. To enhance the

perceived realism of each scenario and help participants imagine the hypothetical experience, a picture was presented along with the verbal depiction that portrayed the service robot's appearance and described its level of service efficiency or service customization. Additionally, a study conducted by Tay et al., (2013) stated that users perceived the security robot with matching gender-related role stereotypes more useful and acceptable than the mismatched security robot as a second-degree social response. Therefore, to reduce possible gender bias, participants were only exposed to pictures that showed a customer with the same gender as the participant.

Previous studies have used different service areas as the research settings, indicating the importance of service area in hotel technology studies (Pan et al., 2015; Pinillos et al., 2016). Pan et al (2015), for example, conducted an experimental study to examine service robots in the lobby of a hotel in Japan as an alternative to digital signs (Pan et al., 2015). Additional studies were conducted to assess service functions of service robots in place of bellboy (Pinillos et al., 2016), room service delivery (e.g. Butler robot in Aloft, U.S.), and guest room services (e.g. in-room robot in Henn-na hotel, Japan). In order to evaluate the essential role of service robots in hotel operations, this study developed experimental scenarios related to customers' check-in activity with the front-desk service robot (Hartline & Jones, 1996). In the study of Tussyadiah and Park (2018), they indicated that anthropomorphism is a significant feature to derive customers' use intentions of hotel service robots for check-in. Since different settings or service areas could lead to different study results, it is important to be aware of the critical role of the front-desk service area in affecting hotel guests' perceptions and experiences toward the service as well as the hotel brand.

3.2 STUDY 1

3.2.1 Experimental Design

A 3 (appearance: extremely humanoid vs. humanoid vs. non-humanoid) x 2 (efficiency: high vs. low) between-subjects factorial experiment was developed in Study 1 to examine the impact of the service robot's appearance and service efficiency on customers' perceived experiences interacting with the service robot. Six front-desk check-in scenarios were designed (Appendix 3). Based on Hameet et al.' (2016) study, the main treatment in this study - hotel service robot's appearance - had three levels, namely extremely humanoid, humanoid, and non-humanoid. The other treatment "efficiency" had two levels - "high" and "low". For example, in one condition, participants were asked to imagine the hypothetical situation in which a service robot with extremely humanlike features (e.g. humanlike look, facial expressions, motion) provided the check-in service at the hotel front desk within 2 minutes, whereas in another condition, a machinelike robot was presented to complete the check-in service, using more than 10 minutes. Participants were randomly assigned to one of the six scenarios in Study 1.

3.2.2 Manipulation Check

Manipulation checks were conducted for the two constructs, appearance and efficiency, in both the pilot study and the actual study. To check the degree of differences perceived by participants regarding the "appearance" of the hotel service robot, questions from the "anthropomorphism" dimension in HRI scale were used (Bartneck et al., 2009). Specifically, three questions were asked with a 7-point semantic differential scale and they were: whether the service robot presented in this scenario looked "fake" or "real",

"extremely machinelike" or "extremely humanlike", and "artificial" or "lifelike" to the participant. Three questions were asked to check whether efficiency was well manipulated at two levels, high and low. High efficiency referred to the completion of check-in within 2 minutes, while low efficiency indicated that a completed check-in takes more than 10 minutes (Wu et al., 2015). The questions were: whether the participants perceived the check-in process "took a "long" or "short" time, the entire check-in process was "efficient" or "inefficient", and the service robot delivered a "fast" or "slow" service.

3.2.3 Sampling

A pilot study was first conducted online, using M-Turk panel, and then followed by the actual study. This study recruited participants who are over 18 years old and have stayed in a hotel and completed the check-in in person at the front desk in the past 12 months. Each participant was paid $.75 for their participation in both the pilot study and the actual study. Participants were exposed to the hypothetical scenarios and asked to complete the self-administered online survey right after reading the scenarios. Invalid or incomplete responses were deleted.

The pilot study aimed to identify whether respondents perceived the condition for each treatment (e.g. robot appearance and service efficiency) differently as intended and to test the validity and reliability of other proposed constructs in the theoretical model. The multistage sampling method that includes simple random sampling and clustered sampling was used for Study 1. The survey was developed on Qualtrics and participants were randomly assigned to one of the six experimental scenarios using the "randomizer" function in Qualtrics. A third-party marketing research company M-Turk was recruited to randomly distribute the online survey to its consumer panels and incentives were given to

those who completed the survey in a reasonable amount of time with complete and valid answers.

The survey consisted of five sections: first, a screening question used to determine the participants' qualification for the current study; second, a pre-survey section that asked participants to provide the name of their preferred hotel brand; third, a hypothetical experiment scenario along with a series of manipulation check questions of the main treatments; fourth, main measurement questions related to customer' robot anxiety, self-image congruity, technology readiness, perceived experiences interacting with the service robot, and perceived brand equity; and fifth, questions about respondents' demographic information.

3.2.4 Measurements

In addition to the two main treatments "appearance" and "efficiency", the dependent variable was customers' perceived experiences interacting with the hotel service robot. In the current study, robots' service efficiency, which assesses the service speed using the length of service completion time in an experimental scenario, was examined in a hotel front-desk setting. In Study 1, anxiety was used as a moderator to test how it affected the relationship between the service robots' appearance and customers' experiences. Moreover, this study tested the confounding role of customer self-image congruity and customer technology readiness in the theoretical model.

Using a 7-point Likert scale, participants were asked to indicate their perceived experiences interacting with the hotel service robot. A 13-item scale from Verleye (2015) was modified to fit this study's context. The hedonic experience was measured by asking the participants questions such as "it was fun interacting with the service robot"; the

cognitive experience was measured with items such as “interacting with the service robot allows me to keep up with new ideas and innovations”; and participants were asked whether the overall experience with the service robot for my check-in would be “satisfactory”, “positive”, “excellent”, and “delightful.” In addition, the potential moderator “anxiety” was measured by items generated from studies of Ho and MacDorman (2010), Bartneck et al. (2009), and Sundar et al. (2017). For example, customers were asked whether the presence of the service robot at the front desk was perceived “frightening” or “agitating”.

The confounding factor, customers’ level of technology readiness, was measured with 13 items from the original scale developed by Parasuraman (2000), which included four dimensions, namely optimism, innovativeness, insecurity, and discomfort. Examples include: “in general, I am among the first in your circle of friends to acquire new technology when it appears” and “I believe that technology gives me more control over my daily life”. The other important confounding factor was customers’ levels of self-image congruity adopted from the studies by Kang, Hong, and Lee (2008) and Jamal (2004), asking respondents whether interacting with the hotel service robots would “help maintain my image and character”, “help reflect who I am”, “fit well with my image”, and “be consistent with how I see myself”.

Lastly, in order to identify whether and how customers perceived brand equity would change after interacting with the hotel service robot, this study compared customers’ brand equity perceptions toward their preferred hotel before and after being exposed to the hypothetical robot interaction. Measurement items from Kim and Kim’s (2004) study were adopted. Built upon Aaker’s (1991) brand equity scale, the modified

measurement scale was applied to a hotel context by Kim and Kim (2004). The measurement constructs were categorized into brand loyalty, perceived quality, brand image, and brand awareness. Seventeen items from this scale were used and further modified to fit the context of the current study. All measurement items were measured by a 7-point Likert scale, from 1 being “strongly disagree” to 7 being “strongly agree”. The measurement items of each construct were displayed in Table 3.1.

Table 3.1 Measurement Items in Study 1

Constructs	Measurement Items
Appearance	The service robot looked like a real person.
	The service robot looked like a machine.
	The service robot looked lifelike.
Efficiency	The service robot's service was slow (vs. fast)
	The service robot's service was inefficient (vs. efficient)
	The service robot's service took a long time to complete the task (vs. a short time)
Anxiety	The presence of the service robot at the front desk would be frightening.
	The presence of the service robot at the front desk would be agitating.
	The presence of the service robot at the front desk would be uncomfortable.
	The presence of the service robot at the front desk would be anxious.
Self-image Congruity	Having the service robot complete my check-in would help maintain my image.
	Having the service robot complete my check-in would fit well with my character.
	Having the service robot complete my check-in would be consistent with how I see myself.
	Having the service robot complete my check-in would reflect who I am.
Technology Readiness	I like computer programs that allow me to tailor things to fit my own needs.
	I find new technologies to be mentally stimulating.
	I believe that technology gives me more control over my daily life.
	Technology makes me more efficient in my occupation.
	In general, I am among the first of my friends to acquire new technology when it appears.
	I can usually figure out new high-tech products and services without help from others.
	I do not consider it safe to do any kind of financial business via online technologies.
	I worry that information I send over the Internet will be seen by other people.
	If I provide information over the Internet, I can never be sure it really gets to the right place.
	It is embarrassing when I have trouble with a high-tech gadget while people are watching.
	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.
	New technology is often too complicated to be useful.

Experience	Having the service robot complete my check-in would be a nice experience. Having the service robot complete my check-in would be fun. I would enjoy having the service robot complete my check-in. Having the service robot complete my check-in would enable me to think in an innovative way. I could test my capabilities via having the service robot complete my check-in. I would gain a sense of accomplishment by having the service robot complete my check-in. I would gain new knowledge by having the service robot complete my check-in. The overall experience with the service robot for my check-in would be satisfactory. The overall experience with the service robot for my check-in would be positive. The overall experience with the service robot for my check-in would be excellent. The overall experience with the service robot for my check-in would be delightful.
Brand Equity	I (still) believe that the hotel (hotel's name is shown to substitute "the hotel" based on customers' answers in the previous question) has a futuristic and innovative style. I (still) believe that the hotel has a different image from other hotel brands. I (still) believe that the hotel offers a high level of service. I (still) believe that the hotel has a consistent brand image. I (still) believe that the hotel has a clear image of the types of guests. I (still) believe that the hotel has a unique personality. The hotel (still) has modern-looking equipment. The hotel (still) provides visually appealing facilities. The hotel (still) uses materials associated with the service that are visually appealing. I would (still) consider myself to be loyal to the hotel. I would (still) have the hotel as my first choice. I would (still) intend to visit the hotel again. I would (still) not choose other hotel brands if the hotel is an available option. Overall, I (still) believe that it makes sense to choose the hotel of any other brand, even if they are the same. Overall, I (still) believe that even if another brand has the same features as the hotel, I would prefer to choose the hotel. Overall, I (still) believe that if there is another brand as good as the hotel, I prefer to choose the hotel. Overall, I (still) believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.

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3.3. STUDY 2

3.3.1 Experimental Design

The objective of Study 2 was to examine the impact of the service robot's appearance and service customization on customer's perceived experiences interacting with the service robot. Like Study 1, the service robot's appearance was manipulated at three levels, namely extremely humanoid, humanoid, and non-humanoid. Service customization was measured with two levels - "high" and "low". For example, in one condition, a humanoid service robot was presented in the front desk who was able to call out the customer's name and provide information related to the customer's preference during the check-in process, whereas in another condition, a machine-like service robot asked general questions such as name, credit card information, and specific requests to returning customers at the front desk. The impact of service robot appearance and customization was tested in six conditions to understand the social features of hotel service robots on customer experience interacting with the robot (Appendix 4). Participants were randomly assigned to one of the six scenarios in Study 2.

3.3.2 Manipulation Check

Manipulation checks were conducted for the two treatments "appearance" and "customization", in both the pilot study and the actual study. The same manipulation check questions used in Study 1 were used to check the degree of differences perceived by participants regarding the "appearance" of the hotel service robot (Bartneck et al., 2009), including "whether the service robot presented in this scenario looked fake or real, extremely machinelike or extremely humanlike, and artificial or lifelike. Another treatment proposed in Study 2 was "customization", which was manipulated at two

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levels, high and low. In Study 2, high service customization refers to the robot's capability to call out a customer's name and remembers his/her preferences, whereas low customization means the inability to do so but instead ask all general questions again to customers who have stayed here before (Lee et al., 2012). Three manipulation check questions were given to participants asking whether the service robot provided "individualized" service, "non-personalized" service, and "customized" service (Xu et al., 2009).

3.3.3 Sampling

For Study 2, a pilot test was conducted online, followed by the actual study. Similar to Study 1, this study recruited participants who are over 18 years old and have stayed in a hotel and completed the check-in in person at the front desk in the past 12 months. Each participant was paid $.75 for their participation in both of pilot study and actual study. Participants were exposed to the hypothetical scenarios and then completed the self-administered online survey. Invalid or incomplete responses were deleted. The multistage sampling method that includes simple random sampling and clustered sampling was used for Study 2. The survey was developed on Qualtrics and participants were randomly assigned to one of the six experimental scenarios in Study 2 using the "randomizer" function in Qualtrics. Again, M-Turk was used to generate the data and incentives were given to those who completed the survey in a reasonable amount of time with complete and valid answers.

The entire survey consisted of five sections: first, a screening question used to determine the participants' qualification for the current study; second, a pre-survey section that asked participants to provide the name of their preferred hotel brand; third, a

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hypothetical experiment scenario along with a series of manipulation check questions of the main treatments; fourth, main measurement questions related to customer' robot anxiety, self-image congruity, technology readiness, perceived experiences interacting with the service robot, and perceived brand equity; and fifth, questions about respondents' demographic information. The majority of the questions remain the same as in Study 1, but participants were asked to put down the name they preferred to be used at check-ins and their preferred services right before being exposed to the scenarios in Study 2.

3.3.4 Measurements

In addition to the two main treatments "appearance" and "customization", the dependent variable was customer's perceived experiences interacting with the hotel service robot in Study 2 and the same measurement items from Verleye (2015) used in Study 1 were used. The potential moderator "customer's robot anxiety" was also measured by the items generated from studies of Ho and MacDorman (2010), Bartneck et al. (2009), and Sundar et al. (2017). Additionally, customer's level of technology readiness was measured using the 13 items from the original scale developed by Parasuraman (2000). Customer's level of self-image congruity was measured by 4 items used by Kang, Hong, and Lee (2008) and Jamal (2004). Study 2 also compared customers' perceived brand equity toward their preferred hotel before and after interacted with the hypothetical service robot using the same measurement items from Kim and Kim's (2004) study. The measurement items were listed in Table 3.2.

Table 3.2 Measurement Items in Study 2

Constructs	Measurement Items
Appearance	The service robot looked like a real person.
	The service robot looked like a machine.
	The service robot looked lifelike.
Customization	The service robot's service was individualized.
	The service robot's service was non-personalized.
	The service robot's service was customized.
Anxiety	The presence of the service robot at the front desk would be frightening.
	The presence of the service robot at the front desk would be agitating.
	The presence of the service robot at the front desk would be uncomfortable.
	The presence of the service robot at the front desk would be anxious.
Self-image Congruity	Having the service robot complete my check-in would help maintain my image.
	Having the service robot complete my check-in would fit well with my character.
	Having the service robot complete my check-in would be consistent with how I see myself.
	Having the service robot complete my check-in would reflect who I am.
Technology Readiness	I like computer programs that allow me to tailor things to fit my own needs.
	I find new technologies to be mentally stimulating.
	I believe that technology gives me more control over my daily life.
	Technology makes me more efficient in my occupation.
	In general, I am among the first of my friends to acquire new technology when it appears.
	I can usually figure out new high-tech products and services without help from others.
	I do not consider it safe to do any kind of financial business via online technologies.
	I worry that information I send over the Internet will be seen by other people.
	If I provide information over the Internet, I can never be sure it really gets to the right place.
	It is embarrassing when I have trouble with a high-tech gadget while people are watching.
	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.
	New technology is often too complicated to be useful.

Experience	Having the service robot complete my check-in would be a nice experience. Having the service robot complete my check-in would be fun. I would enjoy having the service robot complete my check-in. Having the service robot complete my check-in would enable me to think in an innovative way. I could test my capabilities via having the service robot complete my check-in. I would gain a sense of accomplishment by having the service robot complete my check-in. I would gain new knowledge by having the service robot complete my check-in. The overall experience with the service robot for my check-in would be satisfactory. The overall experience with the service robot for my check-in would be positive. The overall experience with the service robot for my check-in would be excellent. The overall experience with the service robot for my check-in would be delightful.
Brand Equity (pre/post)	I (still) believe that the hotel (hotel's name is shown to substitute "the hotel" based on customers' answers in the previous question) has a futuristic and innovative style. I (still) believe that the hotel has a different image from other hotel brands. I (still) believe that the hotel offers a high level of service. I (still) believe that the hotel has a consistent brand image. I (still) believe that the hotel has a clear image of the types of guests. I (still) believe that the hotel has a unique personality. The hotel (still) has modern-looking equipment. The hotel (still) provides visually appealing facilities. The hotel(still) uses materials associated with the service that are visually appealing. I would (still) consider myself to be loyal to the hotel. I would (still) have the hotel as my first choice. I would (still) intend to visit the hotel again. I would (still) not choose other hotel brands if the hotel is an available option. Overall, I (still) believe that it makes sense to choose the hotel of any other brand, even if they are the same. Overall, I (still) believe that even if another brand has the same features as the hotel, I would prefer to choose the hotel. Overall, I (still) believe that if there is another brand as good as the hotel, I prefer to choose the hotel. Overall, I (still) believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.

3.4 STATISTICAL ANALYSIS TECHNIQUES

This study conducted descriptive analysis to identify the characteristics of respondents using SPSS 22. To test the main effect, one-way ANOVA and non-parametric t-test were conducted. ANCOVA was used to test the interaction effect of efficiency and appearance as well as customization and appearance on customer experience. Univariate analysis with a third moderator – level of anxiety – was conducted in both studies. In addition, this study used factorial ANCOVA analysis to test the confounding effects of technology readiness and self-image congruity on customers' experiences interacting with the hotel service robot. Lastly, in order to assess whether customers' perceptions toward the hotel brand equity would have statistically significant differences before and after interacting with the hypothetical hotel service robot, Wilcoxon signed-rank test was conducted over student t-test due to the skewed distribution of the sample.

CHAPTER 4

RESULTS

This chapter presents the results of data analysis in Study 1 and Study 2. Study 1 tested the impact of hotel service robot's "appearance" and "efficiency" on customers' perceived experiences interacting with the robot, whereas Study 2 examined the impact of service robots' "appearance" and "customization" on customers' perceived experiences. Detailed statistical results of the pilot study and actual study are discussed in the following section.

4.1 STUDY 1

Respondents of Study 1 were those who had checked in at a hotel during the past 12 months. The main purpose of Study 1 was to examine the impact of hotel service robot's appearance and efficiency on customers' experiences interacting with the service robot.

4.1.1 Results of Pilot Study

A total of 180 participants were recruited to complete the pilot study for Study 1. After eliminating incomplete and invalid surveys, 123 respondents were used for further data analysis. Of the 123 respondents, 57.7% were male and more than half of the respondents fell into the age group between 18 and 35 (89.4%). At least 82.1% of the respondents obtained an undergraduate degree. The majority of the respondents were Asian (49.6%), followed by White (43.1%). Regarding the annual household income,

most of them made $75,000 or less (78%). The detailed descriptive information of the pilot study was provided in Table 4.1.

Table 4.1 Descriptive Data of Pilot Study for Study 1 (n=123)

Variables	Specification	Frequency	Percent
Gender	Male	71	57.7
	Female	52	42.3
Age	18-25	52	42.3
	26-35	58	47.2
	36-45	8	6.5
	46-55	3	2.4
	56-65	2	1.6
	66 and above	0	.0
Ethnicity	White	53	43.1
	Hispanic or Latino	1	.8
	African American	6	4.9
	Native American or	0	.0
	American Indian	61	49.6
	Asian or Pacific Islander	2	1.6
	Other	0	0
Education	High school	16	13.0
	Associate college	5	4.1
	Bachelor's degree	82	66.7
	Master's degree	18	14.6
	Doctoral degree	1	.8
	Other	1	.8
Employment Status	Employed full-time	63	51.2
	Employed part-time	12	9.8
	Self-employed	1	.8
	Student	46	27.4
	Other	1	.8
Annual Household Income	Less than $35,000	37	30.1
	$35,000-$50,000	30	24.4
	$50,001-$75,000	29	23.6
	$75,001-$100,000	10	8.1
	$100,001-$125,000	9	7.3
	$125,001-$150,000	3	2.4
	$150,001 and above	5	4.1
Interacted with a "service robot"	Yes	78	63.4
	No	45	36.6
Interacted with a "hotel service robot"	Yes	50	40.7
	No	28	22.8
Types of service robot interacted	Front desk robot	32	26
	Concierge robot	15	12.2
	Room service robot	30	24.4
	In-room robot	15	12.2
	Housekeeping robot	17	13.8

Results of the manipulation check showed that service robots' appearance was statistically different at $p<.05$ for three manipulation questions: the service robot looks fake vs. real (extremely humanoid (M=5.21, SD=1.68) vs. humanoid (M=4.09, SD=1.87) vs. non-humanoid (M=4.59, SD=1.86)); extremely machinelike vs. extremely humanlike (extremely humanoid (M=5.21, SD=1.53) vs. humanoid (M=3.29, SD=1.82) vs. non-humanoid (M=4.06, SD=2.09)); and artificial vs. lifelike (extremely humanoid (M=4.89, SD=1.90) vs. humanoid (M=3.35, SD=1.97) vs. non-humanoid (M=4.14, SD=2.16)). Even though all three levels of service robots were significantly different on three questions, the mean values of humanoid and non-humanoid on three manipulation questions were different from what the researchers expected. Based on the results, two different types of service robots were modified by selecting the different form of service robot.

The manipulation check for the treatment "service efficiency" was measured with three semantic differential questions, which were "regarding the speed of service completion in the scenario, the service robot was slow vs. fast; inefficient vs. efficient; took a long time vs. took a short time". Results of the manipulation check showed that service robots' efficiency was statistically different at $p<.05$ for the manipulation questions: slow vs. fast (high efficiency (M=5.93, SD=1.26) vs. low efficiency (M=4.08, SD=2.07)); inefficient vs. efficient (high efficiency (M=6.03, SD=1.16) vs. low efficiency (M=4.71, SD=1.90)); and took a long time vs. took a short time (high efficiency (M=6.00, SD=1.15) vs. low efficiency (M=4.33, SD=2.00)). Therefore, statistically significant difference existed between the efficient and non-efficient conditions.

The validity and reliability tests were conducted to examine whether all constructs met or exceeded the recommended statistics of discriminant validity and reliability. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy for perceived experience, level of anxiety, technology readiness, and level of self-image congruity was .92, .86, .81 and .86, respectively, which exceeded the recommended level for sampling adequacy of 0.60 (Hair et al., 1998; Tabachnick & Fidell, 2001). The Bartlett's test of significance was less than .05 for all constructs, indicating good validity of these four measurement scales. The Cronbach's alpha was .95, .94, .81, and .94 for perceived experience, level of anxiety, technology readiness, and level of self-image congruity, respectively, exceeding .70, which indicated reliability or internal consistencies of the items in this study, as suggested by Nunnally (1978). Therefore, all measurements items for each construct were used for the actual study.

4.1.2 Results of Main Study

4.1.2.1. Descriptive Analysis

A total of 220 valid responses were obtained for Study 1 using M-Turk. Of the participants, 52.7% were male and 47.3% were female. Most of the respondents fell in the age group ranging from 26 to 45 years old (63.2%), followed by those in the 18-25 age group (20%). More than half of the respondents were White (52.7%), followed by Asian or Pacific Islander (37.7%). About 73.6% of the respondents were employed full-time and 72.3% of them made $75,000 or less. About 78.2% of the participants held at least Bachelor's degree. About 65.5% of the respondents had interacted with a service robot before and 62.5% of them had interacted with a service robot in a hotel. The majority of the respondents had used service robots for room service in a hotel (68%),

followed by service robots for front desk check-in/out (54%). About two-thirds of the respondents frequently stayed at four-or five-star hotels, followed by three-star hotels (29.5%) and one or two-star hotels (3.6%) (Table 4.2).

Table 4.2 Descriptive Data of Study 1 (n=220)

Variables	Specification	Frequency	Percent
Gender	Male	116	52.7
	Female	104	47.3
Age	18-25	44	20.0
	26-35	102	46.4
	36-45	37	16.8
	46-55	22	10.0
	56-65	11	5.0
	65 and above	4	1.8
Ethnicity	White	116	52.7
	Hispanic or Latino	5	2.3
	African American	9	4.1
	Native American or American	3	1.4
	Indian	83	37.7
	Asian or Pacific Islander	4	1.8
	Other	0	0
Education	High school	26	11.8
	Associate college	22	10.0
	Bachelor's degree	99	45.0
	Master's degree	65	29.5
	Doctoral degree	5	2.3
	Other	3	1.4
Employment Status	Employed full-time	162	73.6
	Employed part-time	18	8.2
	Self-employed	14	6.4
	Student	21	9.5
	Not currently employed	1	.5
	Other	4	1.8
Annual Household Income	Less than $35,000	62	28.2
	$35,000-$50,000	36	16.4
	$50,001-$75,000	61	27.7
	$75,001-$100,000	25	11.4
	$100,001-$125,000	20	9.1
	$125,001-$150,000	5	2.3
	$150,001 and above	11	5.0
Interacted with a "service robot"	Yes	144	65.5
	No	76	34.5
Interacted with a "hotel service robot"	Yes	90	40.9
	No	54	24.5
Types of service robot interacted	Front desk robot	54	24.5
	Concierge robot	40	18.2
	Room service robot	68	30.9
	In-room robot	36	16.4
	Housekeeping robot	25	11.4

4.1.2.2 Model and Hypotheses Testing

Normality check and homogeneity check were performed to justify the selection of ANOVA. The dependent variable – perceived experience interacting with the service robot – had a skewness value of -.990 and a kurtosis value of .292. According to George and Mallery (2010), the absolute values for skewness and kurtosis less than 2 are considered acceptable in order to prove normal univariate distribution, therefore, the outcome variable "experience" met the normality assumption. In addition, homogeneity is only needed for sharply unequal sample size (Kim & Cribbie, 2018). In the current study, the number of respondents greatly varied by three levels of robot appearance not by two levels of service efficiency, therefore, the test of homogeneity of variances was performed on appearance and experience and the result is non-significant ($p>.05$), which means the variance of the dependent variable "experience" was equal in each subpopulation.

Two-way analysis of variance (ANOVA) was used to test the main effect and interaction effect of hotel service robot's appearance and service efficiency on customers' perceived experiences interacting with the service robot using SPSS 22. As shown in Model 1 in Table 4.3, no significant effect of service robots' appearance on experience was found ($p>.05$), rejecting H1. However, the K Matrix simple contrast showed that there was a significant difference between level 1 (extremely humanoid) and level 3 (non-humanoid) at $p<.05$, but not between level 1 (extremely humanoid) and level 2 (humanoid) or level 2 (humanoid) and level 3 (non-humanoid), resulting in the final non-significant p-value of .060. However, there was a significant effect of service robots' efficiency on experience ($p<.05$), supporting H2. Unexpectedly, there was no interaction

effect of service robots' appearance and efficiency on experience (p>.05). The construct "anxiety" was tested as a potential moderator in this study, which was included in Model 2. The median (4.25) was used to divide "anxiety" into two groups (DeCoster, Iselin, & Gallucci 2009; Ro, 2012), high and low. It was found that "anxiety" exhibited a significant direct impact on experience (p<.05) and an interaction effect was shown between efficiency and anxiety on experience (p<.05).

Table 4.3 Results of ANCOVA for Study 1

	Model 1 P(/β/F-statistic)	**Model 2 (p/β/F-statistic)**	**Model 3 (p/β/F-statistic)**	**Model 4 (p/β/F-statistic)**
Appearance	.373 (.043) (.992)	.341 (.805) (1.081)	.091 (-.650) (2.425)	.060 (-.592) (2.854)
Efficiency	.025* (-.283) (5.099)	.020* (-.947) (5.469)	.038* (-.518) (4.347)	.029* (-.450) (4.810)
Appearance*efficiency	.330 (-.097) (1.115)	.296 (-.833) (1.225)	.423 (.058) (.863)	.456 (.137) (.787)
Anxiety		.021* (-1.012) (5.413)	.206 (-1.023) (1.613)	.041* (-1.023) (4.238)
Anxiety*appearance		.331 (-.499) (1.112)	.483 (.231) (.731)	.173 (.399) (1.770)
Anxiety*efficiency		.023* (.566) (5.273)	.152 (.421) (2.067)	.164 (.567) (1.951)
Anxiety*appearance *efficiency		.040* (.184) (1.137)	.297 (-.073) (1.225)	.167 (-.149) (1.763)
Self-image congruity			.000*** (.702) (176.227)	.000*** (.592) (114.548)
Technology readiness (positive)				.013* (.157) (6.276)
Technology readiness (negative)				.000*** (-.215) (15.856)
Adjusted R square	**.019**	**.062**	**.491**	**.534**

*Note: P-values are provided in this table. The values in parentheses indicate the coefficient. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*

From the results in Table 4.3, the three-way interaction did show statistical significance on customers' perceived experiences from the two-way ANOVA analysis, supporting H3. To further probe the interaction effects, simple slope tests were conducted and plotted in Figure 4.1 and Figure 4.2. Figure 4.1 showed that among customers with low level of robot anxiety, regardless of the robot's appearance, the inefficient service would lead to decreased perceived experience. Figure 4.2 showed a potential interaction effect of service efficiency and robot appearance on customer experience. Specifically, the level of service efficiency did not affect customers' experiences interacting with a moderate humanoid robot; however, when the efficiency decreased, it greatly lowered customers' experiences interacting with an extremely humanoid service robot but greatly enhanced customers' perceived experiences interacting with a non-humanoid service robot. With that being said, H3a and H3b were both supported in Model 2.

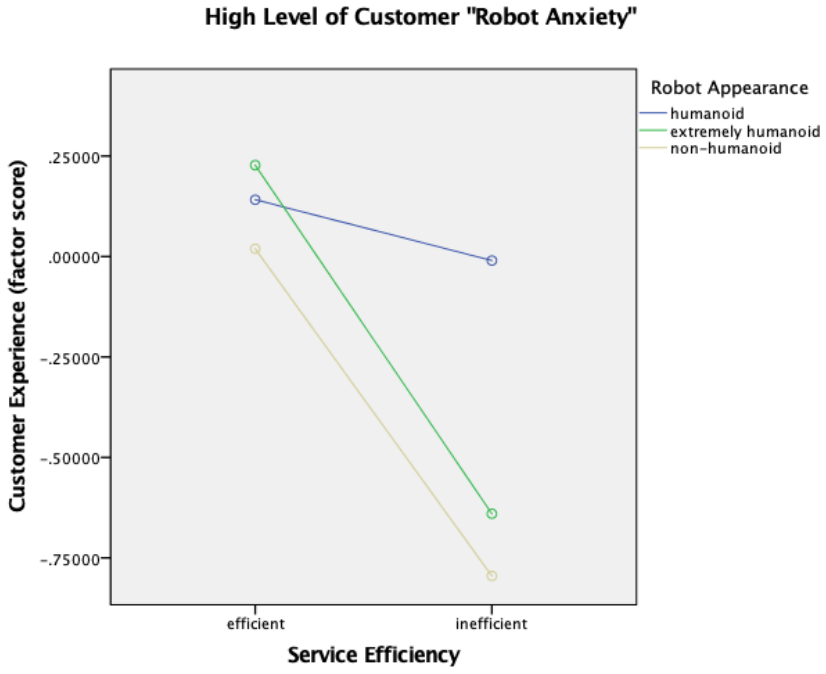

Figure 4.1 Slope Plot for Customer Experience – "High Anxiety" (Study 1)

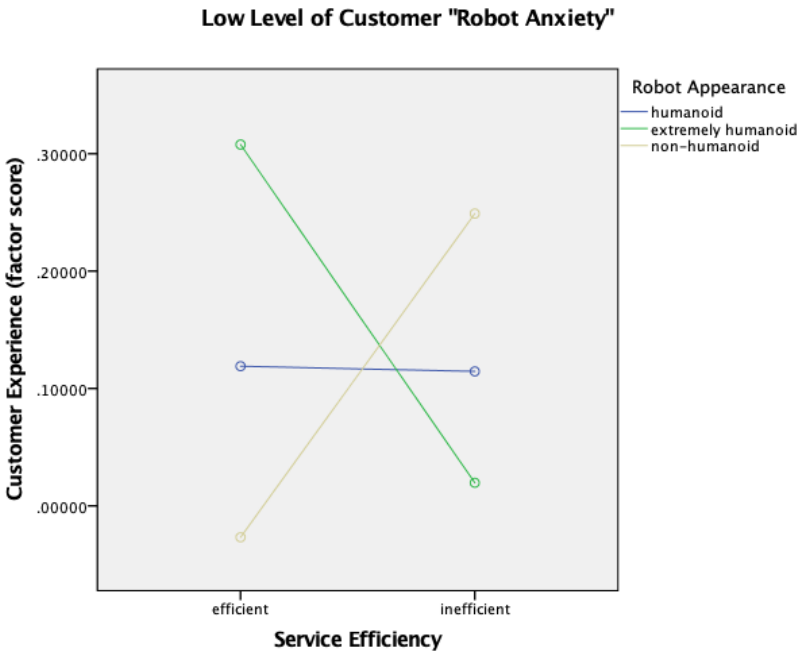

Figure 4.2 Slope Plot for Customer Experience – "Low Anxiety" (Study 1)

An analysis of covariance (ANCOVA) was conducted with two cofounding variables, customers' technology readiness and level of self-image congruity, to test their effects on experience. Factor scores were used to conduct ANCOVA: two factor scores for technology readiness, one factor score for self-image congruity, and one factor for experience (Table 4.4). As shown in Model 3 in Table 4.3, self-image congruity was a statistically significant covariate affecting customers' perceived experience with hotel service robot at $p<.05$, supporting H7. As a result of factor analysis, the constructs of technology readiness had two factors. An item "other people come to me for advice on new technologies" was dropped due to cross loading. Originally, technology readiness has four dimensions – optimism, innovativeness, discomfort, and insecurity (Parasuraman & Colby, 2001). In this study, one positive factor that included items in optimism and innovativeness was obtained with an eigenvalue of 3.655; one negative factor that

included items in discomfort and insecurity was obtained with an eigenvalue of 2.827 (Table 4.4). Two technology readiness factors in Model 4 were significant covariates ($p<.05$), indicating that hotel customers' level of TR significantly affected their perceived experiences interacting with the hotel service robot, supporting H6.

Model 1 and Model 2 both had low adjusted R square, .019 and .062 respectively. The adjusted R square increased to .491 for Model 3, meaning that 49.1% of the variables were explained by the model. Specifically, the inclusion of self-image congruity did not change the results of significance of the main treatments when compared to Model 1, but the results were significantly different from Model 2 in a way that "anxiety" was not significant anymore. A positive coefficient showed that the higher hotel customers self-image congruity was, the more their perceived experience interacting with the service robot was. In Model 4 there was a significant effect of efficiency and anxiety on experience after controlling for the effect of technology readiness and self-image congruity. The adjusted R square increased to .534, indicating that 53.4% of variables were explained by Model 4.

Table 4.4. Factor Analysis for Study 1

Constructs and Measurement Items	Loadings	Cronbach's alpha	Eigenvalue
User Anxiety (*KMO 86; Bartlett's test p<.01*)		.94	3.38
The presence of the service robot at the front desk would be frightening.	.88		
The presence of the service robot at the front desk would be agitating.	.90		
The presence of the service robot at the front desk would make me feel uncomfortable.	.89		
The presence of the service robot at the front desk would make me feel anxious.	.90		
Self-image Congruity *(KMO .86; Bartlett's test p<.01)*		.94	3.41
Having the service robot complete my check-in would help maintain my image.	.89		
Having the service robot complete my check-in would fit well with my character.	.89		
Having the service robot complete my check-in would be consistent with how I see myself.	.89		
Having the service robot complete my check-in would reflect who I am.	.92		
Technology Readiness *(KMO .79; Bartlett's test p<.01)*		.80	
Factor 1 – Positive TR			3.76
I like computer programs that allow me to tailor things to fit my own needs.	.61		
I find new technologies to be mentally stimulating.	.69		
I believe that technology gives me more control over my daily life.	.68		
Technology makes me more efficient in my occupation.	.68		
In general, I am among the first of my friends to acquire new technology when it appears.	.43		
I can usually figure out new high-tech products and services without help from others.	.63		
Factor 2 – Negative TR			3.03
I do not consider it safe to do any kind of financial business via online technologies.	.72		
I worry that information I send over the Internet will be seen by other people.	.65		

If I provide information over the Internet, I can never be sure it really gets to the right place.	.73		
It is embarrassing when I have trouble with a high-tech gadget while people are watching.	.65		
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	.79		
New technology is often too complicated to be useful.	.75		
Customer Experience *(KMO .92; Bartlett's test p<.01)*		.95	7.56
Having the service robot complete my check-in would be a nice experience.	.83		
Having the service robot complete my check-in would be fun.	.82		
I would enjoy having the service robot complete my check-in.	.87		
Having the service robot complete my check-in would enable me to think in an innovative way.	.79		
I could test my capabilities via having the service robot complete my check-in.	.78		
I would gain a sense of accomplishment by having the service robot complete my check-in.	.77		
I would gain new knowledge by having the service robot complete my check-in.	.77		
The overall experience with the service robot for my check-in would be satisfactory.	.76		
The overall experience with the service robot for my check-in would be positive.	.83		
The overall experience with the service robot for my check-in would be excellent.	.86		
The overall experience with the service robot for my check-in would be delightful.	.88		

4.1.4 Brand Equity Perception Changes

This study also aimed to explore whether the interaction with hotel service robots would change customers' perceived brand equity toward their preferred hotel. Paired t-test is the common approach to examine whether there is a significant difference between a pretest and a posttest (Hsu, 2005). The assumptions to conduct paired t-test include: 1) The dependent variable must be continuous (interval/ratio); 2) The observations are independent of one another; 3) The dependent variable should be approximately normally distributed; 4) The dependent variable should not contain any outliers. In the current study, the first two assumptions were met. To check the normality, the difference was obtained by subtracting 17 post-brand equity items from 17 pre-brand equity items. The skewness ranged from -.903 to .399, so the absolute value was below 2, indicating moderate normality; however, the kurtosis ranged from 1.472 to 5.232, exceeding the cutoff 2 in most items, violating the normality assumption (Joanes & Gill, 1998). Moreover, the p-value for normality test (Shapiro-Wilk significance) was less than .05 for all 17 items, supporting that the dependent variables were not normally distributed. Furthermore, each variable contained several outliers after running Q-Q plot. Therefore, a non-parametric statistical method called Wilcoxon signed-rank test, which is equivalent to paired t-test, was more appropriate for this dataset. The Wilcoxon signed rank test is a non-parametric statistical hypothesis test used to compare two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (Hollander, Wolfe, & Chicken, 2013). The Wilcoxon signed-rank test can be used as an alternative to the paired Student's t-test when the sample size is small and when the population cannot be assumed to be normally distributed (Lowry, 2014).

As shown in Table 4.5, among the 17 brand equity items, the majority of them did not show any significant differences after participants interacted with the hypothetical service robot. Specifically, in terms of "high efficiency", neither "extremely humanoid" condition nor "humanoid" condition showed any changes toward customers' perceived hotel brand equity before and after the exposure to the hotel service robot. In the "nonhumanoid" condition, the difference regarding "I would intend to visit again" before and after the scenario was negative and significant at $p<.05$, meaning that the exposure to a hotel service robot decreased customer's visit intention. In terms of "low efficiency", the "extreme humanoid" scenario exhibited significant changes in three items. The pre- and post- difference toward "the hotel had a futuristic and innovative style", "the hotel had a clear image of the types of customers", and consequently, "the likelihood to be loyal to the hotel" decreased. Likewise, in the "nonhumanoid" condition, the difference of perceptions toward "I believe the hotel has a unique personality", "I think the hotel uses materials associated with the service that are visually appealing", and "the intent to visit the hotel" all decreased. Finally, in the "humanoid" condition, after being exposed to the hypothetical robot, the perception toward "the hotel had a different image from other hotel brands" increased, while "the intent to visit" decreased. In general, the existence of the hotel service robot and the hypothetical interactions with them exhibited a negative impact on hotel customers' brand equity perceptions. Even though a few items showed significant changes after customers interacted with the hypothetical service robot, overall, the post-brand equity perceptions did not show statistically significant differences from the pre-brand equity ($p>.05$), rejecting H8.

Table 4.5 Perceived Brand Equity Changes

Pre/Post Brand Equity	Conditions					
Measurement items	EH-HE	H-HE	NH-HE	EH-LE	H-LE	NH-LE
I believe that the hotel (hotel's name is shown to substitute "the hotel" based on customers' answers in the previous question) has a futuristic and innovative style. I still believe that the hotel has a futuristic and innovative style.				.025* (-)		
I believe that the hotel has a different image from other hotel brands. I still believe that the hotel has a different image from other hotel brands.					.046* (+)	
I believe that the hotel offers a high level of service. I still believe that the hotel offers a high level of service.						
I believe that the hotel has a consistent brand image. I still believe that the hotel has a consistent brand image.						
I believe that the hotel has a clear image of the types of guests. I still believe that the hotel has a clear image of the types of guests.				.032* (-)		
I believe that the hotel has a unique personality. I still believe that the hotel has a unique personality.						.003** (-)
The hotel has modern-looking equipment. I still think that the hotel has modern-looking equipment.						
The hotel provides visually appealing facilities. I still think that the hotel provides visually appealing facilities.						

The hotel uses materials associated with the service that are visually appealing. I still think that the hotel uses materials associated with the service that are visually appealing.				.040* (-)
I would consider myself to be loyal to the hotel. I would still consider myself to be loyal to the hotel.		.014* (-)		
I would have the hotel as my first choice. I would still have the hotel as my first choice.				
I would intend to visit the hotel again. I would still intend to visit the hotel again.	.006** (-)		.022* (-)	.016* (-)
I would not choose other hotel brands if the hotel is an available option. I would still not choose other hotel brands if the hotel is an available option.				
Overall, I believe that it makes sense to choose the hotel of any other brand, even if they are the same. Overall, I still believe that it makes sense to choose the hotel of any other brand, even if they are the same.				
Overall, I believe that even if another brand has the same features as the hotel, I would prefer to choose the hotel. Overall, I still believe that if there is another brand as good as the hotel, I prefer to choose the hotel.				

Overall, I believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.
Overall, I still believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.

*Note: P-values are provided in this table. The values in parentheses indicate the coefficient. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*
EH – extremely humanoid; H – humanoid; NH – non-humanoid; HE – high efficiency; LE – low efficiency
"+/-":difference (post-brand equity minus pre-brand equity)

A summary of the hypotheses testing results for Study 1's actual study is provided in Table 4.6.

Table 4.6 Summary of Hypotheses Testing

Hypotheses	P values	Supported
H1 (appearance-experience)	.431	No
H2 (efficiency- experience)	.025*	Yes
H3 (appearance*efficiency*anxiety – experience)	.040*	Yes
H4 (Not applicable)		
H5 (Not applicable)		
H6 (TR-experience)	.000***	Yes
H7 (self-image congruity – experience)	.000***	Yes
H8 (brand equity changes)	.195	No

*Note: P-values are provided in this table. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*

4.2 STUDY 2

Respondents of Study 2 were those who had checked in at a hotel during the past 12 months. The main purpose of Study 2 was to examine the impact of hotel service robot's appearance and customization on customers' experiences interacting with the service robot.

4.2.1 Results of Pilot Study

A total of 185 participants were recruited to conduct the pilot study for Study 2. After eliminating incomplete and invalid surveys, 100 respondents were used for further data analysis. Of the 100 respondents, 69% were male and more than half of the respondents fell into the age group between 26 and 35 (43%). Regarding the ethnicity of the respondents, 41% were Asian, followed by White (28%). In terms of the employment status, about 59% of them were employed full-time. The majority of respondents held at least a bachelor's degree (60%) and 80% of the respondents had an annual income below

$75,000. The detailed descriptive information of the pilot study was provided in Table 4.7.

Table 4.7 Descriptive Data of Pilot Study for Study 2 (n=100)

Variables	Specification	Frequency	Percent
Gender	Male	69	69.0
	Female	31	31.0
Age	18-25	17	22.4
	26-35	43	56.6
	36-45	11	14.5
	46-55	4	5.3
	56-65	0	0
	66 and above	1	1.3
Ethnicity	White	28	36.8
	Hispanic or Latino	2	2.6
	African American	2	2.6
	Native American or	3	3.9
	American Indian	41	53.9
	Asian or Pacific Islander	0	0
	Other	0	0
Education	High school	3	3.9
	Associate college	5	6.6
	Bachelor's degree	60	78.0
	Master's degree	7	9.2
	Doctoral degree	1	1.3
	Other	0	0
Employment Status	Employed full-time	59	77.6
	Employed part-time	8	10.5
	Self-employed	4	5.3
	Student	5	6.6
	Other	0	0
Annual Household Income	Less than $35,000	21	27.6
	$35,000-$50,000	16	21.1
	$50,001-$75,000	24	31.6
	$75,001-$100,000	11	14.5
	$100,001-$125,000	2	2.6
	$125,001-$150,000	0	0
	$150,001 and above	5	2.6
Interacted with a "service robot"	Yes	78	78.0
	No	22	22.0
Interacted with a "hotel service robot"	Yes	65	83.3
	No	13	16.7
Types of service robot interacted	Front desk check-in/out robot	43	43
	Concierge robot	27	27
	Room service robot	48	48
	In-room robot	36	36
	Housekeeping robot	24	24

Results of the manipulation check showed that service robots' appearance was statistically different at $p<.05$ for three manipulation questions: the service robot looks fake vs. real (extremely humanoid (M=5.21, SD=1.68) vs. humanoid (M=4.09, SD=1.87) vs. non-humanoid (M=4.59, SD=1.86)); extremely machinelike vs. extremely humanlike (extremely humanoid (M=5.21, SD=1.53) vs. humanoid (M=3.29, SD=1.82) vs. non-humanoid (M=4.06, SD=2.09)); and artificial vs. Lifelike (extremely humanoid (M=4.89, SD=1.90) vs. humanoid (M=3.35, SD=1.97) vs. non-humanoid (M=4.14, SD=2.16)). Even though all three levels of service robots were significantly different on three questions, the mean values of humanoid and non-humanoid on three manipulation questions were different from what the researchers expected. Based on the results, two different types of service robots were modified by selecting the different form of service robot.

To investigate respondents' perceived differences of "service customization", Study 2 conducted the manipulation check of "service customization" by asking three questions: whether the service robot provided "individualized service" (high customization (M=5.18, SD=1.38) vs. low customization (M=4.49, SD=1.75), $p<.05$), "non-personalized service" (high customization (M=4.59, SD=1.26) vs. low customization (M=5.09, SD=1.20), $p<.05$), and "customized service" (high customization (M=5.26, SD=1.20) vs. low customization (M=4.71, SD=1.54), $p<.05$). Since three manipulation check questions all showed significant differences, it was concluded that statistically significant difference existed between the customized and non-customized conditions.

Like Study 1, Study 2 also conducted reliability and validity test for the main constructs. The results showed that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value was .94 for perceived experience, .87 for level of anxiety, .82 for technology readiness, and .84 for level of self-image congruity, exceeding the cutoff of .60 recommended by Hair et al., (1998). The Bartlett's test of significance was less than for all constructs, meaning the validity of the measurements was established. In order to assess the reliability of the measurement scales, Cronbach's alpha was analyzed, and the value was .94, .94, .80, and .90 for experience, anxiety, TR, and self-image congruity, respectively. Since the cutoff proposed by Nunnally (1978) was .70 to claim reliability of a measurement scale, this study had all constructs meeting the requirement, referring to internal consistencies of the measurement items in Study 2.

4.2.2 Results of Main Study

4.2.2.1 Descriptive Analysis

Study 2 obtained a total of 161 valid responses through M-Turk. Regarding the demographic information of the participants, there were 67.1% male respondents and 32.9% female respondents. About 60.9% of respondents were between 26 and 35 years old. Most of the respondents were Asian or Pacific Islander (66.5%). Approximately 87.6% were employed full-time. Regarding the participants' education level, about 67.1% held a Bachelor degree and 20.5% held a Master degree. Lastly, approximately 24% of the respondents had annual household income between $35,000 and $50,000 and 23% had less than $35,000. Furthermore, respondents were asked whether they had interacted with service robots and if so, what type of service robots they used. It was found that 67.7% of the respondents understood what a "service robot" was and 78.9% of the 161

participants claimed that they had interacted with a service robot before. Out of the respondents who interacted with service robots before, 85% claimed that they had interacted with a HOTEL service robot in particular. About 49% of the those who had experience with a hotel service robot used the robot for room service and 46.5% used it for front desk check-in/out service. The majority of the respondents had used service robots for room service in a hotel (68%), followed by service robots for front desk check-in/out (54%). More information was collected regarding the hotels the respondents frequently stay during travels. Out of 161 respondents, about 70.2% indicated the hotels were four or five stars, while 23.6% indicated the hotels being three-star and only 6.2% chose two-star hotels. Table 4.8 displayed the profile information for Study 2.

Table 4.8 Descriptive Data of Study 2 (n=161)

Variables	Specification	Frequency	Percent
Gender	Male	108	67.1
	Female	53	32.9
Age	18-25	18	11.2
	26-35	98	60.9
	36-45	30	18.6
	46-55	9	5.6
	56-65	4	2.5
	65 and above	2	1.2
Ethnicity	White	39	24.2
	Hispanic or Latino	4	2.5
	African American	10	6.2
	Native American or	1	.6
	American Indian	107	66.5
	Asian or Pacific Islander	0	0
	Other	0	0
Education	High school	10	6.2
	Associate college	9	5.6
	Bachelor's degree	108	67.1
	Master's degree	33	20.5
	Doctoral degree	1	.6
	Other	0	0
Employment Status	Employed full-time	141	87.6
	Employed part-time	7	2.7
	Self-employed	6	2.3
	Student	3	1.1
	Not currently employed	2	.8
	Other	2	.8

Annual Household Income	Less than $35,000	37	23.0
	$35,000-$50,000	62	38.5
	$50,001-$75,000	32	19.9
	$75,001-$100,000	15	9.3
	$100,001-$125,000	8	5.0
	$125,001-$150,000	4	2.5
	$150,001 and above	3	1.9
Interacted with a "service robot"	Yes	127	78.9
	No	34	21.1
Interacted with a "hotel service robot"	Yes	108	85.0
	No	19	15.0
Types of service robot interacted	Front desk check-in/out robot	75	28.7
	Concierge robot	33	12.6
	Room service robot	79	30.3
	In-room robot	43	16.5
	Housekeeping robot	28	10.7

4.2.2.2 Model and Hypotheses Testing

Like Study 1, normality check and homoiconicity check were performed to justify the utlization of ANOVA for Study 2 as well. The dependent variable – perceived experience interacting with the service robot – had a skewness value of -.832 and a kurtosis value of 1.131. According to George and Mallery (2010), the absolute values for skewness and kurtosis less than 2 are considered acceptable in order to prove normal univariate distribution, therefore, the outcome variable "perceived experience" in the current study was claimed normally distributed. In addition, the test of homogeneity of variances was performed and the Levene's test result was not statistically significant ($p>.05$), which means the variance of the dependent variable "perceived experience" was equal in each subpopulation. Therefore, the assumptions to run ANOVA were met in Study 2.

In Study 2, ANOVA was used to test the main effect and interaction effect of hotel service robot's appearance and service customization on customers' perceived experiences interacting with the service robot using SPSS 22. As shown in Model 1 in

Table 4.9, there was no significant effect of service robots' appearance or customization on their perceived experiences interacting with the service robot ($p>.05$), rejecting H1 and H4. There was also no interaction effect between appearance and customization on customers' perceived experiences interacting with the service robot. However, the K Matrix simple contrast was further conducted, and the results showed that there was a significant difference between level 1 (extremely humanoid) and level 2 (humanoid) at $p<.05$, but not between level 1 (extremely humanoid) and level 3 (non-humanoid) or level 2 (humanoid) and level 3 (non-humanoid), which lead to the final non-significant p-value of .116.

The construct "anxiety" was tested as a potential moderator as well in Study 2; it was included in Model 2 as shown in Table 4.9. The median value of anxiety (4.25) was used to divide it into two groups, high and low. It was found that "anxiety" did not exhibit a significant impact directly on experience ($p>.05$), but it appeared to have a significant interaction effect with service robots' customization at $p<.05$ on customers' perceived experiences interacting with the service robot. Furthermore, in Model 2, it is seen that a significant three-way interaction effect of service robot appearance, customization, and customer anxiety on customers' perceived experiences interacting with the service robot ($p<.05$) confirmed H5.

Table 4.9 Results of ANCOVA for Study 2

	Model 1 P(/β/F-statistic)	**Model 2 (p/β/F-statistic)**	**Model 3 (p/β/F-statistic)**	**Model 4 (p/β/F-statistic)**
Appearance	.116 (-.364) (2.185)	.151 (.538) (1.916)	.529 (-.786) (.639)	.634 (-.700) (.457)
Customization	.535 (-.775) (.387)	.508 (-.818) (.440)	.165 (-2.242) (1.944)	.218 (-1.934) (1.531)
Appearance*customization	.312 (.341) (1.174)	.311 (-.102) (1.177)	.134 (.556) (2.037)	.340 (.511) (1.086)
Anxiety		.201 (.081) (1.649)	.000*** (-2.098) (1.613)	.005* (-1.715) (8.046)
Anxiety*appearance		.611 (-.614) (.494)	.829 (.284) (.187)	.792 (.283) (.233)
Anxiety*customization		.042* (.019) (4.208)	.006** (1.051) (7.733)	.014 (.941) (6.136)
Anxiety*appearance *customization		.024* (.299) (3.837)	.204 (-.200) (1.608)	.358 (-.210) (1.034)
Self-image congruity			.000*** (.670) (108.895)	.000*** (.512) (49.184)
Technology readiness - positive				.048* (.374) (5.021)
Technology readiness - negative				.000*** (-.004) (37.137)
Adjusted R square	**.049**	**.137**	**.463**	**.566**

*Note: P-values are provided in this table. The values in parentheses indicate the coefficient. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*

To further probe the interaction effects, simple slope tests were conducted and plotted in Figure 4.3 and Figure 4.4. Figure 4.3 showed that among customers with high level of robot anxiety, the non-customized service would lead to decreased perceived

experience for humanoid and non-humanoid robots, but the opposite effect would occur for extremely humanoid robot. Figure 4.4 showed that the level of service customization moderates the relationship between the service robot appearance and customers' experiences interacting with the service robot. Specifically, when the customization decreased, customers' perceived experiences with a moderate humanoid robot and an extremely humanoid robot were influenced negatively; however, customers' perceived experiences interacting with a non-humanoid service robot was somewhat enhanced. Therefore, H5a was not supported but H5b was based on the results from Model 2.

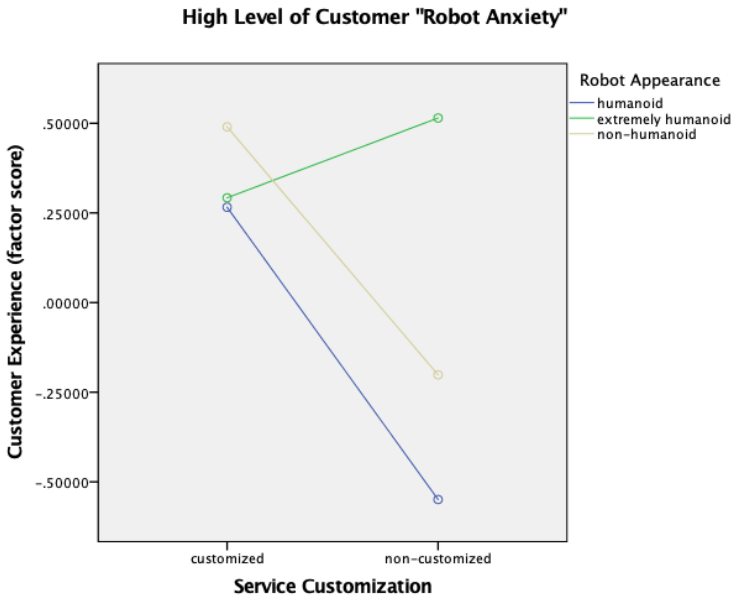

Figure 4.3 Slope Plot for Customer Experience – "High Anxiety" (Study 2)

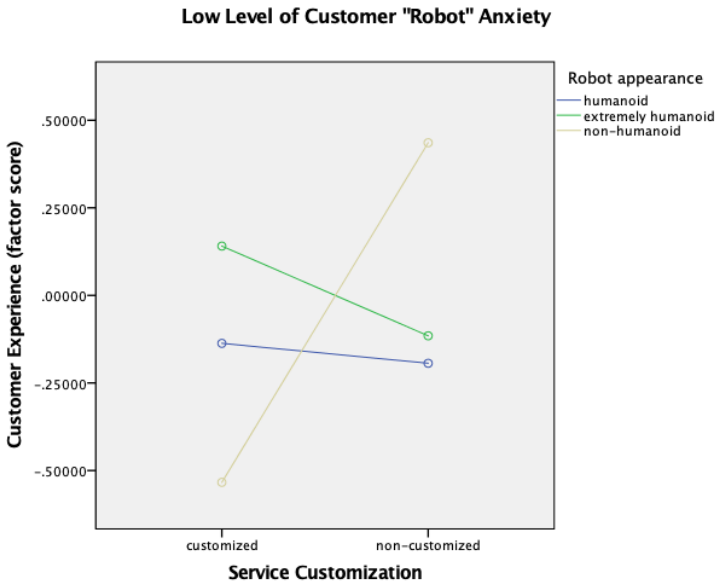

Figure 4.4 Slope Plot for Customer Experience – "Low Anxiety" (Study 2)

An analysis of covariance (ANCOVA) was conducted with two cofounding variables, customers' technology readiness and level of self-image congruity, to test their effects on experience. Factor scores were used to conduct ANCOVA: two factor scores for technology readiness, one factor score for self-image congruity, and one factor for experience. As shown in Model 3 in Table 4.9, self-image congruity was a statistically significant covariate affecting customers' perceived experience with hotel service robot at $p<.05$, supporting H8. As a result of factor analysis, the constructs of technology readiness had two factors (Table 4.10). An item "other people come to me for advice on new technologies" was dropped due to cross loading. Originally, technology readiness has four dimensions – optimism, innovativeness, discomfort, and insecurity (Parasuraman & Colby, 2001). In Study 2, one positive factor that included items in optimism and innovativeness was obtained with an eigenvalue of 3.295; one negative factor that included items in discomfort and insecurity was obtained with an eigenvalue of 2.054

(Table 4.10). Only the positive technology readiness factor was significant in Model 4 ($p<.05$), indicating that hotel customers' level of positive TR significantly affected their perceived experiences interacting with the hotel service robot, partially supporting H7.

Model 1 and Model 2 both had low adjusted R square, .049 and .137. The adjusted R square increased to .463 for Model 3, meaning that 46.3% of the variables were explained by the model. Specifically, the inclusion of the covariate self-image congruity in Model 3 changed the significance of "anxiety" as well as its interaction with customization, making it a significant moderator in Study 2. In other words, there was a significant effect of and anxiety on experience after controlling for the effect of self-image congruity. A positive coefficient showed that the higher hotel customers self-image congruity was, the more their perceived experience interacting with the service robot was. In Model 4, except the significant effect of "positive TR", which was an added covariate in this model, the result pattern was the same as Model 3 in that "anxiety", the interaction of "anxiety" and "customization", and "self-image congruity" were significant. A positive coefficient showed that the higher hotel customers positive TR was, the more their perceived experience interacting with the service robot was. The adjusted R square increased to .566, indicating that 56.6% of variables were explained by Model 4.

Table 4.10 Factor Analysis for Study 2

Constructs and Measurement Items	Loadings	Cronbach's alpha	Eigenvalue
User Anxiety (*KMO .85; Bartlett's test p<.01*)		.94	3.43
The presence of the service robot at the front desk would be frightening.	.88		
The presence of the service robot at the front desk would be agitating.	.92		
The presence of the service robot at the front desk would make me feel uncomfortable.	.90		
The presence of the service robot at the front desk would make me feel anxious.	.89		
Self-image Congruity *(KMO .84; Bartlett's test p<.01)*		.90	3.06
Having the service robot complete my check-in would help maintain my image.	.75		
Having the service robot complete my check-in would fit well with my character.	.83		
Having the service robot complete my check-in would be consistent with how I see myself.	.86		
Having the service robot complete my check-in would reflect who I am.	.88		
Technology Readiness *(KMO .82; Bartlett's test p<.01)*		.79	
Factor 1 – Positive TR			4.11
I like computer programs that allow me to tailor things to fit my own needs.	.65		
I find new technologies to be mentally stimulating.	.77		
I believe that technology gives me more control over my daily life.	.73		
Technology makes me more efficient in my occupation.	.52		
In general, I am among the first of my friends to acquire new technology when it appears.	.47		
I can usually figure out new high-tech products and services without help from others.	.42		
Factor 2 – Negative TR			3.00
I do not consider it safe to do any kind of financial business via online technologies.	.75		
I worry that information I send over the Internet will be seen by other people.	.71		

If I provide information over the Internet, I can never be sure it really gets to the right place.	.76	
It is embarrassing when I have trouble with a high-tech gadget while people are watching.	.57	
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	.82	
New technology is often too complicated to be useful.	.82	
Customer Experience *(KMO .94; Bartlett's test p<.01)*		6.96
Having the service robot complete my check-in would be a nice experience.	.82	
Having the service robot complete my check-in would be fun.	.79	
I would enjoy having the service robot complete my check-in.	.82	
Having the service robot complete my check-in would enable me to think in an innovative way.	.75	
I could test my capabilities via having the service robot complete my check-in.	.73	
I would gain a sense of accomplishment by having the service robot complete my check-in.	.73	
I would gain new knowledge by having the service robot complete my check-in.	.75	
The overall experience with the service robot for my check-in would be satisfactory.	.70	
The overall experience with the service robot for my check-in would be positive.	.76	
The overall experience with the service robot for my check-in would be excellent.	.80	
The overall experience with the service robot for my check-in would be delightful.	.83	

4.2.3 Brand Equity Perception Changes

Another objective of Study 2 was to see whether the presence of hotel service robots would change customers' perceived brand equity toward their preferred hotel. Similar to Study 1, assumption check was conducted to select the best statistical method. The 17 measurement items showed a high skewness (from .017 to -2.201) but high kurtosis (from 1.626 to 6.474), violating the normality rule according to Joanes and Gill, (1998). Additionally, the p-value for normality test (Shapiro-Wilk significance) was less than .05 for all 17 items, supporting that the dependent variables were not normally distributed. Furthermore, each variable contained several outliers after running Q-Q plot. Therefore, a non-parametric statistical method called Wilcoxon signed-rank test, which is equivalent to paired t-test, was more appropriate for this dataset.

As shown in Table 4.11, among the 17 brand equity items, the majority of them did not show any significant differences after participants interacted with the hypothetical service robot. In the "high customization" condition, participants in the "extremely humanoid" scenario, the perceptions toward "I believe the hotel has a unique personality" decreased after interacting with the robot, meaning that the exposure to a hotel service robot negatively affected customer's perception toward the hotel's brand image. In the "humanoid" scenario, the difference toward four brand equity items was positive. These four items were "I believe the hotel offers a high level of service", "I think the hotel has modern-looking equipment", "I think the hotel provides visual appealing facilities", "I think the hotel uses materials associated with the service that are visually appealing". In the "nonhumanoid" scenario, after being exposed to the hypothetical robot, the perception that "the hotel has a futuristic and innovative image" increased. In terms of the

"low customization" condition, no perception changes were found toward the hotel brand equity in all three levels of appearance scenarios. In general, the existence of the hotel service robot exhibited a positive impact on customers' brand equity perceptions, especially in "high customization" conditions.

Table 4.11 Perceived Brand Equity Changes

Pre/Post Brand Equity	Conditions					
Measurement items	EH-HC	H-HC	NH-HC	EH-LC	H-LC	NH-LC
I believe that the hotel (hotel's name is shown to substitute "the hotel" based on customers' answers in the previous question) has a futuristic and innovative style. I still believe that the hotel has a futuristic and innovative style.			.021* (+)			
I believe that the hotel has a different image from other hotel brands. I still believe that the hotel has a different image from other hotel brands.						
I believe that the hotel offers a high level of service. I still believe that the hotel offers a high level of service.		.018* (+)				
I believe that the hotel has a consistent brand image. I still believe that the hotel has a consistent brand image.						
I believe that the hotel has a clear image of the types of guests. I still believe that the hotel has a clear image of the types of guests.						
I believe that the hotel has a unique personality. I still believe that the hotel has a unique personality.	.480* (-)					
The hotel has modern-looking equipment. I still think that the hotel has modern-looking equipment.		.007** (+)				

The hotel provides visually appealing facilities. I still think that the hotel provides visually appealing facilities.	.002** (+)
The hotel uses materials associated with the service that are visually appealing. I still think that the hotel uses materials associated with the service that are visually appealing.	.004* (+)
I would consider myself to be loyal to the hotel. I would still consider myself to be loyal to the hotel.	
I would have the hotel as my first choice. I would still have the hotel as my first choice.	
I would intend to visit the hotel again. I would still intend to visit the hotel again.	
I would not choose other hotel brands if the hotel is an available option. I would still not choose other hotel brands if the hotel is an available option.	
Overall, I believe that it makes sense to choose the hotel of any other brand, even if they are the same. Overall, I still believe that it makes sense to choose the hotel of any other brand, even if they are the same.	
Overall, I believe that even if another brand has the same features as the hotel, I would prefer to choose the hotel.	

Overall, I still believe that if there is another brand as good as the hotel, I prefer to choose the hotel.
Overall, I believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.
Overall, I still believe that if another brand is not different from the hotel in any way, it seems smarter to choose the hotel.

*Note: P-values are provided in this table. The values in parentheses indicate the coefficient. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*
EH – extremely humanoid; H – humanoid; NH – non-humanoid; HC – high customization; LC – low customization
"+/-": difference (post-brand equity minus pre-brand equity)

A summary of the hypotheses testing results for Study 2's actual study is provided in Table 4.12.

Table 4.12 Summary of Hypotheses Testing

Hypotheses	**P values**	**Supported**
H1 (appearance - experience)	.116	No
H2 (Not applicable)		
H3 (Not applicable)		
H4 (customization - experience)	.535	No
H5 (appearance* customization*anxiety – experience)	.024*	Yes
H6 (TR-experience)	.000***	Yes
H7 (self-image congruity – experience)	.000***	Yes
H8 (brand equity changes)	.278	No

*Note: P-values are provided in this table. The asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.*

CHAPTER 5

CONCLUSION

This chapter summarizes and discusses the findings from the two experimental studies and illustrates the implications for both academia and industry. Two main objectives of the current study were to examine the main treatments – service robot's appearance and efficiency/customization – on customers' experiences interacting with the service robot and to compare the changes of customers' perceived brand equity toward their preferred hotel before and after interacting with the hypothetical service robot. Specifically, the current study aimed to provide empirical answers to the research questions asking "how would the hotel service robot's appearance would affect customers' perceived experiences interacting with the service robot?", "how would other attributes such as robot service efficiency, customization, and customer anxiety affect customer experience?", "will customer's technology readiness and self-image congruity influence their perceived experiences interacting with the robot?", and "whether customers' perceived brand equity toward their preferred hotel brand would exhibit significant changes before and after interacting with the hypothetical hotel service robot?"

As discussed in previous chapters, most technology-focused hospitality and tourism literature focus on technology acceptance. According to Murphy et al., (2019), engagement, interaction, or experience, which is critical for HRI and ultimately customer

future research. By launching two online experiments focusing on hotel customers' interaction experiences with the service robot, the research questions of the current study were answered. The empirical findings of the relationship between "appearance" and "experience" as well as the effects of other important attributes moved beyond the current theoretical limit by understanding anthropomorphism and HRI from its experiential perspective, which has been recently called for as one of the primary research priorities in the literature of hospitality service robots (Murphy et al., 2019).

By addressing the research questions in Chapter 1, this study made several noteworthy contributions to the theoretical discussions in both fields of robotics and hospitality. This study designed a comprehensive model to examine hotel customers' experiences interacting with a hotel service robot by mainly focusing on the robot's appearance and functional attributes such as service efficiency and customization. In addition, this study incorporated a relatively new concept "robot anxiety" as well as TR and self-image congruity to expand the proposed model, enriching the literature in this field from an innovative perspective. While it is important to note the contextual nature of this study, the findings and discussion presented previously still provide insight into the understanding of hotel service robots and customers' psychological and attitudinal responses.

5.1 DISSCUSION OF THE RESEARCH MODEL

In general, both studies showed no significant impact of hotel service robot's appearance on customers' perceived experiences interacting with the robot. Service efficiency was a significant factor on customer experience, while customization was not. Anxiety had a significant direct impact on customer experience but didn't play as a

moderator in the relationship between service robot's appearance and customer experience. The customers' personal recognition and trait, self-image congruity and TR, significantly affected their perceived experiences interacting with the service robot.

Although no significant effect was found among three levels of service robot's appearance on customer experience interacting with the robot, a significant difference toward customer experience was found between two levels, "extremely humanoid" (M=5.048) and "non-humanoid" (M=4.684) at $p<.05$. Participants exposed to extremely humanoid service robot exhibited more positive experience compared to those in the other group, indicating that hotel customers prefer interacting with a robot agent that has extremely humanlike features such as look, motion, and communication style. When "efficiency" was added to the model in Study 1, it was found to be a significant factor of customer experience, meaning that hotel customers' experiences with the robot would be enhanced when the service delivered by the robot was fast. In the current study, a check-in service completed within 2 minutes led to more positive interaction experience than a check-in service being completed after 10 minutes. Surprisingly, there was no interaction between service robot's appearance and efficiency, which means even though the service robot provides an efficient check-in service at the hotel front desk, service robots with different levels of humanlike appearance would not change customers' perceived experiences interacting with the robot. Regarding the construct "customization" in Study 2, even though it was not significant, the mean values showed that customized service such as calling out the customer's name and memorizing his/her preferences would lead to enhanced experience in "extremely humanoid" and "humanoid" condition, but not in

“non-humanoid” condition. In other words, hotel customers expect and prefer robots that look like human to provide more personalized service when they check in.

“Robot anxiety” had a direct negative impact on customer experience, meaning the higher the anxiety was, the lower the positive experience was. Furthermore, the addition of “robot anxiety” exhibited an interaction effect with efficiency and customization. Specifically, if the customer has a high robot anxiety, thinking the robot looks frightening (M=3.81), agitating (M=3.91), makes him/her feel uncomfortable (M=3.93), and makes him/her feel anxious (M=4.01), there was no difference in terms of the customers’ experiences between efficient and inefficient service. On the contrary, if the customer has a low robot anxiety, an inefficient service will decrease his/her perceived experience. In terms of the interaction with “customization”, interestingly, customers who had low robot anxiety exhibited worse experience when the service robot provided non-customization service, whereas those with high robot anxiety exhibited positive experience when the service robot provided non-customized service. The reason might be, when someone feel nervous interacting with the service robot for hotel check-in, general service will put him/her more at ease because this is the standard service other people receive as well.

"Self-image congruity” was found to exert significant positive impact on customers’ experiences interacting with the hotel service robot. The higher the level of customers’ self-image congruity was, the more positive his/her perceived experience was. Most customers showed high self-image congruity in this study: having the service robot complete his/her check-in helps maintain his/her image (M=4.43), fits well with his/her character (M=4.59), is consistent with how he/she sees himself/herself (M=4.58), and

reflects who he/she is (M=4.53). Likewise, “TR”, especially the positive dimension, had a significant positive impact on customer experience. In other words, the higher the customer's technology readiness level was, the more positive his/her interaction experience was with the service robot at the hotel front desk. The negative dimension showed a negative impact on customer experience in Study 1 1 and Study 2, indicating that hotel customers who had concerns about the hotel service robot perceived the interaction experience less favorable. Moreover, the inclusion of these two concepts did not change the main relationships tested in the model, meaning that even the “TR” and “self-image congruity” were controlled, the way the service robot’s appearance, efficiency, and customization affected customers’ experiences interacting with the robot remained the same.

5.2 DISCUSSION OF PERCEIVED BRAND EQUITY CHANGES

In addition to the first primary research objective, which was to test one theoretical model in each experimental study pertaining to the examination of the relationships between the hotel service robot’s appearance and efficiency or customization and customer’s perceived experience interacting with the robot, the current study also aimed to compare the potential perception changes toward the hotel brand equity before and after interacting with the robot in the hypothetical scenarios. In Study 1, the exposure to a service robot negatively influenced customers’ perceptions toward the hotel brand equity when the service provided was not efficient, regardless of the appearance of the robot. Regardless of the level of service robot’s service efficiency, when the non-humanoid service robot served the customers, customers showed decreased intention to visit the hotel again after they interacted with this service robot. Hotel

customers perceived that the presence of an inefficient extremely humanoid service robot made the hotel's brand image unclear and because of that their loyalty decreased. On the other hand, customers exposed to non-humanoid service robots expressed that their perceptions toward "the unique personality the hotel possessed" was negatively influenced by the inefficient non-humanoid robot, and the presence of a non-humanoid robot was not visually appealing. Overall, the employment of a service robot did not change much of customers' perceived brand equity toward the hotel they stayed frequently. Similarly, in Study 2, in general, hotel customers' perceptions toward their preferred hotel's brand equity did not change dramatically. Basically, customers who were exposed to robots that delivered customized check-in service changed their perceptions toward certain aspects such as brand image and service quality. Different from Study 1, the changes in Study 2 were mostly positive, meaning that an efficient service was not influential as a personalized service, regardless of the service robot's appearance. For example, customers perceived "the hotel was providing a high level of service" when a humanoid robot delivered a customized service. They also agreed that the hotel with a humanoid service robot would "look more modern and visually appealing". Surprisingly, customers perceived a non-humanoid robot would "provide a futuristic and innovative brand image" compared to an extremely humanoid robot, when customized service was offered. When the service was not customized, customers were indifferent about the appearance of the service robot and their brand equity was not influenced. Both studies concluded that "extremely humanoid" robot would negatively affect their brand equity perceptions. Moreover, the service robot's ability to provide

customized or efficient service outweighs its appearance in customers' perceptions toward the hotel's brand equity.

5.3 THEORETICAL IMPLICATIONS

Previous studies in service technology mainly focus on consumers' acceptance behaviors and preferences of SST as an alternative service delivery option (e.g., Blut, Wang, & Schoefer, 2016; Kim, Christodoulidou, & Brewer, 2012; Oh, et al., 2016). Recently, researchers have started to expand the service encounter literature by introducing service provided by the humanlike robots and focusing more on customer experience. For example, Van Doorn et al. (2016) predicted that the major advancement in service experiences would be technology infusion engaging customers on a social level and enabling social interactions between humanoid service robots and customers. They also suggested that anthropomorphizing and customer technology readiness (e.g., technology self-efficacy) might interact in technology infused service experiences and call for empirical tests for such effects. Tung and Au (2018) have further explored the guest experience brought by robot hotel services and indicated that hotel guests can have novel experiences when hotel services are provided by robots. Studies have investigated consumers' attitudes towards robot hotel services, their acceptance level, satisfaction and robot hotel service evaluation (Ivanov & Webster, 2019b; Kim & Lee, 2014; Tussyadiah & Park, 2018). Since "customer experience" has become a critical and attentive topic in the hospitality industry, the current study attempted to identify key features of hotel service robots that affect customers' experiences interacting with the service robot, to help explain the rapidly developed phenomenon in service industry.

The current study extended the Uncanny Valley Theory to a hotel front desk context. Robot appearance has been frequently mentioned in the hospitality industry recently (Yu 2018; Zalama et al., 2014). Previous research showed that people are more likely to exhibit favorable attitudes, evaluations and behavioral intentions towards anthropomorphic (vs. non-anthropomorphic) agents (e.g., Aaker, 1997; Aggarwal & McGill, 2007; Keeling, McGoldrick, & Beatty, 2010; Köhler, Rohm, de Ruyter, & Wetzels, 2011; Verhagen, Van Nes, Feldberg, & Van Dolen, 2014). In the hospitality and tourism discipline, this statement was confirmed by Tussyadiah and Park (2018), who designed experiments and found the positive impact of anthropomorphism on consumers' adoption intention of hotel service robots. Different from the existing studies, this study claimed that whether the service robot was humanoid or non-humanoid did not affect hotel customers' experiences interacting with it, which was supported by a conclusion reached by Wirtz et al., (2018). They mentioned that consumers' attitudes toward service robot's social-emotional elements (e.g., perceived humanness or anthropomorphism) are much complex and depend on the consumer characteristics and the context. A few empirical studies about service robot were found in hospitality and tourism research. While most of the studies have focused on the functional or operational features of a service robot, the current study moved beyond to incorporate the level of humanlike features – appearance – into a more holistic examination of customer experience. The findings from the current study were consistent with one of the existing empirical studies in that the respondents were indifferent to the robots appearing machine- or human-like (Ivanov et al., 2018). Moreover, Murphy et al., (2019) suggested that future research should focus on users and the Uncanny Valley Theory, therefore, the current study

contributed to the existing hospitality robotics literature by mainly focusing on robot appearance and two key service attributes – efficiency and customization.

Regarding the effect of service efficiency, the result from the current study was consistent with other studies in that efficiency plays a significant role in affecting customer experience in hotel industry (Rao & Sahu, 2013). However, studies related to service efficiency of "hotel service robots" remained conceptual (Pinillos et al., 2016), and most studies in hospitality analyzed efficiency from the perspective of economics (Kuo et al., 2016; Zhong et al., 2020). The current study further expanded the examination of robot service efficiency to the hotel front-desk setting, providing empirical analysis. In addition, the current study advanced the understanding of SERVQUAL in a hotel environment. A dominant research stream in the past century has applied SERVQUAL to electronic service quality, or eService (e.g. Elliott, Meng, & Hall, 2012; Lin & Hsieh, 2011; Narteh, 2015). Extending SERVQUAL to service robots could merit hospitality research from one particular aspect: robots as a self-service technology (Murphy et al., 2019). "Responsiveness", or "promptness" has been widely discussed as an important dimension of the SERVQUAL model, which emphasizes the ability to provide prompt and speedy service to customers (Zeithaml, Parasuraman, & Berry, 1988). By examining this essential robot feature in a hotel front-desk context, the current study contributed to fill in the research gap in the existing literature.

Customization as a unique feature of a service robot has attracted much attention from researchers and practitioners (Kim & Lee, 2014). However, most of the studies are conducted in healthcare, introducing the personalized feature of home-assistive service robots (Datta et al., 2012), or extended to smart devices in a general environment (Marsa-

Maestre et al., 2008). The research of service robot's customization function in hospitality is scant. Therefore, this study supplemented the literature by applying this concept to the hospitality field. The existing literature in service marketing claims that customization or personalization is critical in affecting service quality and consequently customer evaluation (Ball, Coelho, & Vilares, 2006; Coelho & Henseler, 2012). In hotel service robot studies, Ivanov and Webster (2019b) also confirmed that consumers have become more in favor of personalized services and expect new experiences brought by robot hotel services. However, in the current study, customization was not found influential on customers' experiences interacting with the service robot, which is different from most of the current literature, supporting the conclusion that customer experience with service robot is context-dependent (Wirtz et al., 2018) and calling for more empirical studies to focus on the role of customization.

Due to the social effect of anthropomorphism on consumers, the present study added other consumer traits to examine how the three factors (e.g., robot anthropomorphism, robot efficiency/customization, and user anxiety) together influence consumers' experiences interacting with the hotel service robot. Furthermore, this study modified the measurement of "technology anxiety" to fit the context and renamed it "robot anxiety", addressing the importance of testing important concepts with context-dependent items and expanding the literature to the specific robotics field. In addition, different from previous studies that proposed "anxiety" as a mediator in TAM that was normally influenced by "perceived ease of use" and "perceived usefulness" and affected user adoption intention (Alrajawy et al., 2018; Venkatesh, 2000), this study found its role

as a direct influencer of customer experience, expanding the understanding of the construct "robot anxiety" from an innovative perspective.

A recent experimental study confirmed and provided evidence that HRI engagement models should consider user attitudes and personality traits in addition to robot qualities (Ivaldi et al., 2016). Hotel customer's personality has been proposed as a factor worth considering in service robot studies. For instance, extroversion and emotional stability may relate positively to anthropomorphizing a robot (Salem, Lakatos, Amirabdollahian, & Dautenhahn, 2015). TR has been regarded as a personality trait that has four personality dimensions: optimism, innovativeness, discomfort, and insecurity (Parasuraman, 2000). This concept has been rarely applied in hotel service robot studies, while mostly in manufacturing technology (Charalambous, Fletcher, & Web, 2017) or healthcare (Cesta et al., 2016). The adoption of TR in the current study introduced the role of customer personality in service robot experience, contributing to the existing literature in this field. Moreover, recent studies have summarized the four TR personality dimensions into two categories – positive and negative. As a result of factor analysis, the current study supported the categorization, therefore, two dimensions (positive vs. negative) instead of four, were used. Furthermore, this study concluded that positive dimension and negative dimension exhibited different impact on customer experience interacting with the service robot. While many studies discuss TR and its impact as one concept, this study further divided it into two sub-concepts and found different significance of each sub-concept, providing new perspectives in understanding TR in social studies.

The current study obtained consistent results as those of previous studies that the higher the self-image congruity is between the customer personality and the product or brand personality, the more positive attitudinal and behavioral reactions consumers hold toward the product, service, or brand (Hosany & Martin, 2012; Sirgy & Su, 2000). Specifically, this study extended the conclusion to customer experience, stating that a higher congruence level would lead to a more positive experience. However, most studies that included self-image congruity existed in the tourism industry (Ahn, Ekinci, & Li, 2013). The current study further expended self-image congruity to a hotel front-desk context. Previous studies have started to examine self-image congruity toward new technologies (Goh, Jiang, & Tee, 2016), indicating the need for empirical studies toward service robots, which are the most current new innovations in the service industry. Therefore, the findings from the current research could enrich the existing literature in hotel service robotics. Additionally, studies have focused on assessing what could enhance self-image congruity (Unal, Dalgic, & Akar, 2018), while the current study, took a different perspective, tested how self-image congruity could enhance customer experience.

Moreover, the current study examined the "brand equity" concept considering the condition of service robot's appearance, level of service efficiency, and level of service customization, expanding the scope of "hotel brand equity". Supplementing the existing literature in "hotel brand equity" that focus on "what factors affect hotel brand equity" when innovations and technologies are involved (Gil-Saura, Ruiz-Molina, & Servera-Francés, 2019), the current study was one of the few studies that focused on the comparison of hotel customers' potential perceived brand equity changes before and after

interacting with the service robot. Overall, few studies related to service robots examined customers' personality traits such as TR and self-image congruity or particular pre- and post- consumer behavior such as perceived brand equity. The current research extended the stream of work on hotel service robots by demonstrating boundary conditions (TR and self-image congruity) for the effect of appearance, service efficiency, and customization on experience and analyzed "hotel brand equity" from an innovative perspective. In general, this study advanced the understanding of commonly discussed constructs, technology readiness, self-image congruity, and brand equity in a hotel front-desk service robot context, taking service robot's appearance, efficiency, and customization into account. Recent studies have gradually shifted from manufacturing robots to hotel service robots, but conceptual papers remain the mainstream (e.g. Murphy, Gretzel, & Pesonen, 2019), which requires more in-depth, experimental, or empirical studies to develop a theoretical framework for measuring customers' adoption of and experiences with service robots.

Lastly, regarding the methods that have been applied to hospitality and tourism, most of them adopted survey methods, while only a small number of studies used experiment method, even if the method assists in directly examining causal relationships (Lynn & Lynn, 2003; Xiao & Smith, 2006). In particular, experimental studies in hospitality and tourism are still in development (Li, Yang, & Pan, 2015; Wang, Kim, & Agrusa, 2018). Thus, to examine the causal relationships between hotel service robot's attributes and customer experience interacting with the service robot and contribute to the methodological rigor and advancement of hospitality and tourism studies, the study adopted an experimental design method for investigation.

5.4 PRACTICAL IMPLICATIONS

From a managerial perspective, this study provided insights to hospitality practitioners regarding the investment on service robot. Out of the 381 participants from Study 1 and Study 2, 177 of them said that they always prefer a human agent over a service robot for the hotel check-in service, while 123 respondents wanted to interact with a service robot, and the rest of them (81) had no preference of one over another. This finding is consistent with previous studies that claim robots cannot completely replace human agents (Tung & Au, 2018). Service firms want to enhance customer experiences by adding humanlike features to their technological facilities. However, hoteliers should always invest in a front desk service robot with caution and consider having both human agent and robot agent for check-in service.

For hotel managers who are interested in using service robots for front desk check-in service, this research provided implications on the design requirements for employing robots. The findings highlight an important design factor for managers to pay attention to, that is, the robot anthropomorphism. Since extremely humanoid service robot did exert slightly higher positive experience than non-humanoid service robot, hotels could work on infusing the robots with humanlike characteristics (e.g., by programming humanlike expressions) if financial budget allows, (Tussyadiah & Park, 2018; Zhong et al., 2020). Robots with certain level of human features, such as those at Henn-na Hotel in Japan, are more likely to put consumers at ease, and provide a positive interaction experience. However, the appearance of the service robot did not dramatically affect customers' experiences compared to the service efficiency provided by the robot, so hoteliers should invest more on improving the robot's speed of completing the check-

in task. Interestingly, customized service did not seem to affect hotel customers' experiences interacting with the service robot; however, the current research shows that, to an extent, service robots that provide customized check-in service can help mitigate customer's bad experience caused by robot anxiety. Therefore, it is still regarded as a feature that is worthy being considered when designing the service robot for the hotel's front desk service.

Furthermore, the current research suggests that the use of robot-enabled services should not follow a one-size fits all approach. Customers' levels of TR and self-image congruity play a role in affecting their experiences interacting with the robot. Such findings further emphasize the need for hotels to understand their target markets. Understanding how personal factors affect service robot perceptions (Bartneck et al., 2007; Kaplan, 2004; Rau et al., 2009) should provide important service marketing insights (Murphy et al., 2019). According to Rojas-Méndez, Parasuraman, and Papadopoulo (2017), younger respondents scored higher on innovativeness and optimism, and lower on discomfort and insecurity than their older counterparts. Males score higher than females on innovativeness and lower on discomfort and insecurity. In addition, more educated individuals are more prone than are less educated ones to adopt new technological developments. Since positive TR dimension (innovativeness and optimism) does induce enhance interaction experience, hotels that plan to employ service robots should target customers in the demographic group discussed above. Likewise, hotel managers should attract customers (Generation Ys and Zs and people who work in IT-related fields) who see "interacting with a service robot" as a way to reflect their own image by emphasizing the innovative feature of the robot (e.g. speedy, convenient, and

unique service delivery process) and make it visually appealing. To encourage people with low TR or self-image congruity to use service robots, hotels can provide open access of front desk service robots to public and offer promotion if the booking or check-in process is completed by interacting with a service robot. For newly built hotels, the introduction of robot hotel service can be considered as a selling point (Zhong et al., 2020).

In addition, by conducting two complementary experimental studies, the current research provides a better understanding of customers' perceived brand equity toward the hotel that they usually stay during travels. Hotel managers should put effort on enabling the service robots to provide customized service to customers because it will enhance their perceptions toward the hotel's brand equity, especially their perceptions toward the hotel's futuristic and innovative image, the modern-looking equipment, and visually appealing facilities. The ability of the service robot to call out the customer's name during check-ins and to memorize the loyal customer's preferences as well as credit card information could enhance his/her perceived quality of the hotel's overall service. This finding gives hoteliers insights on the design of front desk service robots. Interestingly, the employment of either "extremely humanoid" service robot or "non-humanoid" robot could potentially change the hotel's brand equity negatively after the customers interact with the robot; however, the "humanoid" robot, which has moderate humanlike feature, exhibited more positive outcome regarding hotel customers' perceived brand image and brand loyalty. Therefore, it might be smarter and more realistic for hoteliers to introduce "humanoid" service robot that has moderate rather than extremely humanlike or machinelike characteristics for front desk check-ins.

5.5 LIMITATIONS AND FUTURE RESEARCH

Although this study made contributions to the existing literature and the industry, it is not free of limitations. The first limitation is related to the design of the study. The scenarios shown in the questionnaire are hypothetical in this research, and customers' experiences were based on their perceptions after being exposed to the service robot in the hypothetical depicted situations. Although the realism of each scenario is perceived high by the respondents, future studies should measure customers' actual experiences with the service robots in the hotel right after customers interact with them. Moreover, the dimension of playfulness, novelty, and interactivity of a hotel service robot experience should be included in future studies.

Second, the online self-administered survey has its own limitations. When conducting online research, investigators can encounter problems as regards sampling (Andrews et al., 2003; Howard, Rainie, & Jones, 2001). Social desirability bias and self-selection bias (Trochim & Donnelly, 2001) might reduce the reliability and accuracy of the survey responses. Moreover, M-Turk, the third-party online survey company, was used to recruit the study's respondents from its established panel so that the sample could not represent the study's population (Dillman, 2000). It is also hard to generate a sampling frame for online survey studies and the incentives provided in the online survey could potentially undermine the credibility of the survey (Wright, 2005). These issues potentially inhibit researchers' ability to generalize the study findings. However, in social studies, the online survey has been used quite often, and the best way to defend for adopting this method is replication across different samples.

The third limitation is the lack of consideration of participants' socio-demographics and the impact they have on their perceived experiences interacting with the hotel service robot. Future studies should investigate the impact of hotel customers' age, gender, education level, income, and nationality on their experiences. Similar studies should be conducted across countries and cultures to identify differences among samples. Furthermore, future research should consider factors such as the level of hotel service, customers' previous experience interacting with a service robot, customers' mood during the interaction with the service robot, and other service robot's features such as its motion, communication style, the language it speaks, and its empathy level. The current study proposed "customers' experiences interacting with the service robot" as the dependent variable, while future studies can further examine its relationship with "customers' overall experiences with the hotel stay" to enhance the scope of research.

Finally, this study only selected the front desk check-in as the research setting, so the measurement items are developed to fit its context. It is suggested that future studies look at other service encounters such as in-room, food delivery, or housekeeping service in a hotel environment, in order to have a better understanding of the value of a hotel service robot. Moreover, customers might have different preferences toward service robots that work in different service areas. For example, the extremely humanoid appearance at front desk might enhance or neutralize customers' experiences but might not be ideal in the guest room. In addition, based on the results from this experimental study, future studies can expand the subject and develop a "hotel service robot's performance" scale or a "hotel HRI experience" scale, using different statistical methods such as regression or econometric modeling.

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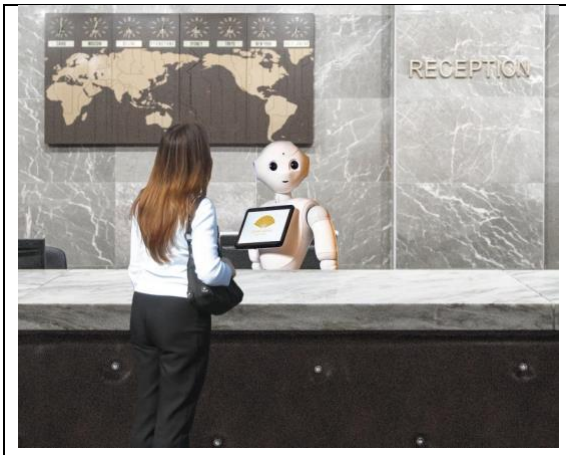
APPENDIX A: STUDY 1 SCENARIOS

You are about to check in at **${Name_hotel/ChoiceTextEntryValue}**. You see the following service robot greeting you at the front desk.

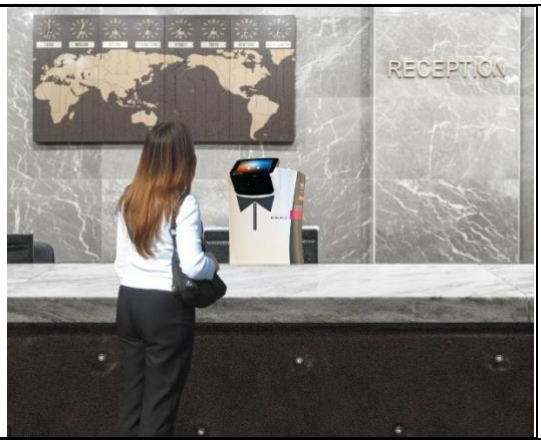
Scenario 1 – extremely humanoid and high efficiency (female)

<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(greeting you with a smile)
“Hello, how can I help you?”</td></tr>
<tr><td>You</td><td>(speaking)
“Hello, I would like to check in.”</td></tr>
<tr><td>Service Robot</td><td>(reaching out her hand to you and asking) “Can I have your ID, please?”</td></tr>
<tr><td>You</td><td>(speaking)
“Sure, here it is.”</td></tr>
<tr><td colspan="3">It only took the service robot a few seconds to process your ID and locate your information on the computer. The check-in service was completed within 2 minutes after you showed up at the front desk.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(handing in your key and ID with a smile)
"You are all set! Here is the room key.
Enjoy your stay!”</td></tr>
<tr><td>You</td><td>(speaking)
“Thank you very much for your prompt service!”</td></tr>
</table>

Scenario 2 – humanoid and high efficiency (female)

<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(lighting up the computer screen and speaking)
“Hello, how can I help you?”</td></tr>
<tr><td>You</td><td>(choosing “check-in” on the screen)</td></tr>
<tr><td>Service Robot</td><td>(speaking right after you chose "check-in")
“Can I have your ID, please?</td></tr>
<tr><td>You</td><td>(taking out your ID and scanning it on the screen.)
“ID scanning” is shown on the screen</td></tr>
<tr><td colspan="3">It only took the service robot a few seconds to process your ID and locate your information on the computer. The check-in service was completed within 2 minutes after you showed up at the front desk.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing your key and speaking)
"You are all set! Here is the room key.
Enjoy your stay!"</td></tr>
<tr><td>You</td><td>(taking your key and heading to your room).</td></tr>
</table>

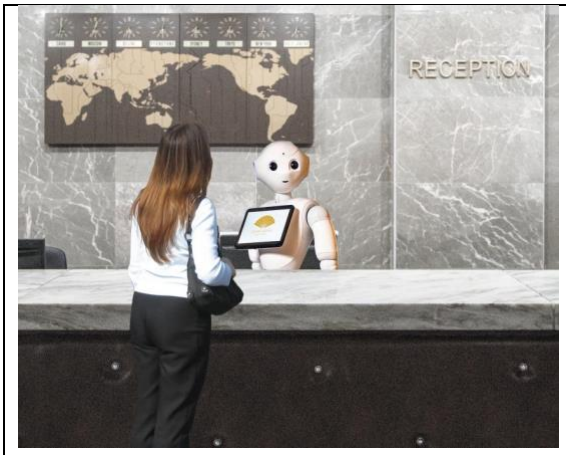
Scenario 3 – non-humanoid and high efficiency (female)

<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(lighting up the computer screen and showing)
“Hello, how can I help you?”</td></tr>
<tr><td>You</td><td>(choosing the “check-in” button on the screen)</td></tr>
<tr><td>Service Robot</td><td>(showing)
"Can I have your ID please?”</td></tr>
<tr><td>You</td><td>(taking out your ID and inserting it into the reader)</td></tr>
<tr><td colspan="3">It only took the service robot a few seconds to process your ID and locate your information on the computer. The check-in service was completed within 2 minutes after you showed up at the front desk.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing the room key to you and showing)
“You are all set!”</td></tr>
<tr><td>You</td><td>(taking your room key and heading to your room)</td></tr>
</table>

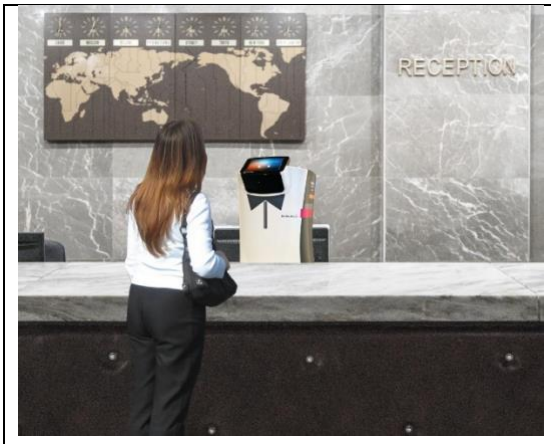
Scenario 4 – extremely humanoid and low efficiency (female)

	**Service Robot**	(*looking at you with a smile)* *"Hello, how can I help you?"*
	You	*(speaking)* *"Hello, I would like to check in."*
	Service Robot	(*reaching out her hand to you and speaking **slowly**)* *"Can I have your ID please?"*
	You	(*giving your ID to the robot*) "Sure, here it is."
The service robot read your ID **slowly** and **spent some time** locating your information on the computer.		
	Service Robot	*(asking **slowly**)* "Can I have your credit card for incidentals please?"
	You	*(handing in your credit card to the robot)* "Yes"
	Service Robot	*(working on the computer for a while and speaking **slowly**)* "Thank you for providing me with your ID and credit card. Is there anything else I can do for you?"
	You	*(speaking)* "No, that's it. Thank you".
The service robot completed your check-in **after 10 minutes** you showed up at the front desk.		
	Service Robot	(*smiling and speaking **slowly***) "You are all set! Here is the key to your room, your ID and credit card. Enjoy your stay!"
	You	*(taking the room key, ID and credit card and heading to your room*) "Thank you."

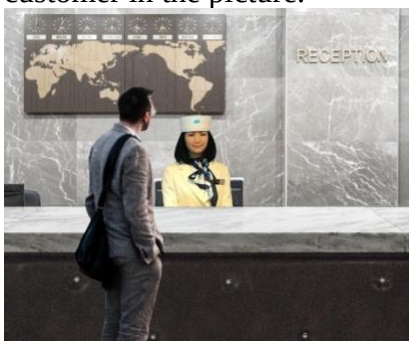
Scenario 5 – humanoid and low efficiency (female)

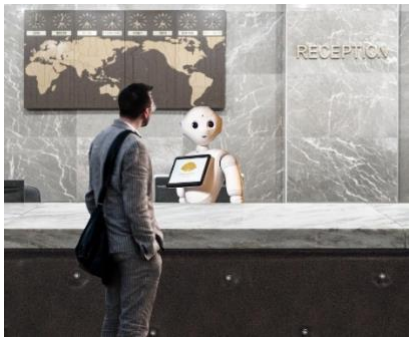
<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(the computer screen was not on until a few minutes' wait and then the robot started speaking slowly)
"Hello, how can I help you?"</td></tr>
<tr><td colspan="2">The options didn't show up right away and you had to wait until you can choose "check-in" on the screen. It took the service robot a while to process the information and it showed "processing" on the screen.</td></tr>
<tr><td>Service Robot</td><td>(speaking slowly)
"Can I have your ID, please?"</td></tr>
<tr><td>You</td><td>(taking out your ID and scanning it.)</td></tr>
<tr><td colspan="3">The service robot scanned your ID slowly and spent some time locating your information on the computer.</td></tr>
<tr><td rowspan="4"></td><td>Service Robot</td><td>(speaking slowly)
"Can I have your credit card for incidentals, please?"</td></tr>
<tr><td>You</td><td>(having your credit card scanned)</td></tr>
<tr><td>Service Robot</td><td>(working on the computer for a while and then speaking slowly)
"Thank you for providing me with your ID and credit card. Is there anything else I can do for you?"</td></tr>
<tr><td>You</td><td>(choosing the option "No" on the screen)</td></tr>
<tr><td colspan="3">The service robot completed your check-in after 10 minutes you showed up at the front desk.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing the room key and speaking slowly)
"Enjoy your stay!"</td></tr>
<tr><td>You</td><td>(taking your room key and heading to your room)</td></tr>
</table>

Scenario 6 – non-humanoid and low efficiency (female)

<table>
<tr><td rowspan="5"> 
</td><td>Service Robot</td><td>(the screen showed the greeting message word by word after you waited for a while)
“H-i, h-o-w c-a-n I h-e-l-p y-o-u?”</td></tr>
<tr><td colspan="2">The options didn’t show up right away and you had to wait until you can choose “check-in” on the screen. It took the service robot a while to process the information and it showed “processing” on the screen.</td></tr>
<tr><td>Service Robot</td><td>(showing word by word)
"C-a-n I h-a-v-e y-o-u-r I-D, p-l-e-a-s-e-?"</td></tr>
<tr><td>You</td><td>(taking out your ID and scanning it)
“ID scanning” is shown on the screen.</td></tr>
<tr><td colspan="2">The service robot spent some time processing your ID information and locating your information on the computer.</td></tr>
<tr><td rowspan="4"></td><td>Service Robot</td><td>(showing word by word slowly)
“C-a-n I h-a-v-e y-o-u-r c-r-e-d-i-t c-a-r-d p-l-e-a-s-e?"</td></tr>
<tr><td>You</td><td>(scanning your credit card on the screen)</td></tr>
<tr><td>Service Robot</td><td>(working on the computer for a while and then showing slowly)
“I-s t-h-e-r-e a-n-y-t-h-i-n-g e-l-s-e I c-a-n d-o f-o-r y-o-u?”</td></tr>
<tr><td>You</td><td>(choosing the option "No" on the screen.)</td></tr>
<tr><td colspan="2">The service robot spent some more time processing your check-in and finally completed your check-in after 10 minutes you showed up at the front desk.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing you the room key and showing word by word on the screen)
“E-n-j-o-y y-o-u-r s-t-a-y!”</td></tr>
<tr><td>You</td><td>(taking your room key and heading to your room)</td></tr>
</table>

*Note: the scenarios for male are identical to the scenarios for female except using a male customer in the picture.





APPENDIX B: STUDY 2 SCENARIOS

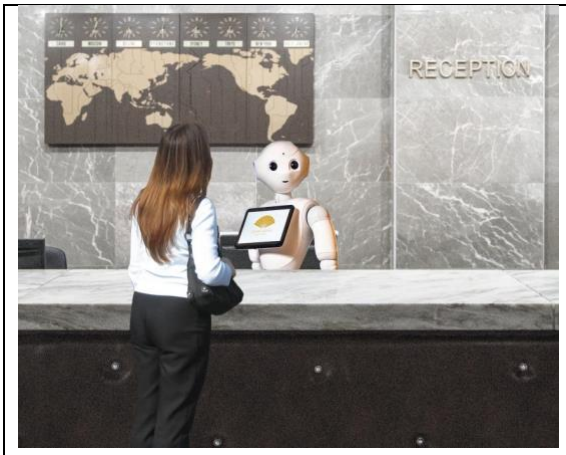
You are about to check in at **${Name_hotel/ChoiceTextEntryValue}**. You see the following service robot greeting you at the front desk.

Scenario 1 – extremely humanoid and high customization (female)

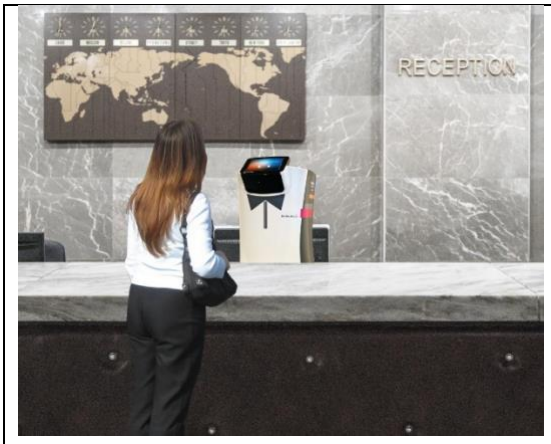
<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(looking at you with a smile) “Hello, Ms. ${q://QID139/ChoiceTextEntryValue}, how can I help you?”</td></tr>
<tr><td>You</td><td>(speaking)
“Hello, I would like to check in.”</td></tr>
<tr><td>Service Robot</td><td>(reaching out her hand to you and asking) “Can I have your ID, please?”</td></tr>
<tr><td>You</td><td>(giving your ID to the robot)
“Sure, here it is.”</td></tr>
<tr><td colspan="3">The service robot located your information on the computer right away to identify your preferred services.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing the room key to you and speaking)
“You are all set Ms.

${q://QID139/ChoiceTextEntryValue}.
Here is the key to your room. We will use the existing credit card information for incidentals and ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry} are already prepared for you. Enjoy your stay!”</td></tr>
<tr><td>You</td><td>(speaking)
“Thank you for catering to me preferences!”</td></tr>
</table>

Scenario 2 – humanoid and high customization (female)

<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(lighting up the computer screen and speaking)
“Hello, Ms. ${q://QID139/ChoiceTextEntryValue}, how can I help you?”</td></tr>
<tr><td>You</td><td>(speaking)
"I would like to check in please."</td></tr>
<tr><td>Service Robot</td><td>(speaking)
“Can I have your ID, please?”</td></tr>
<tr><td>You</td><td>(taking out your ID and scanning it on the screen)
“ID scanning” is shown on the screen.</td></tr>
<tr><td colspan="3">The service robot located your information on the computer right away to identify your preferred services.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing the room key to you and speaking)
“You are all set Ms. ${q://QID139/ChoiceTextEntryValue}.
Here is the key to your room.
We will use the existing credit card
information for incidentals and
${q://QID140/ChoiceGroup/SelectedChoicesTextEntry}
are already prepared for you.
Enjoy your stay!”</td></tr>
<tr><td>You</td><td>(speaking)
"Thank you for catering to my preferences!"</td></tr>
</table>

Scenario 3 – non-humanoid and high customization (female)

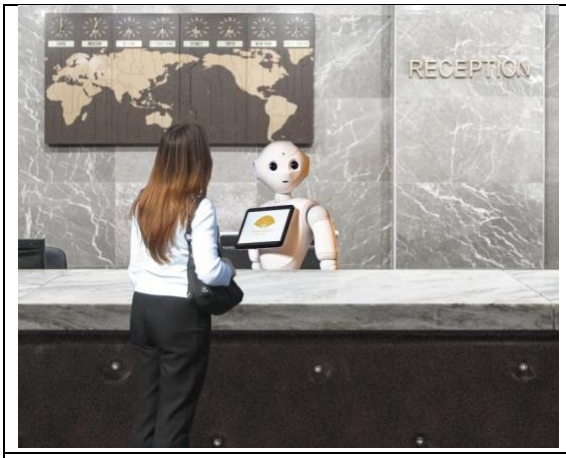
<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(lighting up the computer screen and showing)
“Hello, Ms. ${q://QID139/ChoiceTextEntryValue}, how can I help you?”</td></tr>
<tr><td>You</td><td>(choosing the “check-in” button on the screen)</td></tr>
<tr><td>Service Robot</td><td>(showing on the screen)
"Can I have your ID please?”</td></tr>
<tr><td>You</td><td>(taking out your ID and inserting it into the reader)
"ID scanning" is shown on the screen.</td></tr>
<tr><td colspan="3">The service robot located your information right away to identify your preferred services.</td></tr>
<tr><td rowspan="2"></td><td>Service Robot</td><td>(issuing the room key to you and showing)
“You are all set Ms. ${q://QID139/ChoiceTextEntryValue}.

Here is the key to your room. We will use the existing credit card information for incidentals and ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry} are already prepared for you. Enjoy your stay!”</td></tr>
<tr><td>You</td><td>(thinking)
"Thank you for catering to my preferences."</td></tr>
</table>

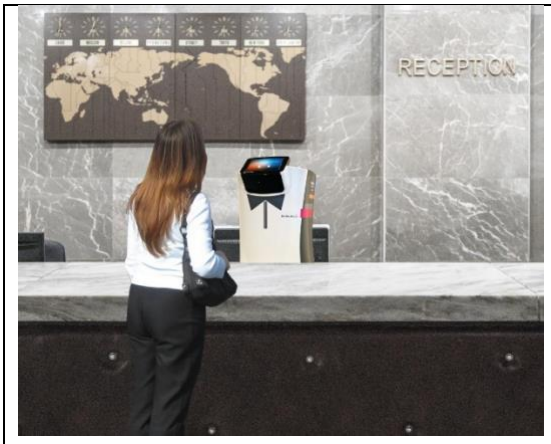
Scenario 4 – extremely humanoid and low customization (female)

<table>
<tr><td rowspan="4"> 
</td><td>Service Robot</td><td>(looking at you with a smile)
“Hello Ma'am, how can I help you?”</td></tr>
<tr><td>You</td><td>(speaking)
“Hello, I would like to check in.”</td></tr>
<tr><td>Service Robot</td><td>(reaching out her hand to you and asking)
“Can I have your ID please?”</td></tr>
<tr><td>You</td><td>(giving your ID to the robot)
“Sure, here it is.”</td></tr>
<tr><td colspan="3">The service robot started processing your ID information on the computer.</td></tr>
<tr><td rowspan="4"></td><td>Service Robot</td><td>(asking)
“Can I have your credit card for incidentals please?"</td></tr>
<tr><td>You</td><td>(handing in the SAME credit card you used before at this hotel to the robot)
“Here it is.”</td></tr>
<tr><td>Service Robot</td><td>(Processing your information on the computer and speaking)
“Ok, you are all set.
Here is your room key.”</td></tr>
<tr><td>You</td><td>(speaking)
“Thank you.
Can you please prepare ${q://QID140/ChoiceTextEntryValue}?”
(you always prefer to have ${q://QID140/ChoiceTextEntryValue}
when you stay at this hotel but you have to repeat this request every time when you check in.)</td></tr>
<tr><td></td><td>Service Robot</td><td>(speaking) "Ok, the hotel staff will be notified.
Enjoy your stay!"</td></tr>
</table>

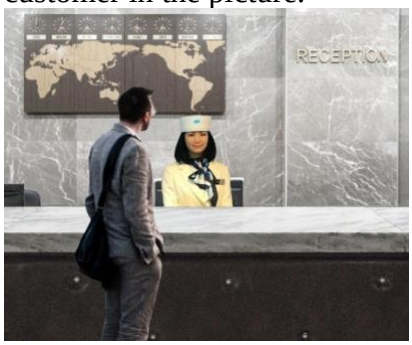
Scenario 5 – humanoid and low customization (female)

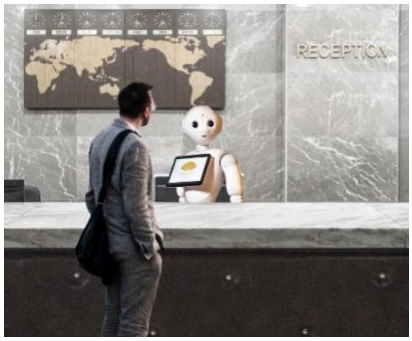
<table>
<tr><td rowspan="5"> 
</td><td>Service Robot</td><td>(lighting up the computer screen and speaking)
“Hello Ma'am, how can I help you?”</td></tr>
<tr><td>You</td><td>(speaking) "I would like to check in please"</td></tr>
<tr><td>Service Robot</td><td>(speaking)
“Can I have your ID, please?”</td></tr>
<tr><td>You</td><td>(scanning your ID) "ID scanning" is shown on the screen.</td></tr>
<tr><td colspan="2">The service robot started processing your ID information on the computer.</td></tr>
<tr><td rowspan="4"></td><td>Service Robot</td><td>(speaking)
“Can I have your credit card for incidentals, please?”</td></tr>
<tr><td>You</td><td>(scanning the SAME credit card you used before at this hotel on the screen.)
"Yes".</td></tr>
<tr><td>Service Robot</td><td>(processing your information on the computer and speaking)
“Ok you are all set! Here is your room key.”</td></tr>
<tr><td>You</td><td>(speaking) "Thank you. Can you please prepare ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry}?" (you always prefer having ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry} when you stay at this hotel, but you have to repeat this request every time
when you check in.</td></tr>
<tr><td></td><td>Service Robot</td><td>(speaking) "Ok"</td></tr>
</table>

Scenario 6 – non-humanoid and low efficiency (female)

	**Service Robot**	*(lighting up the computer screen and showing)* "Hello Ma'am, how can I help you?"
	You	(choosing the "check-in" button on the screen)
	Service Robot	*(showing on the screen)* "Can I have your ID please?"
	You	*(taking out your ID and inserting it into the reader)* "ID scanning" is shown on the screen.
The service robot started processing your ID information on the computer.		
	Service Robot	*(showing)* "Can I have your credit card for incidentals please?"
	You	*(scanning the SAME credit card you used before at this hotel on the screen)*
	Service Robot	*(processing your information on the computer and showing)* "You are all set!"
	You	(typing ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry} (you always prefer having ${q://QID140/ChoiceGroup/SelectedChoicesTextEntry} when you stay at this hotel but you have to repeat this request every time when you check in.

*Note: the scenarios for male are identical to the scenarios for female except using a male customer in the picture.





APPENDIX C: STUDY 1 FORMAL SURVEY

Dear respondent,

You are invited to participate in this study. This study aims to obtain your thoughts and perceptions of hotel service robots and your behavior intentions.

You don't have to be an "expert" in the hotel service robot to take part in this survey. Your **honest and thoughtful response** to each question would be much appreciated. Please remember that there are no right or wrong answers to the questions but just answer each question by checking the option that best describes your opinion.

The survey will take approximately 10-15 minutes for you to complete. Your participation is entirely voluntary. The information you provide will be kept strictly confidential. Should you have any questions about the survey or procedures, please feel free to contact me at chuhan@email.sc.edu or Dr. Miyoung Jeong at jeongm@mailbox.sc.edu.

Thank you very much for your participation!

We care about the quality of our data. In order for us to get the most accurate measures of your opinions, it is important that you thoughtfully provide your best answers to each question in this survey.

Do you commit to thoughtfully provide your best answers to each question in this survey?

- ○ I will provide my best answers.
- ○ I will not provide my best answers
- ○ I can't promise either way.

Have you personally checked in a hotel with the front desk staff before you stayed in the hotel in the past 12 months?

- ○ Yes
- ○ No

Please check the option that explains **what the service robot is** from your understanding. **The service robot** is:

- ○ automated robot system used for manufacturing such as assembly and material handling.
- ○ a robot that performs useful tasks to assist human activities such household chores and food delivery.
- ○ technological interfaces such as kiosks allowing customers to produce services independent of involvement of direct service employee.

The service robots are the robots that perform useful tasks to assist human activities such as household chores and food delivery. They typically are autonomous and/or operated by a built-in control system, with manual override options. For your clear understanding, here are several examples:

Picture A:  A cleaning robot

Picture B:  Airport check-in robot

Picture C:  Restaurant food delivery robot

Have you had an interaction with a service robot before?

- ○ Yes
- ○ No

Have you had an interaction with a service robot in a **HOTEL** before?

- ○ Yes
- ○ No

What service robots have you experienced at a hotel before? (check all that apply)

- ☐ Front desk check-in/out service robot
- ☐ Concierge robot
- ☐ Room service robot
- ☐ In-room service robot
- ☐ Housekeeping service robot
- ☐ Other (please specify)

_____

Please write the **Name of the HOTEL** that you frequently stay when you travel:

_____

What is the service level of (the Hotel you provided)?

- ○ One-star hotel
- ○ Two-star hotel
- ○ Three-star hotel
- ○ Four-star hotel
- ○ Five-star hotel

Please check the option that represents your perceptions of (the Hotel you provided).

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
I believe that (the Hotel you provided) has a futuristic and innovative style.	○	○	○	○	○	○	○
I believe that (the Hotel you provided) has a different image from other hotel brands.	○	○	○	○	○	○	○
I believe that (the Hotel you provided) offers a high level of service.	○	○	○	○	○	○	○
Please select disagree.	○	○	○	○	○	○	○
I believe that (the Hotel you provided) has a consistent brand image.	○	○	○	○	○	○	○
I believe that (the Hotel you provided) has a clear image of the types of guests.	○	○	○	○	○	○	○
I believe that (the Hotel you provided) has a unique personality.	○	○	○	○	○	○	○

Please check the option that best represents your perceptions of (the Hotel you provided).

	Strongly disagree	Disagree	Some-what disagree	Neu -tral	Some-what agree	Agree	Strongly agree
(the Hotel you provided) has modern-looking equipment.	○	○	○	○	○	○	○
(the Hotel you provided) provides visually appealing facilities.	○	○	○	○	○	○	○
(the Hotel you provided) uses materials associated with the service that are visually appealing.	○	○	○	○	○	○	○

Please check the option that best represents your perceptions of (the Hotel you provided).

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
I would consider myself to be loyal to (the Hotel you provided).	○	○	○	○	○	○	○
I would have (the Hotel you provided) as my first choice.	○	○	○	○	○	○	○
I would intend to visit (the Hotel you provided) again.	○	○	○	○	○	○	○
I would not choose other hotel brands if (the Hotel you provided) is an available option.	○	○	○	○	○	○	○
Overall, I believe that it makes sense to choose (the Hotel you provided) instead of any other brand, even if they are the same.	○	○	○	○	○	○	○
Overall, I believe that even if another brand	○	○	○	○	○	○	○

has the same features as (the Hotel you provided), I would prefer to choose (the Hotel you provided).							
Overall, I believe that if there is another brand as good as (the Hotel you provided), I prefer to choose (the Hotel you provided).	○	○	○	○	○	○	○
Please select strongly disagree.	○	○	○	○	○	○	○
Overall, I believe that if another brand is not different from (the Hotel you provided) in any way, it seems smarter to choose (the Hotel you provided).	○	○	○	○	○	○	○

Your gender is:

○ Male

○ Female

Scenarios

	checking out at the front desk.	checking in at the front desk.	filing a complaint at the front desk.	inquiring information at the front desk.	asking for help at the front desk.
What's this scenario about?	○	○	○	○	○

Please indicate your impression of **how the service robot looks like** in the scenario above, compared to **human employees** in a hotel.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
The service robot looks like a real person.	○	○	○	○	○	○	○
The service robot looks like a machine.	○	○	○	○	○	○	○
The service robot looks lifelike.	○	○	○	○	○	○	○

The service robot's service was/took:

	1	2	3	4	5	6	7	
slow	○	○	○	○	○	○	○	fast
inefficient	○	○	○	○	○	○	○	efficient
a long time to complete the task	○	○	○	○	○	○	○	a short time to complete the task

Based on the scenario, please indicate the level of your agreement about **your perceived experience interacting with the service robot**.

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
Having the service robot complete my check-in would be a nice experience.	○	○	○	○	○	○	○
Having the service robot complete my check-in would be fun.	○	○	○	○	○	○	○
I would enjoy having the service robot complete my check-in.	○	○	○	○	○	○	○

Based on the scenario, please indicate the level of your agreement about **your perceived experience interacting with the service robot**.

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
Having the service robot complete my check-in would enable me to think in an innovative way.	○	○	○	○	○	○	○
I could test my capabilities via having the service robot complete my check-in.	○	○	○	○	○	○	○
I would gain a sense of accomplish ment by having the service robot complete my check-in.	○	○	○	○	○	○	○
I would gain new knowledge by having the service robot complete	○	○	○	○	○	○	○

my check-in.							
The overall experience with the service robot for my check-in would be satisfactory.	○	○	○	○	○	○	○
The overall experience with the service robot for my check-in would be positive.	○	○	○	○	○	○	○
The overall experience with the service robot for my check-in would be excellent.	○	○	○	○	○	○	○
The overall experience with the service robot for my check-in would be delightful.	○	○	○	○	○	○	○

Based on the scenario, please indicate the level of your agreement about **your level of anxiety interacting with the service robot**.

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
The presence of the service robot at the front desk would be frightening.	○	○	○	○	○	○	○
The presence of the service robot at the front desk would be agitating.	○	○	○	○	○	○	○
The presence of the service robot at the front desk would make me feel uncomfortable.	○	○	○	○	○	○	○
The presence of the service robot at the front desk would make me feel anxious.	○	○	○	○	○	○	○

Please indicate the level of your agreement about **your own image**, compared to that of the hotel using a service robot in place of a human employee.

	Strongly Disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
Having the service robot complete my check-in would help maintain my image.	○	○	○	○	○	○	○
Having the service robot complete my check-in would fit well with my character.	○	○	○	○	○	○	○
Having the service robot complete my check-in would be consistent with how I see myself.	○	○	○	○	○	○	○
Having the service robot complete my check-in would reflect who I am.	○	○	○	○	○	○	○

Considering the **level of confidence with technologies**, please indicate the level of your agreement with the following statements

	Strongly Disagree	Disagree	Some-what disagree	Neutral	Some-what agree	Agree	Strongly agree
I like computer programs that allow me to tailor things to fit my own needs.	○	○	○	○	○	○	○
I find new technologies to be mentally stimulating.	○	○	○	○	○	○	○
I believe that technology gives me more control over my daily life.	○	○	○	○	○	○	○
Technology makes me more efficient in my occupation.	○	○	○	○	○	○	○
Please select neutral.	○	○	○	○	○	○	○
Other people come to me for advice on new technologies.	○	○	○	○	○	○	○

In general, I am among the first in your circle of friends to acquire new technology when it appears.	○	○	○	○	○	○	○
I can usually figure out new high-tech products and services without help from others.	○	○	○	○	○	○	○
I do not consider it safe to do any kind of financial business via online technologies.	○	○	○	○	○	○	○
I worry that information I send over the Internet will be seen by other people.	○	○	○	○	○	○	○
If I provide information to a machine or over the Internet, I can never be sure it really gets to the right place.	○	○	○	○	○	○	○
It is embarrassing	○	○	○	○	○	○	○

when I have trouble with a high-tech gadget while people are watching.							
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	○	○	○	○	○	○	○
New technology is often too complicated to be useful.	○	○	○	○	○	○	○

Please indicate the level of your agreement about **your perceptions of** (the Hotel you provided) **after** you hypothetically interacted with the service robot.

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
I **still** believe that (the Hotel you provided) has a futuristic and innovative style.	○	○	○	○	○	○	○
I **still** believe that (the Hotel you provided) has a different image from other hotel brands.	○	○	○	○	○	○	○
I **still** believe that (the Hotel you provided) offers a high level of service.	○	○	○	○	○	○	○
Please select neutral.	○	○	○	○	○	○	○
I **still** believe that (the Hotel you provided) has a consistent brand image.	○	○	○	○	○	○	○
I **still** believe that (the Hotel you provided) has a clear image of the types of customers.	○	○	○	○	○	○	○
I **still** believe that (the Hotel you provided) has a unique personality.	○	○	○	○	○	○	○

Please indicate the level of your agreement about **your perceptions of** (the Hotel you provided) **after** you hypothetically interacted with the service robot.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
I **still** think that (the Hotel you provided) has modern-looking equipment.	○	○	○	○	○	○	○
I **still** think that (the Hotel you provided) provides visually appealing facilities.	○	○	○	○	○	○	○
I **still** think that (the Hotel you provided) uses materials associated with the service that are visually appealing.	○	○	○	○	○	○	○
I would consider myself to be loyal to (the Hotel you provided)	○	○	○	○	○	○	○
I would have (the Hotel you provided) as my first choice.	○	○	○	○	○	○	○
I would intend to visit (the Hotel you	○	○	○	○	○	○	○

provided) again.						
I would not choose other hotel brands if (the Hotel you provided) is an available option.	○	○	○	○	○	○
Overall, I believe that it makes sense to choose (the Hotel you provided) instead of any other brand, even if they are the same.	○	○	○	○	○	○
Overall, I believe that even if another brand has the same features as (the Hotel you provided), I would prefer to choose (the Hotel you provided).	○	○	○	○	○	○
Overall, I believe that if there is another brand as good as (the Hotel you provided), I prefer to choose (the Hotel you provided).	○	○	○	○	○	○

Please select somewhat disagree.	○	○	○	○	○	○
Overall, I believe that if another brand is not different from (the Hotel you provided) in any way, it seems smarter to choose (the Hotel you provided).	○	○	○	○	○	○
	○	○	○	○	○	○

Please provide your comments, if any, about the service robot's greeting you at the front desk in (the Hotel you provided), **compared to a human employee**.

Your age:

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56-65
- ○ 66 or above

Your ethnicity:

- ○ White
- ○ Hispanic or Latino
- ○ African American
- ○ Native American or American Indian
- ○ Asian/Pacific Islander
- ○ Other (Please specify)

_____

Your annual household income before taxes:

- ○ Less than $35,000
- ○ $35,000 to $50,000
- ○ $50,001 to $75,000
- ○ $75,001 to $100,000
- ○ $100,001 to $125,000
- ○ $125,001 to $150,000
- ○ More than $150,000

Your highest education level is:

- ○ High school
- ○ Associate degree
- ○ Bachelor degree
- ○ Master's degree
- ○ Doctoral degree
- ○ Other (Please specify)

_____

You are currently:

- ○ Employed full-time
- ○ Employed part-time
- ○ Self-employed
- ○ Student
- ○ Not currently employed
- ○ Other (Please specify)

_____

In general, do you always prefer a human agent over a service robot for the hotel check-in service?

- ○ Yes
- ○ No
- ○ It depends

APPENDIX D: STUDY 2 FORMAL SURVEY

(Note: since the questionnaire in Study 2 is identical to the one in Study 1 except the manipulation question for "customization", only this question is displayed below)

Please indicate your impression of the **service customization** provided by the service robot in the scenario above.

	Strongly disagree	Disagree	Some-what disagree	Neu-tral	Some-what agree	Agree	Strongly agree
The service provided by the robot was **individualized.**	○	○	○	○	○	○	○
The service provided by the robot was **non-personalized**.	○	○	○	○	○	○	○
The service provided by the robot was **customized**.	○	○	○	○	○	○	○