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iRobot: Conceptualising SERVBOT for humanoid social robots

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List of Abbreviations

AI = Artificial Intelligence

ASP = Automated Social Presence

BSQ = Behavioural Service Quality

EE = Emotional Engagement

EFA = Exploratory Factor Analysis

e-SQ = Electronic Service Quality

HHI = Human-Human-Interaction

HHRI = Human-Human & Robot-Interaction (HHRI)

HREC= Human Research Ethics Committee

HRI = Human-Robot Interaction

KMO = Kaiser-Meyer-Olkin

MSQ = Machine Service Quality

RSQS = Retail Service Quality Scale

SAR = Socially Assistive Robots

SE = Social Engagement

SERVQUAL = Service Quality Model

SQ = Service Quality

SSQ = Service System Quality

STA = Service Transaction Accuracy

TAM = Technology Acceptance Model

UTAUT = Unified Theory of Acceptance and Use of Technology

For the purpose of this master's thesis, the terms 'customer' and 'consumer' are used interchangeably. The term robots refer to social robots and employees refer to frontline employees unless otherwise stated.

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

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ABSTRACT

Services are intangible in nature and, as a result, it is often difficult to measure the quality of the service. The service is usually delivered by a human to a human customer and the service literature shows SERVQUAL can be used to measure the quality of the service. However, the use of social robots during the pandemic is speeding up the process of employing social roots in frontline service settings. An extensive review of the literature shows there is a lack of an empirical model to assess the perceived service quality provided by a social robot. Furthermore, the social robot literature highlights key differences between human service and social robots. For example, scholars have highlighted the importance of entertainment and engagement in the adoption of social robots in the service industry. However, it is unclear whether the SERVQUAL dimensions are appropriate to measure social robots' service quality.

This master's project will conceptualise the SERVBOT model to assess a social robot's service quality. It identifies reliability, responsiveness, assurance, empathy, and entertainment as the five dimensions of SERVBOT. Further, the research will investigate how these five factors influence emotional and social engagement and intention to use the social robot in a concierge service setting.

To conduct the research, a 2 x 1 (CONTROL vs SERVBOT) x (Concierge) between-subject experiment was undertaken and a total of 232 responses were collected for both stages. The results indicate that entertainment has a positive influence on emotional engagement when service is delivered by a human concierge. Further, assurance had a positive influence on social engagement when a human concierge provided the service. When a social robot concierge delivered the service, empathy and entertainment both influenced emotional engagement, and assurance and entertainment impacted social engagement favourably. For both CONTROL (human concierge) and SERVBOT (social robot concierge), emotional and social engagement had a significant influence on intentions to use.

This study is the first to propose the SERVBOT model to measure social robots' service quality. The model provides a theoretical underpinning on the key service quality dimensions of a social robot and gives scholars and managers a method to track the service quality of a social robot. The study also extends the literature by exploring the key factors that influence the use of social robots (i.e., emotional and social engagement). Insights from this research will not only have methodological significance but also managerial implications as it evaluates the

factors that drive the effectiveness of a social robot's service quality to achieve higher customer engagement. The research highlights and confirms aspects of a robot-delivered service that generate emotional and social engagement; for example, managers should employ social robots that can be programmed to be funny and entertaining to make the customer experience more enjoyable. Insight from this research will help in employing social robots that deliver consistent, convenient and efficient services. This will provide a huge boost to productivity by increasing efficiency and reducing labour costs in the services industry, especially in the post-COVID world. Further, it will help address challenges such as shortages of elderly care staff and shortage of labour in remote areas.

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1 Introduction

1.1 INTRODUCTION AND BACKGROUND TO THE RESEARCH

Traditionally, services were solely provided by humans to other humans. However, with the advancement in technology, social robots are increasingly being used in the service sector to fulfil a service (Chiang & Trimi 2020). Rapid development in the field of digital technologies such as artificial intelligence, the Internet of Things (IoT), mobile and cloud technology, and social robotics has led to a transformation in the service sector and are changing customer service expectations and experiences (Wirtz et al 2018; Huang & Rust 2018; Pavon et al. 2020). Tourism and hospitality companies have also started adopting social robots for a wide variety of roles such as guides, hosts, porters, cooking staff, room servers, housekeeping attendants, waiters etc. (Seyitoğlu & Ivanov 2021). Additionally, the COVID-19 pandemic proved to be a catalyst in advancing the robotics ecosystem and driving robotic adoption (Tung 2020; Yang et al. 2020; Zeng et al. 2020). During the COVID-19 pandemic, social robots were successfully deployed in hotels, retail stores, hospitals, airports, and public spaces, proving the importance and usefulness of deploying robots in a wide range of services and industries. Social robots proved to be useful for preventing cross-infections through contactless services (Pani et al. 2020). They also provided therapeutic services and entertainment for quarantined patients and the vulnerable (Aymerich-Franch & Ferrer 2020).

Social robots are increasingly being used in the structured and repetitive environment, services sector (receptionists in hotels; museum tour guides; teaching assistants in education) and for personal use (companions in aged care; zoomorphic robots) (Mejia & Kajikawa 2017; Wirtz & Zeithaml 2018; Tussyadiah & Park 2018; Louie et al. 2014; Hegel et al. 2008). Robots are used in service organisations to enhance customer experiences such as the concierge robot “Connie” (Hilton Worldwide) is used to interact with hotel guests and provide individualised responses (Prentice & Nguyen 2021). Robots have evolved from being just dumb machines who perform repetitive tasks to being highly intelligent robots that look and act like humans (Lanfranco et al. 2004). Due to the advancement in artificial intelligence (AI), robots have been equipped with ‘social intelligence’. This gives robots to be socially aware and equips them with the

ability to decipher emotional signals and react in a human-like manner (Breazeal 2003; Lazzeri et al. 2013). They not just deliver customer service but also facilitate employees performance of service tasks (Prentice & Nguyen 2021). Service robots are considered the future of the hotel industry where they are expected to deliver consistent, convenient and efficient services (Choi et al. 2020). It is expected that service robots will provide a huge boost to productivity by increasing efficiency and reducing labour costs in the service industry (Rodriguez-Lizundia et al. 2015). In elderly care services, social robots help address challenges such as shortages of elderly care staff. They are specifically useful if the robots are capable of providing support to the elderly by showing emotional sensitivity and engaging in artificial intelligence (AI) based learning with them (Čaić et al. 2019).

However, due to technological limitations, it is difficult for robots to work independently, especially in a situation that requires intuition, judgment, and empathy (Huang and Rust, 2018). The gap between the service provided by humans and by robots is still large, sometimes large enough to render robots useless (Chiang & Trimi 2020). For example, a well-known hotel chain 'Henn-na Hotel' (see figure 1) initially deployed robot staff to replace human staff. However, due to the robot's poor service quality, humans had to be recalled to replace the robot staff (Ryall 2019). The social robot management rule book is still in the development phase (de Kervenoael et al. 2020). Further, managers do not comprehend the factors that lead to higher customer engagement and the robot's sustainable deployment (Chiang & Trimi 2020).

Figure 1: Henn-na Hotel

On the other side, acceptance of social robots by users is not easy to measure since social robots are expected to have state of the art technology and the capability of maintaining friendly social interactions (Tay et al. 2014). It is integral to evaluate the human-robot interactions and the experiences of human users with a social robot if want social robots to successfully integrate into humans' private and personal dimensions (Anzalone et al. 2015). Customer's needs, their perceptions of robots' social skills and social robots' performance should be assessed for wide adoption of social robots (Wirtz et al. 2018). Just increasing the use of robots does not automatically translate into their acceptance by human users.

As per the Computers Are Social Actions (CASA) paradigm, humans treat computers as social entities and, consequently, the social robots will need to be equipped with the same requirements as a human service agent (Niculescu et al. 2013; Nass et al. 1994). A successful humanoid social robot should not just perform a utilitarian role (interacting with humans for instrumental purposes) but also fulfil affective roles (interacting with humans on an emotional level) (Zhao 2006). Amelia et al. (2021) found that participants interacted and engaged with the social robot in the same way as they would with their partners in human-human interactions. Additionally, the participants gave social cues to the social robot such as 'Thank you' or 'Goodbye' (Amelia et al. 2021). In short, a social robot's performance impacts the user's perception of the service quality and subsequently the user's behavioural intentions (Bartneck et al. 2009; Amelia et al. 2021).

Moreover, the SERVQUAL model has been widely used to measure service quality in a number of contexts and cultural settings including tourism (e.g. Shafiq et al. 2019), healthcare (e.g Pekkaya et al. 2017), banking (e.g. Raza et al. 2020), education (e.g. Banahene et al. 2017), and government (e.g. Ocampo et al. 2019). The five dimensions of SERVQUAL (reliability, responsiveness, assurance, empathy and tangibles) have been shown to reliably predict the service quality of human frontline service employees (e.g. Parasuraman et al. 1988). However, due to the nature of social robots, the original SERVQUAL model is inadequate for measuring service quality (Morita et al. 2020). Social robots are very different from humans in service delivery and entertainment is integral in Human-Robot Interaction (HRI) (Morita et al. 2020). For example, scholars in social robotics have highlighted that engagement and entertainment are key to the adoption of the technology (e.g. Liu et al. 201; Coulter et al. 2012; Schodde, Hoffmann, & Kopp 2017). A lack of empirical data (Chiang and Trimi 2020; Čaić et al. 2019;

Lu et al. 2020) and a well-defined framework in this area mean it is very difficult to identify the variables that are critical to measuring the social robots' service quality (Chiang & Trimi 2020). To date, only one study has attempted to examine this phenomenon using the SERVQUAL framework in a multi-robot café (Morita et al. 2020). However, the study failed to adapt the critical factors that are important in the evaluation of the service quality dimensions (e.g., entertainment, emotional engagement and social engagement). As mentioned above, social robots are very different from humans in service delivery. As such, it is unclear whether the SERVQUAL five dimensions are relevant or whether other dimensions should be added to measure the social robots' service quality.

Furthermore, an extensive review of the literature shows a lack of quantitative analysis that examines social robots' service quality in HRI literature and the services marketing literature. The master's thesis attempts to fulfil these research gaps and provide a framework to measure social robots' service quality. It provides insights into how consumers would evaluate the social robots' service quality after the first human-robot interaction. This exploratory research will empirically examine the effects of a social robots' service quality on user engagement and behavioural intentions. Due to limitations in technology and the fact that service robots are still a new phenomenon, this research will attempt to identify the potential antecedents of emotional and social engagement (Tuomi, Tussyadiah, & Stienmetz 2021). Moreover, the study attempts to understand the importance of the service quality dimensions in robot-induced service delivery. The most relevant studies in the area focus on chatbots, and these studies suggest SERVQUAL can accurately measure social robots' service quality (Pavon et al. 2020). Thus, the study will provide key insights into the usage of social robots in a service setting by using well-established theories.

1.2 RESEARCH ISSUE AND JUSTIFICATION

After an extensive literature review, it was evident that there are no studies that examine the influence of service quality dimensions on emotional and social engagement. One of the major reasons why there is a vacuum of studies evaluating the service quality of social robots is due to a lack of reliable measurement tools. The studies that did develop the measurement scale did not focus on emotional and social engagement. They either examined the impact of service quality dimensions on customer satisfaction (Morita et al. 2020) or analysed the gap between customers' expectations and customers' actual experience with social robots (Chiang & Trimi 2020). However, understanding user engagement is important because emotionally engaged

customers are more likely to spend more money and develop affective commitment towards the company (Gallup Consulting 2010 cited in Sashi 2012; Evanschitzky et al. 2006). They are also more likely to refer the company's services to their peers (Guo 2018).

Although SERVQUAL is a well-established instrument, due to the differences in the nature of service delivered by a social robot concierge vs a human concierge, it needs to be modified to reflect these differences. SERVQUAL has been criticized for its inapplicability across different industries (Buttle 1996b). Researchers have acknowledged that service quality can be factorially different in different industries and the service quality dimensions are dependent on the services being offered; for example, E-S-QUAL was developed to measure e-SQ and RSQS was developed to measure retail service quality (Babakus & Boller 1992; Naik et al. 2010; Ladhari 2009). Thus, SERVQUAL needs to be adopted and adapted to measure the service quality of a social robot, just like it was modified to measure the service quality of websites.

Most of the current workaround robots in retail focus on considerably light (or non-empirical) modes of evaluation (such as self-made questionnaires, interviews and acceptance surveys), with the focus on exploratory and technology-based interventions (e.g. Niemelä et al. 2017; Nakanishi et al. 2020; Amelia et al. 2021; Niemelä et al. 2019; Kamei et al. 2011). There is a call for a more theoretical and methodological framework to understand HRI better, particularly to enhance user experience (Tonkin et al. 2018; Bartneck et al. 2009; Ivanov et al. 2019).

Finally, there is a lack of studies that compare the service quality of social robots and compare it with that of a human in a retail frontline service setting. Chiang and Trimi (2020) explored the service quality provided by robots using the SERVQUAL framework after the guests experienced the service. However, they did not provide a comparison and failed to indicate how the robot compares to the human service quality.

Thus, this master's project conceptualises SERVBOT, adopted and adapted from SERVQUAL, to measure the effectiveness of service quality of a social robot in a frontline service setting and compare it with that of a human. It provides results of the first impressions of a social robot by users in a frontline service environment.

1.3 METHODOLOGY

This section introduces the methodologies which were used for data collection and analysis. Chapter 4 will prove details of these methodologies.

The master's project makes use of quantitative methods across two stages. The study uses scales from well-cited studies (Parasuraman et al. 1988; Vivek et al. 2014; Ducoffe, 1996). The study consisted of two stages: Stage 1 consisted of data collection for the CONTROL condition and Stage 2 consisted of data collection for the SERVBOT condition.

In Stage 1 (CONTROL), the data was collected from the student cohort using an online survey at the concierge desk in Western Sydney University Parramatta City Campus. The data were collected to examine the influence of service quality dimensions on social and emotional engagement when the service is delivered by a human concierge. The relationship between social and emotional engagement and intention to use was also examined.

In Stage 2 (SERVBOT), the data were collected from the student cohort using an online survey after they interacted with the social robot in the Western Sydney University Parramatta City Campus classroom. The data were collected to examine the influence of service quality dimensions on social and emotional engagement when the service is delivered by a social robot concierge. The relationship between social and emotional engagement and intention to use was also examined.

The two stages allowed for comparisons to be made between the service delivered by a human concierge and social robot concierge and understand the difference between the two models. To test the model, a multiple regression analysis was performed. Further, a Cronbach’s Alpha and Exploratory Factor Analysis was conducted.

1.4 DELIMITATIONS AND SCOPE

The scope of this research is primarily confined to conceptualizing the SERVBOT model to examine the effectiveness of a robot’s performance in a service environment and compare it with that of a human. The model is limited to the following SERVBOT variables; tangibles, reliability, responsiveness, assurance, empathy and entertainment, and their impact on emotional engagement and social engagement. Additionally, the model examines the influence of social and emotional engagement on the intention to use a social robot as a concierge.

To achieve a desired comparison between the studies, a homogenous sample is required to control for external factors (DelVecchio 2000). By limiting respondents to the same ‘life

stages' (being in this case students), the researchers can control and reduce external factors that may influence the respondent's responses. Many of the studies in HRI have used student samples to test the adoption of social robots (Naneva et al. 2020; Zhu & Deng 2021).

To test the generalizability of the results, it would be necessary to understand perceptions of business travellers as they would have different requirements than the student cohort and would potentially interact with social robot concierges on their travels.

1.5 DEFINITIONS USED IN THIS RESEARCH

For the purpose of the study, the following definitions are adopted:

Social robot: Social robots as autonomous semi-autonomous robots that follow the rules of behaviour expected and accepted by their users (Bartneck and Forlizzi 2004).

Service quality: Service quality is the difference between customers' expectations of service and perception of service quality (Parasuraman et al. 1988).

SERVQUAL: SERVQUAL is a reliable, widely applicable and concise instrument to measure service quality. It is a multiple-item scale with five dimensions, namely reliability, assurance, responsiveness, empathy and tangibles (Parasuraman et al. 1988).

Tangibles: Tangibles refer to the 'physical facilities, equipment and appearance of personnel' (Parasuraman et al. 1988:23).

Reliability: Reliability refers to the "ability to perform the promised service dependably and accurately' (Parasuraman et al. 1988:23).

Responsiveness: Responsiveness is the 'willingness to help customers and provide prompt service' (Parasuraman et al. 1988:23).

Assurance: Assurance is the 'knowledge and courtesy of employees and their ability to inspire trust and confidence' (Parasuraman et al. 1988:23).

Empathy: Empathy is the 'caring, individualized attention the firm provides to its customers' (Parasuraman et al. 1988:23).

Entertainment: Entertainment consists of "activities that people enjoy and look forward to doing, hearing or seeing" (Vogel 2020:xix-xx).

Emotional engagement: Emotional engagement is the amount of subconscious 'feeling' experienced during an activity or an interaction (Heath 2009).

Social engagement: Social engagement can be defined as maintaining social connections and participation in social activities (Bassuk et al. 1999).

Intention to use: Intention to use is defined as 'the strength of one's intention to perform a specified Behaviour' (Fishbein and Ajzen 1977:288).

1.6 OUTLINE OF THIS STUDY

This master's thesis has six chapters. This chapter provided a background to the research topic and gave an overview of the entire master's project. Chapter 2 reviews the relevant literature focusing especially on social robots' literature, service quality literature and customer engagement literature. Additionally, the research gaps are identified in the chapter. Chapter 3 contains the theoretical underpinnings, and a theoretical framework is also developed in this chapter. This chapter concludes by outlining the hypotheses.

Chapter 4 covers the research methodology used to complete this project. The research design, scenario, sampling, ethical considerations and justification for student sampling is provided in this chapter. In chapter 5, the quantitative analysis is undertaken. The discussions and implications are also presented in this chapter.

The final chapter, chapter 6, provides a conclusion about the research problem. Further, it also acknowledges the limitations and presents future research directions.

1.7 CONCLUDING COMMENTS

This chapter provided an overview of the master's project thesis. Firstly, a background to the research was presented along with identified theoretical gaps. Next, the key research problem and related research issues were stated along with a justification for this study. Section 1.4 and 1.5 explained the methodology and scope of the study. The definitions of the key constructs and abbreviations have also been presented. Lastly, an outline of the thesis, including an

overview of the chapters, was given. The following chapter, Chapter 2, contains a review of the literature that informs and sets the stage for the study that follows.

2 Literature Review

2.1 INTRODUCTION

The previous chapter introduced the research problem of measuring the service quality of social robots. The primary purpose of this research is to examine the effectiveness of a social robot concierge and compare it with that of a human concierge. This chapter aims to review the literature on social robots, service quality and customer engagement. This literature review then acts as a foundation for developing the theoretical framework proposed in Chapter 3.

To gain a competitive advantage, cut costs, increase efficiency and engage customers in novel ways, businesses are increasingly looking towards integrating technology in the service delivery process (Ashcroft et al. 2019). Social robots have the ability to streamline and standardise parts of service delivery. They can certainly fulfill low-level service tasks and also collaborate with employees to provide high-level service (Prentice & Nguyen 2021). Currently, social robots are being employed to provide a wider range of services such as check-in and check-out, welcoming customers, cleaning, escorting and in-room delivery in hotels (Kim et al. 2021). Interaction with social robots creates a memorable experience for customers (Van Doorn et al. 2017). Thus, it can be noted that social robots are an integral part of Services 4.0 because of their ability to provide superior service quality and work efficiently and effectively with their human counterparts.

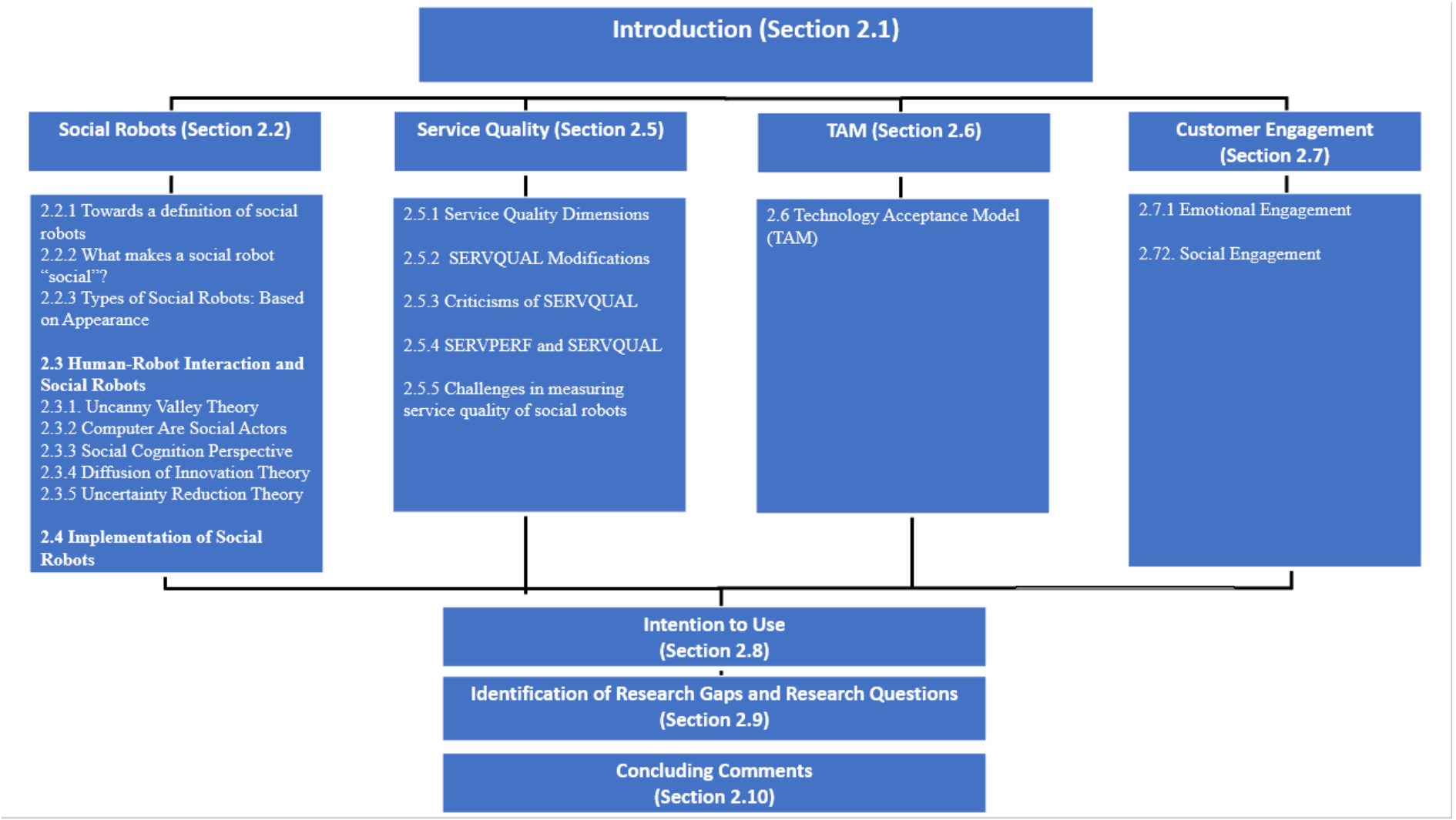
Advancements in service robotics mean that social robots are increasingly being used to interact with customers in a frontline service setting and this challenges the conventional notions of service encounters which are focused on human-to-human service encounters (Tuomi et al. 2021). Even though previous studies have looked at the use of robots in a service environment, most of these studies have been hypothetical in nature and used hypothetical scenarios to measure the service quality of social robots rather than an actual interaction (Chiang and Trimi 2020; Choi et al. 2020). Determining which service quality variables drive the effectiveness of social robot concierges' service delivery and which ones can emotionally and socially engage customers, is an area that is still in need of further attention.

The literature review is divided into five core sections (Figure 1): social robots, service quality, TAM, customer engagement and intentions to use. **The first section** on social robots' literature

will present the definition of social robots, the variables that influence the adoption and acceptance of social robots and their current implementation in education, in elderly care and hospitality. **The second section** will provide a background of service quality, the scale (SERVQUAL) used to measure service quality, the dimensions of SERVQUAL, its modifications, criticisms and challenges in measuring the service quality of social robots. **The third section** will provide a brief overview of the Technology Acceptance Model and variables that influence the acceptance of new technology. **The fourth section** will present the concept of customer engagement, emotional engagement and social engagement. **The fifth section** will provide an overview of the intention to use social robots in the frontline service setting.

The literature review will help identify the dimensions that are relevant for measuring the service quality of social robots and the theories that are applicable for developing a theoretical framework. Finally, after the literature review, **gaps in the literature are identified and the research questions are presented**, followed by concluding remarks.

Figure 2: List of sections included in Chapter



2.2 SOCIAL ROBOTS

2.2.1 Towards a Definition of Social Robots

The word robot was first coined by Karel Capek in 1920 in the play Rossum's Universal Robots and was later used in short videos written by Isaac Asimov in the 1940s (Hegel et al. 2009). The word 'robot' originated from the word 'robota' which means forced labour in Czech (Jordan 2019). However, robots have evolved from being just dumb machines who perform repetitive tasks to being highly intelligent robots that look and act like humans (Lanfranco et al. 2004). Service robots are 'system-based autonomous and adaptable interfaces that interact, communicate, and deliver services to an organizations' customers' (Wirtz et al. 2018:909). Service robots can be a) virtual or have a physical presentation b) humanoid or non-humanoid c) and can perform both cognitive-analytical and emotional-social tasks (Wirtz et al. 2018). It is important to note that during the service encounter, service robots can create a degree of Automated Social Presence (ASP), making the customer feel like they are in the presence of another social entity (Van Doorn et al. 2017).

When service robots are used in a frontline service setting, they are called social robots as they interact and co-create value with their customers during the interaction (Wirtz et al. 2018; Čaić et al. 2019). Social robots are specifically designed to facilitate human-robot interaction (Hegel et al. 2009). There is no universally agreed-upon definition of social robots in the literature, and there is a lack of consensus on what these robots do and what makes them social (Henschel et al. 2021). The term social refers to the fact that there are two or more entities within the same context (Hegel et al. 2009). As per Duffy (2003), social robots interact with each other whereas societal robots interact with human beings. Fong et al. (2003) defined social robots as embodied agents which are a part of a heterogeneous group i.e., the group could be a society of robots or humans. Fong et al. (2003) further added 'They are able to recognize each other and engage in social interactions, they possess histories (perceive and interpret the world in terms of their own experience), and they explicitly communicate with them and learn from each other' (p.144). Similarly, Breazeal (2002) defines sociable robots as socially intelligent in a human-like manner. Bartneck and Forlizzi (2004) describe social robots, from a design-centred approach, as autonomous or semi-autonomous robots that interact with humans by following socially accepted behavioural norms amongst the people they are interacting with.

All four definitions emphasize the **embodiment of social robots as they create different expectations due to the aesthetic form of robots** (Hegel et al. 2009). Social robots need to have humanlike qualities as humans tend to anthropomorphize technology and interpret behaviour as intentional (Breazeal 2002). They are different from virtual agents or computer-based intelligent tutoring systems as social robots are always present in some physical form as opposed to being present virtually or through a screen (van den Berghe et al. 2019). Therefore, it can be said that a social robot has technical as well as social aspects but the purpose of using social robots is the social aspects for which the social robot needs specific communicative capabilities (Hegel et al. 2009). Socially interactive robots should be able to express and perceive emotions, be able to engage in conversations, learn and recognize models of other agents, can establish and maintain social relationships using cues like gaze, gestures, natural language processing etc., and show a personality and a character (Fong et al. 2003). The ability to interact socially remains a key characteristic of social robots in all the definitions.

For this research, Bartneck and Forlizzi's (2004) definition will be used which defined **social robots as autonomous semi-autonomous robots that follow the rules of behaviour expected and accepted by their users**.

2.2.2 What makes a social robot 'social'?

Even though the understanding of social robots is heterogeneous, there are few traits identified by Sarrica et al. (2019) such as **social robots are physically embodied agents** that have some or full autonomy, and they engage in social interactions with humans by communicating, cooperating and making decisions. Humans then interpret these behaviours as 'social'. De Graaf et al. (2016) acknowledged that **social robots 'evoke' meaningful social interactions** because it is the human users who try to interpret the behaviour of robots in social terms. It is the social nature of human beings that prompts them to treat technological artifacts as social entities.

In their study, De Graaf et al. (2015) suggest eight main characteristics that users described as social and important for social robots to be accepted as social entities in their homes. These are:

a. The capability of two-way interaction as they expected the social robots to respond to a human socially. Additionally, they expected the robot to share the same physical environment as them (physically embodied or embedded),
b. Ability to display thoughts and feelings,
c. Be socially aware of their environment,
d. Provide social support by being there for them,
e. Ability to demonstrate autonomy,
f. Cosiness,
g. Similarity to self, and
h. Mutual respect.

2.2.3 Types of Social Robots: Based on Appearance

It is important to note that all robots are not social robots and not all social robots are humanoid robots (Zhao 2006). The appearance of social robots is integral when assessing their performance and appropriateness in a particular context (Lohse et al. 2007). Fong et al (2003) propose four types of social robots based on robot morphology: zoomorphic robots, functional robots, caricature robots and anthropomorphic robots.

Zoomorphic robots are social robots that resemble animals such as dogs, cats or seals (Klamer and Allouch 2010; Takayanagi et al. 2014). Zoomorphic robots such as Paro (Figure 3), a baby harp seal is designed for therapeutic purposes in older adults, paediatric and autistic patients (Lane et al. 2016). In a study conducted by Wada and Shibata (2006), the use of Paro led to increased social interaction amongst participants and a reduction in stress in older adults. Similarly, AIBO (Figure 4) has been used successfully in autism-related therapy (Stanton et al. 2008). In another study, the use of the AIBO dog led to an increase in the levels of play amongst children and an increase in their reasoning capability (Leite et al. 2013a).

Figure 3: Paro, baby harp seal

Figure 4: AIBO

Functional robots (Figure 5, 6 and 7) are designed to fulfil operational objectives (Fong et al. 2003). They are designed to fulfil given tasks or functions such as Roomba or PackBot (Veloso et al. 2015). Their appearance leans towards mechanical aspects, purely directed by operational objectives fulfilment (Fong et al. 2003). For example, health care robots designed to assist the elderly should be able to handle bars and cargo space. Thus, the embodiment must reflect the task the social robot is designed to perform (Fong et al. 2003).

Figure 5: People Bot, Mobile Robot

Figure 6: iRobot, a robot vacuum cleaner

Figure 7*: PackBot*

Caricature robots (Figures 8 and 9) are designed to look like cartoons. They do not need to be realistic to appear believable. In fact, they are designed to show humanoid motions in exaggerated ways (Sebastian et al. 2015). It has been proven earlier that it is not essential for animated characters to be realistic to evoke emotional responses (Björklund 2018). The advantage of using caricature robots is they can create desired interaction biases and get users to focus attention or distract them from particular robot features (Fong et al. 2003). Caricature robots use a small amount of degrees of freedom to express motions (Sebastian et al. 2015).

Figure 8: Keepon Robot, a caricature robot

Figure 9: PaPeRo, caricature robots

Anthropomorphic robots are robots with a human-like appearance and behave in a human-like manner (Phillips et al. 2018). In Human-Robot Interaction (HRI), it has been found that

anthropomorphism is a strong determinant of user preference and perceived trust (van Pinxteren et al. 2019). Anthropomorphic robots are humanoid robots (Figure 10 and 11) that can be defined as 'human-made entities (robotic), that interact with humans (social) in a human-like way (humanoid)' (Zhao 2006:405). In short, humanoid robots are anthropomorphized.

It has been observed that users have higher expectations from anthropomorphic robots because of their effective communications skills as compared to other types (Choi et al. 2020). It has been agreed that people would accept robots if they appeared and operated in a human-like manner and this is verified by the research conducted by Hameed et al. (2016) where participants said they preferred the human likeness of the robot. A great example of a humanoid robot is Pepper (Figure 9), the world's first social humanoid robot (Softbank Robotics). Even though Pepper is anthropomorphised, it was designed keeping in mind the 'Uncanny Valley' theory paradigm as per which if robots look too much like humans, users have a negative emotional reaction towards them (Tay et al. 2014). Pepper has also successfully been used in research in a retail environment (Aaltonen et al. 2017), in aged care (Khosla et al. 2017) and educational institutions (Tanaka et al. 2015). **Anthropomorphism has great impacts on the rate of adoption, service quality and service experience** (Yoganathan et al. 2021).

Figure 10: NAO, humanoid robot

Figure 11: Pepper, world's first social humanoid robot

2.3 HUMAN-ROBOT INTERACTION AND SOCIAL ROBOTS

Human-Robot Interaction (HRI) in public spaces is impacted by a range of factors such as user mood, situation, personality, age, gender, voice pitch, humour and many others. To introduce social robots successfully and ensure higher adoption rates, it is vital to understand the variables

that impact the adoption and acceptance of social robots. However, the most important factor for successful robot deployment in the services industry is their degree of autonomy and the quality of HRI. Lu et al. (2019) found that **performance efficacy, intrinsic motivation, anthropomorphism, facilitating conditions and emotions significantly impact consumers' willingness to use service robots.** The below theories present the variables that impact the acceptance and adoption of social robots.

2.3.1 Uncanny Valley Theory

The perception of technology having a mind of its own has great implications for robotic design, highlighting that robots should not just have a human-like appearance but also human-like minds (Waytz et al. 2014). However, simply applying human characteristics to social robots is not enough as it may lead to aversive and repulsive psychological responses as has been explained by the **Uncanny Valley Theory** (Tay et al. 2014). Mori's (1970) Uncanny Valley Theory states that the more the robots look like humans in appearance and motion, the more positive is the emotional reactions that humans have towards them but only up to a certain point (cited in Hanson et al. 2005). Once robots become indistinguishable from humans, the emotional reaction becomes negative, which is known as the Uncanny Valley (Hanson et al. 2005). When the resemblance with humans is too high, users start feeling a sense of eeriness and intense repulsion towards the robot (Čaić et al. 2019). **Therefore, human social characteristics should not be blindly applied to social robots and the appearance of the robot must match its abilities (Hanson et al. 2005).**

2.3.2 Computers Are Social Actors

It was noted that when people approach a humanoid robot for the first time, they usually approach them with other people, instead of approaching them individually (Klamer & Allouch 2010). In another study, it was found that when one customer tried to interact with the robot via a touch screen in the shopping center, at least 10 more customers got curious and tried to interact with it (Weiss et al. 2008). Amelia et al. (2021) found that participants interacted and engaged with the social robot in the same way as they would with their partners in human-human interactions. Interestingly, the participant's response to the social robot also affected their perspective of the company brand.

Therefore, it can be said that **interacting with humanoid robots is like a social activity** (Klamer & Allouch 2010). This has been proven by Nass et al. (1994) when they found that an individual's interactions with computers are fundamentally social and social norms and etiquettes are applied to computers (Choi et al. 2020). Importantly, humans ***mindlessly*** apply human social categories to computers such as ethnicity or gender to the machine. This is also known as the **Computers Are Social Actors** paradigm or CASA. As per this paradigm, users find computers with different voices as different social actors and gender stereotypes are observed during human-computer interaction (Nass et al. 1994). In short, **people treat computers and robots in the same way they treat human beings** (Choi et al. 2020). In a study by Sidner et al. (2005), it was noted that head nodding, just like in human-to-human conversations, occurred frequently and naturally amongst adults interacting with a robot even though the robot could not react to it. Further, a study conducted by de Graaf et al. (2015) pointed out that user expectations of social robots were influenced by their relationship with other social actors such as their friends. **Therefore, if the robot lacks social capabilities, it will not be able to become an 'actual' friend** (Henschel et al. 2021) **and would be less appealing and engaging to its users.**

2.3.3 Social Cognition Perspective

Humans use social cognition to determine the intentions of the other person or group and their ability to act on those intentions. Warmth and competence, the capacity to feel and to do, are two universal dimensions of human social cognition, and they drive service outcomes such as engagement (Van Doorn et al. 2017). Understanding others' mental states help humans thrive as social agents. Warmth 'captures traits that are related to perceived intent, including friendliness, helpfulness, sincerity, trustworthiness and morality, whereas the Competence dimension reflects traits that are related to perceived ability, including intelligence, skill, creativity and efficacy' (Fiske et al. 2007, p.77). People who are perceived to be warm and competent are more likely to evoke positive emotions and are generally more favoured and experience more positive interaction with their peers (Scheunemann et al. 2020).

Even though the technology is not part of conspecific, service organisations try to integrate robots with high Automated Social Presence (ASP) in their frontline service settings (Čaić et al. 2019). Automated Social Presence is the degree to which consumers perceive machines as another social entity (Heerink et al. 2010b). Modern social robots have more humanlike

features such as Pepper which means they can manifest high ASP (Yoganathan et al. 2021). Therefore, when users interact with robots, they perceive their human-like robotic counterparts in terms of two overarching dimensions that emerge during social interactions: **competence (being skilful and efficacious) and warmth (being helpful and caring)** (Čaić et al. 2019). This is also supported by the Computers Are Social Actors theory (Nass et al. 1994). **Therefore, it can be said that the mechanism of social cognition is induced when users interact with cognitively and affectively endowed social robots**. In short, they judge these social robots as social entities based on their warmth (friendliness, kindness and caring) and competence (efficacy, skill and confidence) dimensions and this impacts their behaviours (Čaić et al. 2019; Wirtz et al. 2018). Van Doorn et al. (2017) noted that robots with more human-like features are more likely to inspire trust, are perceived as more sociable, and encourage users to bond with them.

Social robots are not only utilitarian systems (such as performing household tasks) but also hedonic systems that help build (long-term) relationships through interactions with their users (Klamer & Allouch 2010). Apart from the cognitive resources, a social robots' affective resources resulting in warmth are also as important and should resonate with a general human-like appearance (Čaić et al. 2019). During a human-human interaction, humans try to understand others using cues like facial expressions, speech, eye gaze and body posture and form their social cognition (Čaić et al. 2019). Therefore, social robots need to recognise users' emotions through facial expressions, physical gestures, eye gaze and speech recognition so they can respond with affection and empathy during interaction in a human-like manner (Lisetti & Schiano 2000). In a study by Tielman et al. (2014), it was found that children reacted more positively to affective robots than non-affective robots.

According to Fong et al. (2003), 'if technology adheres to human social expectations, people will find the interaction enjoyable, feeling empowered and competent' (p. 146). **Therefore, it is important to study the hedonic factors along with the utilitarian factors** (Klamer and Allouch 2010). **It is important for social robots not just to have cognitive abilities such as Competence but also affective abilities like Empathy and Warmth, in addition to their human-like appearance**.

2.3.4 Diffusion of Innovation Theory

The adoption of new technology can be affected by multiple factors. The Diffusion of Innovation Theory by Rogers (1995) is a popular theory for studying the adoption of Information Technology by people and how innovation spreads between and within communities (Kiwanuka 2015). It considers five characteristics that impact the adoption of technology: complexity, observability, compatibility, trialability and relative advantage (see table 1) (Kiwanuka 2015). According to Rogers (2003), diffusion is 'the process in which an innovation is communicated through certain channels over time among the members of a social system' (p. 5). **Thus, the social system needs to be considered to increase the adoption of an innovation.**

Table 1: Characteristics of innovations

Relative Advantage	The degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 2010:15)
Compatibility	The degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters (Rogers, 2010:15)
Complexity	The degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 2010:16)
Trialability	The degree to which the innovation may be tried and modified (Rogers, 2010:16)
Observability	The degree to which the results of the innovation are visible to others (Rogers, 2010:16])

The usefulness or the '**relative advantage**' is the most important variable for social robot acceptance (Rogers 2003; Davis 1989). As per Rogers (2010), the innovation does not need to have a big objective advantage as long as it is *perceived* as advantageous by the user. Thus, the purpose of using social robots must be very clear for its successful acceptance. This was evident in the long-term study with the Roomba vacuum cleaner robot (Fink et al. 2013). Social robot developers must design the robots to provide clear utility (de Graaf et al. 2016). Further, the innovation needs to be compatible with sociocultural values and the perceived needs, and this compatibility increases the adoption of new technology (Kaminski 2011). A robot's **compatibility** will influence the usefulness, enjoyment and use intention of the users (Pal et

al. 2018). **Social compatibility is an important variable as it can enhance social engagement with friends and family.** For example, when a participant started using a Roomba vacuum cleaner, it triggered conversations and led the participant to invite other colleagues to his place to give them a demo (Fink et al. 2013). In HRI, culture has also been shown to affect the robot's acceptance and appeal. For example, religion is believed to influence cultural views and acceptance of robots (Bartneck et al. 2007).

'**Trialability**' is the extent to which an innovation is tested on a limited basis and results in less risk to the user who intends on using the product. If the users see the social robot as successfully usable, they will experience lower uncertainty (Heerink et al. 2010a). Similarly, when the user observes other people using the social robot successfully, the uncertainty reduces. This is the '**Observability**' characteristic (Heerink et al. 2010a). Furthermore, the more visible the results of an innovation are to users, the more likely they are to adopt it (Rogers 2010). Observability also initiates peer discussion of a new idea, as friends and family would often ask for innovation-evaluation information about it (Rogers 2010). However, if the use of the social robot is too **complex** for the user, it will harm the adoption intention. For example, in a study conducted by Khaksar et al. (2021), it was found that almost all carers stated that social robots should be compatible with the current services, triable in care facilities and observable for carers to understand how to integrate them for providing better care services.

Further, the user's age, gender, education level, and previous experience with technology also impact their acceptance (Robinson et al. 2016). Even though social robots are considered to be generally effective across all age groups, there is no data to show how higher education Australian students would react to social robots being used as a concierge in the university (Belpaeme & Tanaka 2021). There is a positive correlation between beliefs and reactions to a particular technology; for example, social robots need to act like 'superhumans' while interacting with customers or they need to be humourous as it improves the perception of task enjoyment and the robot's personality (Barnett et al. 2014; Niculescu et al. 2013). Therefore, while assessing the service quality of the robots, the socio-cultural values and perceived needs have to be kept in mind along with the five characteristics of innovation that influence adoption intention.

2.3.5 Uncertainty Reduction Theory

Literature has revealed that participants' psychological variables also impact the acceptance process along with their social and physical environment. According to the **Uncertainty Reduction Theory**, during first interactions, people try to seek information about the other party to reduce their uncertainty (Horstmann & Krämer 2019). This information is processed and organised as per the social categories, based on traits or social stereotypes, which then helps people make predictions about others (Horstmann & Krämer 2019). Since social robots represent a novel technology, people may find them hard to classify and, thereby, it increases uncertainty. To reduce this uncertainty about potential interaction partners, people are likely to consider all kinds of information sources such as science fiction movies and books (Horstmann & Krämer 2019). This is evident in the references people make to science fiction movies when they are discussing social robots, which tends to impact their attitudes towards robots (Kriz et al. 2010; Bruckenberger et al. 2013). For example, participants with a higher level of education were found to be less accepting of robots as a social entity (Heerink 2011). This could be because of the second-hand information received by the sources external to the individuals such as science fiction or the media which influence their mental nodes and attitudes towards the robots (Gross et al. 2012). Thus, they perceive the current social robots to be as advanced as they see in popular **science fiction movies such as Star Wars, Ex Machina, iRobot** etc. (see Figure 12 and 13). Consequently, people's expectations about social robots are impacted by the unrealistic social robot depiction in the media (Sandoval et al. 2014). However, these science-fiction robots are still a vision of the distant future (Henschel et al. 2021).

Figure 12: Terminator Genisys Sci-fi Robot

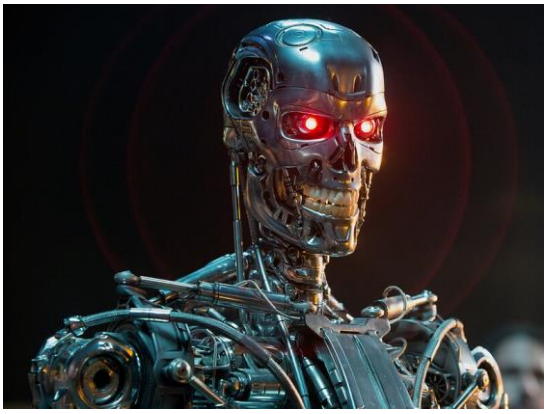
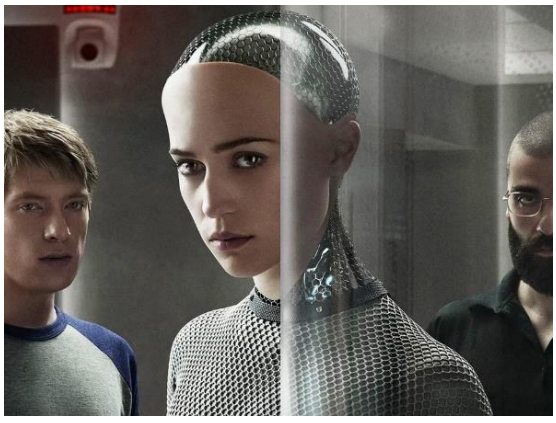


Figure 13: Ex Machina Robot: Ava



The above-mentioned theories show that starting from the appearance of the robot to its compatibility with the user's personal values, all impact the adoption and acceptance of social robots. Thus, while evaluating the service quality effectiveness, these variables need to be kept in mind to understand which variables impact user engagement and perception of service quality.

Service robots are still a rare feature and interacting with them reinforces pleasant experiences for users and contributes to their satisfaction. Due to novelty seeking, users get curious about service robots' service delivery, fulfilling the psychological need for novelty (Choi et al. 2020). However, it has been shown that the current social robots are not as capable and; therefore, the consumers lose interest in the social robots after the initial interaction (Leite et al. 2013a; Tanaka et al. 2015). It needs to be noted that service robots are not widely commercialised and, therefore, their functions are only limited. Hotels have started using service robots but there is only a little information available about their impact on hotels (Choi et al. 2020). Dereshev et al. (2019) noted that participants in their studies quickly lost interest in Pepper as they expected Pepper to go beyond the capability of a smart speaker like the single-turn structure of conversation and engage in reciprocal conversation. The very famous 'Henn-na Hotel' chain, popular for deploying robot staff, recently replaced the robot staff with humans due to low service standards (Ryall 2019). Similarly, **Softbank Robotics has paused the production of the world's first robot 'with a heart', Pepper**, due to low demand. It has been speculated that the sales of Pepper suffered **due to limited functionality and unreliability** (Nussey 2021). This makes it important to, firstly, understand the effectiveness of service quality of social robots and then, introduce them amongst the public. The key hindrances to acceptance of social robots are unrealistic expectations and lack of benefits for specific context use, meaning service providers need to understand the social robots' value proposition better and how this value can be realised for service beneficiaries (Čaić et al. 2019). Therefore, user perceptions need to be measured before deploying robots as disappointment and dissatisfaction can easily be caused due to substandard performance.

Further, it has also been observed that there is a disconnection between how people think they would respond to a robot and how they actually respond to it (Serholt & Barendregt 2016). **This makes it important to understand customers' perceptions about the social robots after they have interacted with them.**

2.4 IMPLEMENTATION OF SOCIAL ROBOTS

Social robots are increasingly being deployed in multiple industries. From being employed as tutors in both first and second language education to being used for assistance and caring for elders, and for entertainment, robots are increasingly being used for public and personal use (Hameed et al. 2016). They are used in public spaces because of their ability to be an effective medium of communication and instructions to users. For example, they are deployed in hotels (Zalama et al. 2014; Ivanov et al. 2018), as tour guides in museums (Faber et al. 2009; Thrun et al. 1999), as customer service representatives at health care centers (Wada and Shibata 2006) and as tutors in educational contexts.

In education, social robots have been used to provide instructions in language development and acquisition, science education and technology and computer programming (Mubin et al. 2013) (see Figure 14). Additionally, they have been employed as language learning tutors as they can allow learners to interact with a real-life physical environment, considered to be integral for language development (van den Berghe et al. 2019). Further, due to the social robot's appearance, they also provide an opportunity for a more natural interaction than other forms of technology (van den Berghe et al. 2019). There has been evidence that students who interacted with robot tutors performed better than those with a human tutor (Howley et al. 2014). However, most of the studies are still conducted in laboratory settings and there is a lack of field studies (Howley et al. 2014). The robots still lack communication skills and responsiveness (Rosenberg-Kima et al. 2020). Due to technological challenges, robots can neither understand the verbal content of discussions nor respond to delicate emotional and social scenarios (Rosenberg-Kima et al. 2020). Further, cultural responsiveness needs to be explored in child-robot interactions (Björling et al. 2021).

Figure 14: Pepper interacting with pre-school students

Social robots are also employed as **socially assistive robots (SAR's)** where they assist individuals who need support with their physical and psychological wellbeing while interacting with them socially (Scoglio et al. 2019) (see Figure 15). Socially assistive robots are embodied, have audio, visual and movement capabilities which allow them to create friendly and effective interactions with human users (Scoglio et al. 2019). In a study by Kramer et al. (2009), it was observed that the conversation with people with dementia (PwD) and AIBO, a dog-like robot, was longer and more effective than what it was with a real dog in some instances. Similarly, a study by Marx et al. (2010) observed that engagement with a real dog was similar to that with a robotic dog. These observations are important to make decisions about the software and hardware development of social robots (Chu et al. 2017). **It has been noted that social engagement is an important element in PwD's long term care as it shows the social interactions between PwD and others to perform actively in aging communities and is also related to lower mortality risk for PwD and others** (Chu et al. 2017). Along with a social robots' ability to have a conversation, a capacity to detect emotions and body language is key for rich engagement (Chu et al. 2017). These positive interactions can then enhance the participant's social capabilities (Chu et al. 2017). However, there is a lack of longitudinal studies that can help understand the long-term effects of using SAR's (Langer et al. 2019) (Khosla et al. 2021). Further, most of the studies are conducted using zoomorphic robots, highlighting the importance of using different types of robots in studies (Kachouie et al. 2014).

Figure 15: Pepper enjoying a slice of cake at a launch party (Palmer-Derrien 2019)

In the hospitality industry, the term robot is a fuzzy concept and refers to a range of different configurations and robot's functions (Choi et al. 2020). For example, they were used in the first robot-staff hotel, 'Henn-na Hotel'. The hotel utilised robots in the form of anthropomorphic figures and dinosaurs to take over human staff services such as a front desk concierge, butler, or housekeeping staff (Reis et al. 2020). 'Aloft Hotels' also used robotic butlers which navigated through the hotel and delivered requested items to customer rooms using elevators (Jordan 2014). Researchers have investigated the use of social robots in hotels with studies focusing on human-robot interaction, improving the ability to perform tasks (Rodriguez-Lizundia et al. 2015), their usage at front desks (Pinillos et al. 2016; Tung & Au 2018) and their appearance and behaviour. Nakanishi et al. (2020) found that heart-warming interactions can enhance customers' overall satisfaction with the hotel services. These heart-warming interactions are behaviours and attitudes that can create feelings of interpersonal warmth such as through a smile, a greeting or eye contact (Nakanishi et al. 2020). In a study conducted in a shopping mall, it was found that social robots do not just need to be reactive but also proactive by initiating interactions and offering information about the shopping services (Rashed et al. 2018). However, there is a need for continued research to understand public perceptions about evolving impacts of social robots in society (de Kervenoael et al. 2020).

2.5 SERVICE QUALITY

Service quality is frequently studied in service marketing literature and many researchers have tried to understand and identify service quality in the last four decades. To compete successfully in future and to gain a competitive advantage, businesses need to have to develop the quality of their service (Gronroos 1984; Parasuraman et al. 1988). Service quality is important because of its relationship with cost, profitability, customer satisfaction, customer retention, and positive word of mouth (Buttle 1996b). It is a judgement about an organisation's overall excellence or superiority (Parasuraman et al. 1988) and service quality significantly impacts behavioural intentions (Cronin Jr. et al. 2000).

It has been established that service quality is positively related to brand loyalty which is why service providers try to harness brand equity and loyalty by improving the service design and the customer experience (Prentice & Wong 2016). When customers encounter a favourable service experience, they react by evoking short term arousal and affective spirit. Service providers try to evoke customer senses and emotional valence through affective responses (Luo et al. 2019). Affective responses are related to the feeling of excitement which may mediate the connection between service quality and brand loyalty (Yüksel & Yüksel 2007).

However, different researchers have defined service quality differently. For example, according to Lehtinen and Lehtinen (1991), service quality is produced during an interaction between the customer and the elements of a service organisation such as contact person/s. Whereas Parasuraman, Zeithaml, and Berry (1988) defined service quality as the difference between customers' expectations of service and perceptions of service quality. They said that service quality is an overall evaluation similar to attitude (Parasuraman et al. 1988). In contrast, Cronin and Taylor (1992) do not think that it is necessary to measure customer expectations, and the performance expectations gap is an inappropriate basis for use in the service quality measurement. According to Gronroos (1984), the quality of service is dependent on perceived service and expected service, and when 'the perceived service is compared with the expected service, we get the perceived service quality' (p. 39). The concept of expectations in service quality is defined as the desires and wants of consumers, measuring their normative expectations which are similar to the ideal standard in customer satisfaction literature (Parasuraman et al. 1988). As per Carman (1990), the reason behind different definitions is because the conceptualisation and measurement of service quality is the intangibility,

simultaneous production and consumption of a service, and the difference between mechanistic and humanistic quality (p. 33). Even though the definitions are different, the researchers concur on the importance of understanding and measuring service quality (Parasuraman et al. 1988; Brown et al. 1993).

Furthermore, Gronroos (1982) identified three types of service quality: functional ('how' the service is provided, the process involved), technical quality ('what' outcome, evaluated after service) and image (how consumers perceive the firm). Lehtinen & Lehtinen (1991) defined service quality "as formed by the qualitative levels of service on different dimensions namely interactive quality, physical quality, and image of the service production process" (p. 288). Physical quality here emanates from the physical elements of the service such as physical product and physical support required in the service production process (Lehtinen & Lehtinen 1991). Interaction quality emanates from the interaction between the customer and the interactive elements of the service organisation (Lehtinen & Lehtinen 1991). Lastly, corporate quality is symbolic and is about how customers and potential customers see the organisation, company, or institutions, its image, or profile (Lehtinen & Lehtinen 1991).

Due to the intangible and heterogeneous nature of service, it can be difficult to compare service providers, and sometimes it is hard to ascertain the technical quality of a service provider (e.g., healthcare providers). To address these concerns, researchers developed a model to help compare the performance of service providers, the SERVQUAL model. The foundations of the scale are in the expectancy-disconfirmation paradigm (EDP). As per the expectancy-disconfirmation paradigm, the gap between the expectations (E) and the actual performance (P) of the service dictates customer satisfaction (Yüksel & Yüksel, 2001). EDP has been considered to be a widely reliable and valid framework to study customer satisfaction within tourism and hospitality services (Zehrer et al. 2011). Customer perceived service quality is the 'gap' (P-E) between their initial expectations and the actual service they receive. If the outcome of the service matches the expectation, then confirmation occurs; however, if there is a difference between expectations and outcomes then disconfirmation occurs (Yüksel & Yüksel 2001). If the disconfirmation is positive then the customer will be satisfied and if the disconfirmation is negative, the customer will be dissatisfied (Yüksel & Yüksel 2001).

The SERVQUAL model is a reliable, widely applicable, and concise instrument to measure service quality. According to the SERVQUAL model, a firm's perceived service quality can

be measured using a multiple-item scale with five dimensions, namely reliability, assurance, responsiveness, empathy, and tangibles (Parasuraman et al. 1988) (see Table 2). Perceived quality, which stems from perceptions and expectations, refers to a customer's perception or judgment about an organization's overall excellence (Parasuraman et al. 1988). According to Parasuraman et al. (1988), 'delivering superior service quality appears to be a prerequisite for success, if not survival, of such businesses in the 1980s and beyond' (p. 13). The 22-item scale was developed to serve as a diagnostic methodology for discovering a company' service quality shortfalls and strengths. SERVQUAL has successfully been used to evaluate service quality in a wide selection of industries (Asubonteng et al. 1996).

Table 2: SERVQUAL Dimensions

Variables	**Definition**
Tangibles	physical facilities, equipment, and appearance of personnel
Reliability	ability to perform the promised service dependably and accurately
Responsiveness	willingness to help customers and provide prompt service
Assurance	knowledge and courtesy of employees and their ability to inspire trust and confidence
Empathy	caring, individualized attention the form provides its customers

Since humans treat computers as social entities and consequently robots, social robots will need to be equipped with the same requirements that a good human service agent would have (Niculescu et al. 2013). Literature has identified that interpersonal interactions with frontline employees are critical to a customer's evaluation of service quality (Babakus et al. 2009, Homburg et al. 2009). Since they are the first human contact, sometimes even last, their interaction with the customer creates a critical impression of how the service experience is going to be (Payne & Webber 2006). Dagger et al. (2013) argued that increasing the interpersonal skill levels of just frontline employees also increase customer perceptions of service quality. One way of developing an emotional bond and relational rapport with customers is by developing friendly relationships with them (Liu et al. 2016). This can help build long-term customer engagement. Since social robots are now being used in the frontline service setting, they will also need to possess high interpersonal skills. This is explained by the Computer Are Social Actors theory, which suggests that humans treat robots as another social entity and apply the same rules to their interactions as they would in human-human interactions.

However, apart from the five service quality dimensions of the original SERVQUAL model, 'entertainment' has also been found to be critical when service is delivered by a humanoid social robot. Thus, the next section will discuss six service quality dimensions, five from the original SERVQUAL framework and entertainment as an added dimension, that are applicable in human-robot interaction in a frontline service setting.

2.5.1 Service Quality Dimensions

The SERVQUAL model is recognised as a rigorous model and has been applied across several service industries to measure service quality from the customers' perspective (Brown et al. 1993). This study uses the original dimensions from the SERVQUAL model: reliability, responsiveness, assurance, and empathy. As highlighted earlier, entertainment is a critical driver in the adoption of social robots (Schodde et al. 2017). Thus, the 'entertainment' dimension is also discussed in this section.

Tangibles

Tangibles are the aspect of the service that can be seen and felt. It is about the physical environment, equipment, staff and communications materials (Parasuraman et al. 1988, p. 23). Since service robots would be and are employed to service customers, they are considered personnel/staff and, thus, tangibility is applicable as this service quality is used to improve engagement. Morita et al. (2020) claimed the tangibility of service robots to have a high influence on service quality. Furthermore, anthropomorphic social robots can have a significant influence on the engagement levels of the users (Cruz-Sandoval et al. 2018). According to Computer Are Social Actors theory, people treat computers/robots in the same way they treat human beings (Choi et al. 2020). Anthropomorphic features are not just limited to appearance but also include voice recognition, emotion recognition and eye gaze (Moriuchi 2021). Anthropomorphism is significantly related to intelligence, fun, the attribution of intention and, thus, the predictability of the robot (Hegel et al. 2008). Therefore, the anthropomorphic characteristics of social robots are an integral part of the tangibles' dimension of service quality. In a study by Kim and Lee (2014), the authors point out that the tangible quality of a personal robot is the most influential precedent factor of perceived usefulness.

Reliability

Reliability is defined as the 'ability to perform the promised service dependably and accurately' (Parasuraman et al. 1988, p. 23). Reliability has also been presented as a sub-dimension of the performance construct of TAMS (Park 2020). In terms of human-robot interaction, reliability is whether the service robot reliably performed the committed services (Chiang & Trimi 2020). According to research, reliability is important for favourable evaluations in information systems. For a chatbot, it was found that reliability was the strongest determinant of perceived usefulness (Meyer-Waarden et al. 2020). In a situation where a robot is used to provide users with information, this dimension refers to the reliability of information (Xifei & Jin 2015) being provided and performing the promised service accurately (Parasuraman et al. 1988). The more reliable information the robot provides, the more the perceived reliability is increased (Park 2020). For a social robot to be more reliable, the robot should be able to proactively engage the user, adapt to their technological level and rely less on speech recognition (Rossi et al. 2020). In a study by Desai et al. (2012), it was observed when the reliability of the robot systems decreased in the autonomous mode, users trust also decreased and they switched to manual mode. In the robot café study, customers evaluated the reliability aspect highly (Morita et al. 2020). Thus, it increases their willingness to engage with the robot more in a service setting.

Responsiveness

Responsiveness is defined as the 'willingness to help customers and provide prompt service' (Parasuraman et al. 1988, p. 23). For social robots being responsive means helping customers deliver immediate service (Chiang & Trimi 2020). While in a usual service firm it may refer to businesses' quick response to phone or email queries (Yang and Fang 2004), in a robot-concierge situation, it may be about how promptly is the robot able to handle customer enquiries. As responsiveness increases, perceived service quality increases (Asubonteng et al. 1996). A social robot should not just be reactive but also proactive by not just responding to external events but also voluntarily providing information when necessary (Salichs et al. 2006). Limited responsiveness and contingency can decrease the users' trust and feelings of closeness (Fox and Gambino 2021). It is the responsiveness of social robots' and their immediacy of actions towards specific tasks that affect how, where and when visitors would interact (or not) with them. A technology that does not respond to visitors cannot survive in today's hypercompetitive marketplace (de Kervenoael et al. 2020). A responsive robot will be seen as more competent, sociable and attractive (Birnbaum et al. 2016).

Assurance

Assurance is defined as 'knowledge and courtesy of the robot and its ability to inspire trust and confidence' (Parasuraman et al. 1988, p. 23). It leads to long term relationships and loyalty (de Kervenoael et al. 2020). In hospitality and tourism, service providers are expected to be specialists in the type of service they provide and to adapt to any new changes involving robots supporting humans (de Kervenoael et al. 2020). For social robots, it is the ability of the social robot to perform a task with expertise, politeness, and trust (Chiang & Trimi 2020). It refers to the robots' ability to create feelings of trust and confidence among customers (Ivkov et al. 2020). Assurance in hospitality and tourism is about maintaining and enhancing the quality of service provided by robots to customers. In some cultural contexts, this has been identified as the most important dimension of service quality (Raajpoot 2004).

In a human-robot interaction scenario, assurance could refer to making users confident of their physical safety. One of the main concerns of social robot users is that the robot they are interacting with is safe (Cucco et al. 2017). Safety concerns can reduce the trust in robots, specifically the ones used at home for older adults (Scopelliti et al. 2005). Perceived safety is also key in inducing users' adoption intention (Bartneck et al. 2009). Additionally, assurance of safety and transparency of override functions are integral to user acceptance of robots (Cucco et al. 2017). Similarly, to an online context, it refers to assuring customers of security or confidentiality during communication. Due to their interactive nature and the use of social and attentional cues, social robots can promote openness, trust and connection. They can be considered as less biased and judgmental as was found in a study by Lisetti et al. (2012) where participants in a motivation interview were more willing to share sensitive information with a conversational agent as compared to a human counsellor. Kidd and Breazeal's (2008) research shows that social robots had a higher rating of trust, credibility and emotional bond when compared to a computer version of a health coach or a paper log.

Empathy

Empathy in SERVQUAL is defined as 'caring, individualized attention the firm provides its customers' (Parasuraman et al. 1988, p. 23). Empathy is a multi-dimensional concept (Powell and Roberts 2017; Shin 2018) which can be defined as the humanoid robot 'ability to identify, understand and react to other' feelings, behaviours, and experiences (Murray et al. 2019, p. 3).

Empathy, in simple words, is a reaction to another person's emotions (Powell & Roberts 2017). It involves taking perspective, understanding non-verbal cues, showing sensitivity to others' affective states and communicating feelings of care and desire to help appropriately (Goldstein & Michaels 1985). Empathy is not a new topic in the human-robot interaction domain. Due to a social robot's humanoid form, researchers have long been interested in measuring robots' level of empathy as perceived by users. In HRI, empathy is providing care and personal attention to customers during the service (Chiang and Trimi 2020).

Within service management, empathy is understood to be a fundamental skill required for successful interactions between social robots and users; for example, a good receptionist should not just be able to communicate effectively but also show empathy and provide help (Niculescu et al. 2013). It is a driver of trust, loyalty and long–term relationships because all the parties involved must understand various positions, stands, requirements and needs to prioritise tasks and actions from the customer's perspective. (Parasuraman et al. 1988). It leads to the creation and development of social relationships by increasing fondness, similarity and affiliation. Therefore, social robot concierges need to have similar characteristics as human concierges (Niculescu et al. 2013). Additionally, users empathise more with human-looking robots as opposed to mechanical-looking robots (Riek et al. 2009). Empathetic capabilities are important for long term HRI (Leite et al. 2012). This is corroborated by the Social Cognition Perspective which highlights the importance of Perceived Warmth in human-robot interactions (Čaić et al. 2019). Furthermore, this is in line with the Computers Are Social Actors paradigm which suggests that users apply the same social rules of human-human interaction to human-robot interaction (Nass et al. 1994).

A study conducted by Horstmann and Kramer (2019) found that people expected social robots to have more technological abilities but they preferred them to have more emotional and interpersonal abilities. Brave et al (2005) found that modelling empathetic emotions in agents increased their positive ratings for likeability and trustworthiness. Empathetic agents were also perceived to be more caring and supportive (Niculescu et al. 2013) and reduced frustration and stress (Hone 2006), consequently, increasing engagement (Klein et al. 2002) and comfort (Bickmore & Schulman 2007). An empathetic robot is well perceived because of its ability to comprehend emotions and express emotions through gestures (Robaczewski et al. 2020). Previous studies have also shown that an empathetic robot was perceived as friendlier and fostered an improved relationship as a companion (Leite et al. 2013b). In a study by Niculescu

et al. (2013), it was found that users felt more confident while interacting with the empathetic robot and interaction appeared to be easier.

Entertainment

Entertainment is defined as 'activities that people enjoy and look forward to doing, hearing or seeing' (Vogel 2020, p. xix-xx). Entertainment can help hold the attention and interest of the audience. It is an important precondition for the effective processing of information (Riskos et al. 2021; Wakefield & Baker 1998). As a construct, entertainment is associated with fun, stimulation, psychological relaxation, positive experiential atmosphere, change and diversion. In an online environment, entertainment has positive effects on consumers' attitudes and loyalty towards online new brands (Bosshart & Macconi 1998). Further, it enhances behavioural and brand engagement (Krebs & Lischka 2019). Entertainment can positively impact the decision to use social media (Lee & Ma 2012). In the context of social media, entertainment is a key motivator for consumers to create and share user-generated content and to participate in the social media brand community; it evokes emotional connection, ultimately, increasing customer engagement (Liu et al. 2019). The relationship between entertainment and engagement has long been recognised as the key in the adoption of social robots (e.g., Liu et al. 2019; Coulter et al. 2012; Schodde et al. 2017; Karat et al. 2002).

If customers are entertained, they are more engaged and have longer interactions (Liu et al. 2019; Coulter et al. 2012). Since Sony's entertainment robot 'Aibo' was first launched in 1999, the world of robotics has seen the massive value in using robots as an 'entertainment tool'. Businesses realise that when a customer is entertained, he or she spends greater time in that situation and is more likely to spend more on purchases (Christiansen et al. 1999). Additionally, acceptability is increased when the robot is found to be entertaining (Whelan et al. 2018). Perceived enjoyment has a significant correlation with an intention to use and minutes of actual usage (Whelan et al. 2018).

Further, humour has been used to entertain customers (Kulms et al. 2014). It is an antecedent of rapport and connects people. Babu et al. (2006) showed that the use of humour by a virtual receptionist agent played a major role in engaging users in social conversations. In education contexts, the use of humour led to better retention and recall (Ceha et al. 2021). In marketing, humour is used to build strong relationships with customers and to evoke positive affect in the

audience (Ge & Gretzel 2018). In tourism marketing, if the destination is presented in humour advertising, it generates more discussion amongst tourists and influences their behavioural intentions (Pearce & Pabel 2015). Researchers established four types of humour that enhance the sociality of a robot: wit and ice-breaker, corny jokes, subtle humour and dry humour and self-deprecation (Kahn Jr et al. 2014). When interacting with virtual agents, conversational and situation-specific jokes have been seen to affect how cooperation is perceived in an agent and humour provides a pleasant user experience (Kulms et al. 2014; Niculescu et al. 2013). Morkes et al. (1999) found that when participants received humourous comments from the computer during their interaction, they rated the computer as more likeable, more competent and more cooperative. Participants also behaved much more socially during the experiment.

2.5.2 Challenges in Measuring Service Quality of Social Robots

SERVQUAL has been subjected to many theoretical and operational criticisms (Buttle 1996b). Some of these criticisms revolve around the inapplicability of the SERVQUAL dimensions across different industries and some criticise the efficacy of the SERVQUAL model itself. For example, SERVQUAL was not considered appropriate for measuring service quality in higher education (Khattab 2018), online retailing (Yang et al. 2004) and IT services (Kang & Bradley 2002).

There is a consensus in service marketing literature that service quality is a multi-dimensional or multi-attribute construct (Kang & James 2004). According to Parasuraman et al. (1988), service quality can be evaluated using the SERVQUAL scale which has five dimensions, namely reliability, responsiveness, empathy, tangibles, and assurance. However, Babakus and Boller (1992) explained that **service quality can be factorially complex in certain industries, and very simple and unidimensional in others**. The dimensions are dependent on the services being offered. There is no real consensus on which dimensions are relevant for service quality (Philip & Hazlett 1997). For example, the hospitality industry research employed 40 items (Carman 1990), while the car service studies employed 48 items (Bouman & van der Wiele 1992). Therefore, it has been suggested in the literature that context-specific modifications must be made to increase the relevancy of the SERVQUAL scale or measures should be designed for specific service industries (Babakus & Boller, 1992; Carman, 1990).

SERVQUAL has also been criticised for its use of the gap model which is measured as the difference between customers' expectations of service outcomes and the actual outcomes (Buttle 1996b). Cronin and Taylor (1992) criticised the SERVQUAL framework for user expectations. According to them, the current performance, not expectations, best reflects a customer's perception of service quality (Cronin Jr & Taylor 1992). This was also confirmed by Quester et al. (1995) who found SERVPERF, a performance only measure, to be better than SERVQUAL (disconfirmation measure). As per Babakus and Boller (1992), customer expectations can be irrational and unreasonably highly which put pressure on the supplier as they will not simply be able to reach the standards expected. Additionally, asking customers to fill in an expectations questionnaire when they come and then completing the perceptions questionnaire at the end of the service is impractical (Carman 1990). Thus, measuring actual performance or SERVPERF has been proved to have stronger predictive validity than SERVQUAL (Lo et al. 2015).

In human-robot interaction, it can be difficult for expectations to be formed and measurement of those expectations may be difficult. In such cases, Cronin Jr and Taylor (1994) suggested SERVPERF for measuring the evaluation items only with perceptual quality. Since using social robots as the concierge is not a widespread phenomenon, evaluating the degree of expectation before experiencing the service is difficult (Morita et al. 2020). Therefore, SERVPERF would be a useful approach to evaluate the service quality of a social robot as a concierge. This same approach was also used by Morita et al. (2020) to evaluate the service quality of a robot café. Further, user perceptions are direct predictors of the quality and nature of engagement of users with robots (Diaz et al. 2011; Anzalone et al. 2015). A category of user experience is engagement and engagement has shown to have a direct impact on the behavioural intention of the users (Anzalone et al. 2015).

The investigation of service quality, in the context of social robots, is important from two key perspectives. First, in a robot-human interaction, it is similar to other forms of technology; humanoid agents such as robots trigger both positive and negative feelings in users (Englis 1990; Wiese et al. 2017). Users may simultaneously present views (i.e., perceptions, beliefs, feelings, motivations) that are both favourable and unfavourable. Researchers agree that the co-existence and balance between these forces of attraction and repulsion determine the individual's likelihood to adopt – and consequently evaluate – service delivery by robots (Bishop et al. 2019). Consumers with highly positive views of technology are likely to be

receptive to robot-based services. On the other hand, users with a highly negative view of technology (e.g., individuals who feel discomfort or insecurity) might be resistant to such services (Wiese et al. 2017; Ferreira et al. 2014). It is well-accepted that not all users are equally ready to embrace technology-assisted services (Yen 2005). Therefore, Parasuraman et al.'s (1998) and Colby's (2001) findings show that it is expected that different users will evaluate technology-based services in different ways.

The second challenge in a robot-delivered service is the knowledge that competitors may easily mimic the technical quality of service provision, particularly as some of the social robots used in service settings are acquired off the shelf and operate using open-source software (Bartneck et al. 2020; Gronroos 1988). This means that it would be simple for competing for retail outlets or restaurants to provide the features enabling particular services through the use of such robots. However, it is far more difficult for competitors to replicate interactive service quality. The interactive quality dimension refers to the actual interaction which takes place between the customers and the frontline staff members (Lehtinen & Lehtinen 1991). Nakanishi et al. (2020) argue that heart-warming interactions can enhance customers' overall satisfaction with the hotel services. This was determined by using qualitative and preference-based questionnaire data. These heart-warming interactions are behaviours and attitudes that can create feelings of interpersonal warmth through a smile, a greeting or eye contact (Nakanishi et al. 2020). This is a constant challenge for robot designers and operators to ensure that the development of an embodied agent is not just limited to attractive physical characteristics. In fact, any agent involved in service delivery must exhibit naturalistic behaviour and appropriate emotional engagement which is highly valued by the customer (Cavallo et al. 2018; Woods 2006). There is a need for continued research to understand public perceptions about evolving impacts of social robots in society (de Kervenoael et al. 2020).

2.5.3 SERVQUAL Modifications

Traditionally, service quality was conceptualised for people-delivered services. However, as technological innovations continue to grow, a critical component of customer-firm interactions is driven by the rise of self-service and humanoid technologies (Meuter et al. 2000). With the increasing proliferation of e-commerce and declining face-to-face interactions, the SERVQUAL model was modified. For example, the traditional five SERVQUAL dimensions did not adequately measure customers interaction with a website (Ladhari 2009). Additionally,

customers' tendency to embrace new technologies is dependent on the relative dominance of positive and negative feelings in their overall technology beliefs (Parasuraman 2000). It also is significantly correlated with perceived ease of use and perceived usefulness (Davis 1989). Consequently, E-S-QUAL was developed to measure e-SQ and it was shown to be highly applicable for the online service environment (Ladhari 2009).

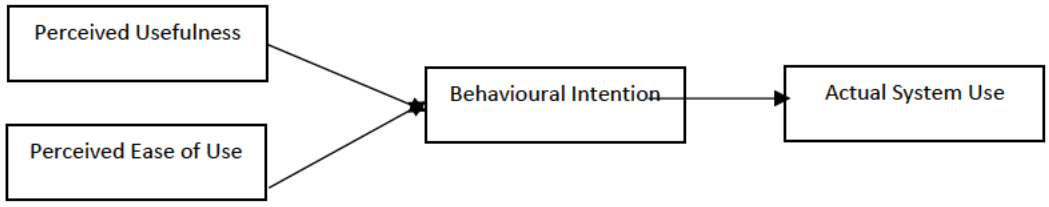
Similarly, numerous scales applicable to specific industries have been developed in recent years such as SYSTRA-SQ to measure service quality perceptions of retail bank customers (Aldlaigan & Buttle 2002). To measure retail service, Dabholkar et al. (1996) successfully developed the Retail Service Quality Scale (RSQS) with five basic dimensions: 'physical aspects', 'reliability', 'personal interaction', 'problem-solving and 'policy' (cited in Naik et al. 2010). An IT consulting SERVQUAL was also developed with 6 dimensions, namely 'responsiveness', 'reliability', 'empathy', 'process' and 'education' (Yoon & Suh 2004). Thus, industry-specific modifications of SERVQUAL are encouraged and have been found useful to evaluate service quality (Carman 1990).

E-S-QUAL, modified SERVQUAL scale, was shown to be highly applicable for the online service environment (Ladhari 2009). Similarly, SERVQUAL needs to be modified for measuring the service quality of social robots (Morita et al. 2020). The social robot literature highlights the importance of engagement and entertainment in the adoption of technology (Liu et al. 2019; Coulter et al. 2012; Schodde, Hoffmann, & Kopp 2017). These two variables are critical in assessing the service quality of social robots but are not included in the original SERVQUAL dimensions. Additionally, the service quality of a robot is very different from that of humans and entertainment is highly regarded in HRI (Morita et al. 2020). As Mick and Fournier (1998) found that technology can induce positive and negative feelings simultaneously, and therefore, the SERVQUAL scale needs to be modified to understand which service dimensions or robot's attributes induce what feelings. As such, the current SERVQUAL dimensions are limited and inaccurate measures of the social robot's service quality. In line with the CASA paradigm (Reeves & Nass 1996), it was noted people treat robots as social actors whose performance could be evaluated using the pre-established concept for human beings. For instance, service quality dimensions that are developed originally to understand the services of human staff should be applied for examining the perceived services of robots along with entertainment as an added dimension (Morita et al. 2020).

2.6 TAM and UTAUT Model

TAM is a widely used and parsimonious theoretical model implemented for explaining and predicting an individual's acceptance of information systems (Lee et al. 2003). It has been extensively utilised to study the adoption and acceptance of social robots in a wide variety of settings such as frontline service (Stock & Merkle 2017) and education (Conti et al. 2017). TAM can help identify how much a population is intending to use a specific technology and what was its actual use (Piçarra & Giger 2018). As per TAM, a user's acceptance is dependent upon two variables: **Perceived Usefulness and Perceived Ease of Use** (Davis 1989). Acceptance is the positive evaluation of a robot which eventually leads to intention to use technology and the eventual act of using the technology. In robotics, **usefulness would be defined as the user's belief about how the robot can enhance their daily activities and ease of use would be defined as the user's belief that using the robot will be free from effort** (Heerink et al. 2010a). Social robots must be useful and relevant to users' unmet needs and, for this, identifying user needs and perceptions are integral to improving robot acceptability (Whelan et al. 2018). Perceived usefulness and ease of use have a significant influence on consumers' behavioural intentions.

Figure 16: Basic TAM assumptions



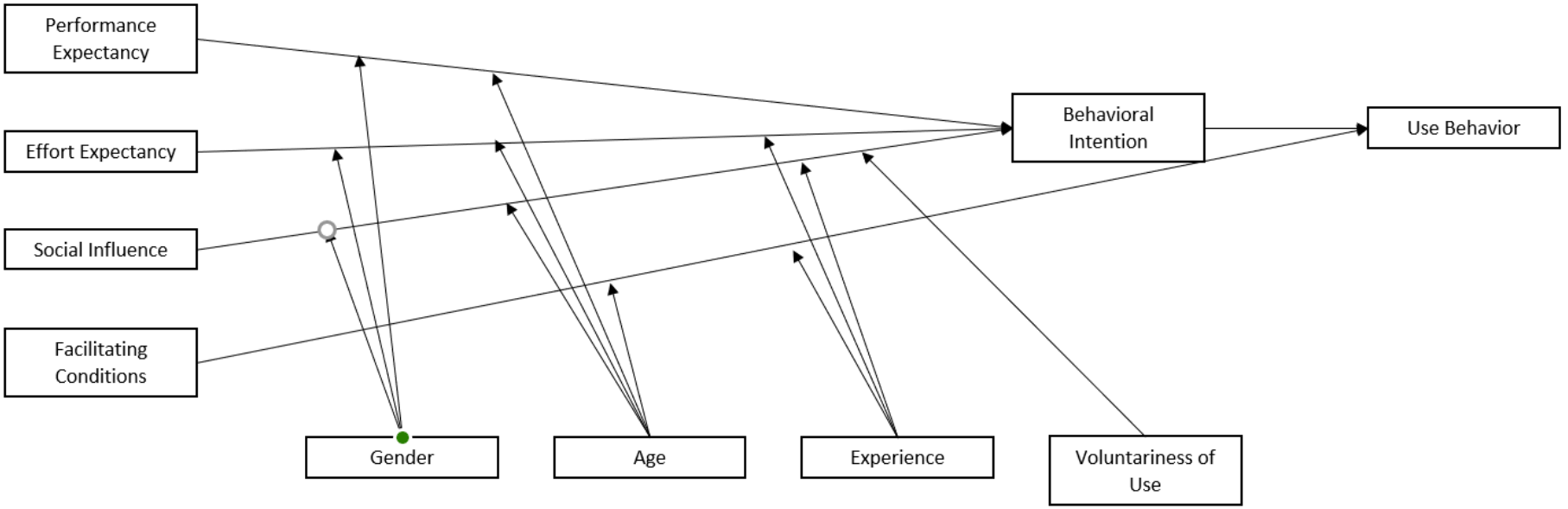
In 2003, Venkatesh, Morris, Davis and Davis formed the Unified Theory of Acceptance and Use of Technology (UTAUT) by integrating eight dominant theories and models: the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model, the Theory of Planned Behaviour (TPB), a combined TP/TAM, the Model of PC Utilisation, Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT) (Venkatesh et al. 2016). It contained four predictors of behavioural intention: 'performance expectancy', 'effort expectancy', 'social influence' and 'facilitating conditions', and four moderators: age, gender, experience and voluntariness (Venkatesh et al. 2016). These factors and moderators predict behavioural intention to use a technology and actual technology use (Venkatesh et al.

2016). As per UTAUT, performance expectancy, effort expectancy and social influence were found to influence behavioural intention to use a technology (Venkatesh et al. 2016).

Performance Expectancy is rooted in the Perceived Usefulness construct of TAM. Performance expectancy is 'the degree to which a person believes that using a particular system would enhance his or her job performance' (Venkatesh et al. 2003, p. 448). Performance can be defined as the past and present operations of robots and its sub-dimensions include reliability (SERVQUAL dimension), predictability and ability (Park 2020). Essentially, it is what the robots do and their ability to achieve users' goals (Park 2020). **Reliability** is also a key measure in SERVQUAL and performance expectancy provides a key underpinning to understand the SERVQUAL model (Park 2020) and is considered to be the strongest determinant of perceived usefulness (Meyer-Waarden et al. 2020). The performance also contributed to overall quality perceptions which influence engagement (Prentice et al. 2020b).

Effort Expectancy is the degree of ease associated with the use of the system and is rooted in the Perceived Ease of Use construct of TAM (Venkatesh et al. 2003).

Figure 17: Unified Theory of Acceptance and Use of Technology



The literature on technology acceptance emphasis the importance of socio-normative beliefs, and, specifically, social influence and image (De Graaf & Allouch 2013; Lee et al. 2003; Rogers 2010). **Social influence** is defined as the user's perception of what others think about using the robot (Karahanna & Limayem 2000). Social Influence has a positive impact on the ease of use, usefulness, use attitude, use intention and actual use (De Graaf & Allouch 2013). For example, in domestic settings, users would consider the opinion of their family, friends and other adopters (De Graaf & Allouch 2013). Additionally, if others approve and support a particular behaviour, it elevates the user's self-image or status within that group (Venkatesh & Davis 2000). **Since social robots are social entities, it is expected that social influence will impact behavioural intention.**

Variables that involve the user also influence the acceptance of robots; these variables are users' age, gender, cultural background, personal innovativeness and the general evaluation of a particular technology (De Graaf & Allouch 2013). For example, it has been confirmed in many studies that older people, compared to younger people, are more likely to enjoy using a robot and also anthropomorphize a robot (De Graaf & Allouch 2013). Similarly, each culture has its level of exposure to robots; for example, in Western culture 'robots will take over the world' scenarios are more common as compared to Japanese culture where robots are more easily accepted and are shown as good and fighting against evil humans (Kaplan 2004; Bartneck & Forlizzi 2004). Further, previous technological experience also impacts acceptance and adoption. If users have previous experience with the robots, then they have less anxiety and there is an increase in perceived safety and more confidence in facilitating conditions. However, this familiarity can also lead to robots looking less intelligent due to their current limitations (Bishop et al. 2019). Therefore, the study needs to control these variables. Additionally, participants' income level and occupation were also added to the questionnaire. Thus, these moderating factors were considered to control their specific effect on the responses.

2.7 CUSTOMER ENGAGEMENT (CE)

Kim et al. (2007) define engagement as 'the state of being involved, occupied, retained, and intrinsically interested in something' (p. 393). Understanding engagement is important to decipher consumer's behaviour, how consumers shape their decisions and the process they follow towards a certain behaviour (Pansari & Kumar 2017). An accurate assessment of

engagement uncovers the extent of a consumer's commitment to a brand, product or firm (Sánchez & Martínez 2020). If individuals are engaged with a brand, a strong psychological connection is formed (Hapsari et al. 2016).

Customer engagement refers to 'the level of a customer's or prospective customer's interactions and connections with a brands' or firm's offering and/or activities, often involving others in the social network created around the brand/offering/activity' (Pap et al. 2017, p. 427). In marketing literature, it is defined as the customer's emotional, cognitive and behavioural involvement with the brand (Vivek et al. 2012; Hollebeek 2011). The concept of customer engagement is underpinned by the Service-Dominant (S-D) logic and relationships marketing. As per the S-D logic, even though the transaction of services occurs at one point in time, the relationships between parties are evident in the joint, interactive, collaborative, unfolding and reciprocal roles that the entities play in the network (Vivek et al. 2014). It is a continuous process of value co-creation. During this process of co-creation of value, they develop deeper and more embedded relationships, and this process is facilitated by Customer Engagement (Gambetti et al. 2012). The parties develop an increased level of affinity, intimacy, mutual commitment and reciprocal trust during the process.

As per Vivek, Beatty and Morgan (2012), combining CE and S-D logic into the relationship marketing will help realise the potential of current or future customers as they interact, immerse and co-create with the brand, its employees, other people or society in general. According to Gallup's studies (2009), a fully engaged customer would make 44% more visits per year to their preferred retailer than a disengaged customer. In the hospitality sector, fully engaged hotel guests would spend 46% more per year. Customer engagement is an important component of an organisation's long-term success. Researchers have identified that customer engagement has a positive influence on behavioural intentions (Pap et al. 2017; Vivek et al. 2014). For example, Pap et al. (2017) confirm that engaged theatre audience is increasingly willing to visit the theatre again.

Furthermore, perceived service quality is a significant antecedent of the consumer-brand engagement construct (Rather & Camilleri 2019; Harimurti & Suryani 2019). Previous studies have shown that providing superior service quality will nurture engagement (Islam et al. 2019; Verleye et al. 2014). If customers do not receive high-quality service, then they will be less willing to be engaged (Van Doorn et al. 2010). For example, according to Puriwat &

Tripopsakul (2014), reliability had the highest positive effect on customer engagement followed by responsiveness and tangibility.

Customer engagement is a multidimensional concept. The most holistic definition of customer engagement and its dimensions, namely cognitive, emotional and behavioural dimensions are provided by Patterson, Yu, & de Ruyter (2006), Hollebeek (2011) and Vivek, Beatty & Morgan (2012). Table 3 presents engagement conceptualisations and dimensions identified in the marketing literature.

Table 3: Engagement Conceptualisations and Dimensionality in the Marketing Literature

(Sourced from Brodie et al. 2011)

Authors	**Concept**	**Definition**	**Dimensionality**
Patterson et al. (2006)	Customer engagement	The level of a customer's physical, cognitive, and emotional presence in their relationship with a service organisation	Multidimensional: Absorption (C), dedication (E), vigor/interaction (B)
Vivek, Beatty, and Morgan (2010)	Customer engagement	The intensity of an individual's participation and connection with the organization's offerings and activities initiated by either the customer or the organization	Multidimensional: C, E, B
Mollen and Wilson (2010)	Online Customer engagement	The customer's cognitive and affective commitment to an active relationship with the brand as personified by the website or other computer-mediated entities designed to communicate brand value	Multidimensional: Sustained cognitive processing (C), instrumental value (C), experiential value (E)
Bowden (2009a)	Customer engagement process	A psychological process that models the underlying mechanisms by which customer loyalty forms for new customers of a service brand as well as the mechanisms by which loyalty may be maintained for repeat purchase customers of a service brand	Multidimensional: C, E, Ba
Van Doorn et al. (2010)	Customer engagement Behaviour	Customers' behavioural manifestation toward a brand or firm, beyond purchase, resulting from motivational drivers such as word-of-mouth activity, recommendations, helping other customers, blogging, writing reviews	Unidimensional: B

Hollebeek (2011)	Customer brand engagement	The level of a customer's motivational, brand-related and context-dependent state of mind characterized by specific levels of cognitive, emotional, and behavioural activity in brand interactions	Multidimensional: C, E. B
Pham and Avnet (2009	Engagement behaviour	Finds that engagement ''seems to be inferred from a pattern of action or withdrawal with respect to a target object (p. 116).''	Multidimensional: C, Ba
Pham and Avnet (2009	Engagement	A state of being involved, occupied, fully absorbed or engrossed in something (i.e. sustained attention), generating the consequences of a particular attraction or repulsion force. The more engaged individuals are to approach or repel a target, the more value is added to or subtracted from it.	Multidimensional: C, E, B

Vivek et al. (2014) identified three dimensions of customer engagement: conscious attention, enthused participation and social connection:

a) **Conscious Attention**: Conscious engagement can be defined as 'the degree of interest the person has or wishes to have in interacting with the focus of their engagement' (Vivek et al. 2014, p. 407).

b) **Enthused Participation**: Enthused engagement can be defined as the 'zealous reactions and feelings of a person related to using or interacting with the focus of their engagement' (Vivek et al. 2014, p. 407).

c) **Social Connection**: Social connection refers to the 'enhancement of the interaction based on the inclusion of others with the focus on engagement, indicating mutual or reciprocal action in presence of others' (Vivek et al. 2014, p. 407). The role of social connection has been emphasised in the literature and theory (Vivek et al. 2014). Van Doorn (2011) claimed that customer-to-customer interactions are also important beyond a specific service relationship. **Social connections can strengthen consumer-brand relationships** (Vivek et al. 2014)**.**

The three dimensions, conscious attention, enthused participation and social connection, are constituting the multidimensional CUE scale that is an important tool for managers to examine

the overall CE to evaluate the strengths and weaknesses of engagement strategies (Vivek et al. 2014). It will help managers understand what kind of interactive experience customers want with the brands (Vivek et al. 2014).

2.7.1 Emotional Engagement

Scholars have had a growing interest in the study of emotional engagement in the Human-Robot Interaction (HRI) field. Previously, the term 'emotional engagement' has been interchangeable with emotional communication (e.g.Cohen-Mansfield et al. 2009) and emotional relationship (Ogawa & Ono 2008). Emotional engagement is the amount of subconscious 'feeling' experienced during an activity or an interaction (Heath 2009). Thus, the term 'engagement' denotes an ongoing feeling over a longer timeframe. Researchers use a range of synonyms to describe the 'emotional engagement': involvement, passion, absorption, zeal, and dedication (Schaufeli 2013). It is this internal state of an individual which provides the impetus to participate in certain behaviours (Finn & Zimmer 2012).

Emotional engagement is relevant while studying human-robot interaction (Hegel et al. 2008). Social robots are perceived by users as if they are real social actors. This social presence is established through appearance and the ability to interact with humans using facial detection, emotion recognition and speech recognition technology (Bartneck et al. 2020). Social robots can add social and physical presence which is missing in virtual avatars. Social robots have anthropomorphic characteristics which help elicit joy and sympathy (Hegel et al. 2008). Thus, robots bring with them a certain level of 'social presence' during human-robot interaction (Choi et al. 2014). This means that users may not notice the artificial nature of robots with whom they are interacting (Lee 2004). According to social impact theory (Latane 1981), people are impacted by the real, implied, or imagined social presence of others. This psychological connection with another entity triggers a series of emotional responses such as a sense of personal, sociable, and warm human contact (Cyr et al. 2007). Thus, emotional engagement is important in how users experience their interaction with the robot. Huang and Alessi (1999) showed that people do not 'think' about their experience with another social entity. In fact, they will *feel* it. The importance of 'feelings' can be judged from the fact that 'feelings' are unavoidable (Zajonc 1980). Processing of emotions is fast and does not require conscious effort (Mast & Zalmter 2006). Moreover, even if a person controls the expression of emotion, almost everyone will still experience the 'feeling'.

Interestingly, a nine-month study conducted by Gockley et al. (2005) indicated that even though many users interacted daily with the robot, after a certain period, only a handful of them interacted with the robot for more than 30 seconds due to a lack of engagement capabilities. Post this study, the same robot was made more engaging by including proper greeting and farewell behaviours, more interactive dialogues, the ability to display emotions, and the ability to identify repeat visitors (Leite et al. 2013a). In short, making the robot more engaging resulted in longer interactions by frequent visitors, especially when the robot was in a negative mood which was justified by the authors with the common ground theory; for example, when the robot smiles, it can be understood as a positive signal that carries a certain amount of conversational content (Leite et al. 2013a). These interactions also depended on the user's familiarity with the robot (Leite et al. 2013a).

A quality service enhances people's experience with the organisation and leads to emotional engagement. The psychological connection with another entity triggers a series of emotional responses such as a sense of personal, sociable, and warm human contact (Cyr et al. 2007). Thus, emotional engagement is important in how users experience their interaction with the robot.

2.7.2 Social Engagement

Social engagement can be defined as maintaining social connections and participation in social activities (Bassuk et al. 1999). It is the interaction a user has with either another user or the robot (Sidner et al. 2003; Poggi 2007). It can also be defined as a social activity referring to an individual's behaviour within a social group (Moshkina et al. 2014). For social television viewing, social engagement is defined as the degree of intensity or types of connections the audience develops with the television content through social media platforms (Guo 2018). Social media, in this case, facilitates information sharing, knowledge distribution and opinion exchanges (Guo 2018).

Social robots are the ideal candidates to increase social engagement because face-to-face interaction can proactively engage people rather than waiting to be called on such as in the case of Amazon Alexa or Google Home. Previous studies have shown that interacting with social robots is like a social activity (Klamer & Allouch 2010). As has been shown in the literature,

social engagement starts with the relationships between the user and the social robot and continues to extend that relationship to other users (Guo 2018). This means that when people start interacting with the social robot, they share their experience of interacting with the robot with their peers which, in turn, fosters the interaction between the users. In a study by Breazeal et al. (2019), it was found that when Jibo was placed in the common area of an assisted living home, the number of people congregating in the common space increases significantly and their feelings of social connectedness increased. This, eventually, led them to interact with other residents when they came to interact with the robot (Breazeal et al. 2019). For a successful social interaction, verbal and nonverbal communications are important (Serholt and Barendregt 2016). With the advancement in technology, social robots can use both verbal and non-verbal communication to engage their users.

2.8 INTENTION TO USE

Intention refers to the subjective probability of an individual performing a specific behaviour in the future (Fishbein & Ajzen 1977). It denotes factors that influence a desired behaviour such as using a social robot concierge (Teo & Zhou 2014). Studies show that behavioural intention can influence the actual use of technology. The literature review shows that multiple factors impact a user's intention to use technology. In technology adoption literature, it shows that perceived usefulness and perceived ease of use can drive acceptance of technology (Davis 1989). In the service quality literature, the five dimensions (tangibles, reliability, responsiveness, assurance and empathy) have been shown to influence future intention to use the service. Similarly, in the customer engagement literature, intention to repurchase is influenced by social and emotional, for example, service quality is considered integral to increase intention to use internet banking services (Namahoot & Laohavichien 2018) and self-service check-in kiosks (Lu et al. 2009). If the passengers find the self-service check-in kiosks to be accurate, compatible and stable or they are able to have self-efficacy in using the kiosks then they would be more likely to use them (Lu et al. 2009). Similarly, if the customers are engaged in online brand communities, it is positively related to repurchase intentions (Chan et al. 2014).

When it comes to using social robots, the intention to use is impacted by service assurance, empathy, personal engagement, tangibles, perceived ease of use, perceived usefulness and information sharing (de Kervenoael et al. 2020). Additionally, perceived enjoyment is considered as a major influence on the intention to use assistive social robots by the elderly

(Heerink et al. 2009) and for domestic purposes (de Graaf et al. 2019). Thus, 'Intention to Use' social robot will help predict consumers' desire to use the social robot for the next service encounter.

2.9 GAPS IN THE LITERATURE AND RESEARCH QUESTIONS

Based on the previous discussion, some literature gaps have been identified in terms of developing a scale to measure social robots' service quality and conducting empirical studies with ecological validity. The key ones are:

2.9.1 Measuring Service Quality of Social Robots

There is no scale available to evaluate the service quality of social robots. Although scales like the Goodspeed questionnaire exists, they are primarily used by creators and developers in their development journey (Bartneck et al. 2009). Most of the current works around robots in retail (e.g. Niemelä et al. 2017; Nakanishi et al. 2020; Amelia et al. 2021; Niemelä et al. 2019; Kamei et al. 2011) focus on considerably light (or non-empirical) modes of evaluation (such as self-made questionnaires, interviews and acceptance surveys), with the focus on exploratory and technology-based interventions. There is a call for a more theoretical and methodological framework to understand HRI better, particularly to enhance user experiences (Tonkin et al. 2018; Bartneck et al. 2009; Ivanov et al. 2019).

Service quality, a fundamental concept of a customer's service experience construct, is considered to be a useful tool to measure and examine various aspects of Human-Robot Interaction (Choi et al. 2020). However, to the best of the authors' knowledge, no attempt has been conducted to apply the modified SERVQUAL framework to understand the impact of service quality of social robots on users' engagement and intention to use. Industry practitioners and academics have called for more research on how social robots influence customers' perception of overall service quality (Lu et al. 2020; Choi et al. 2020). SERVQUAL in its original form is inadequate for measuring the service quality of social robots (Morita et al. 2020). This is because the service quality of a robot is very different from that of humans and entertainment is highly regarded in HRI (Morita et al. 2020). Therefore, the SERVQUAL scale needs to be modified to understand which service dimensions or robot's attributes induce

what feelings. Even though Choi et al. (2020) conducted a study to examine how hotel guests perceive the quality of service provided by hotel staff and service robots, they used *images of* hypothetical service encounters between the robot and the staff instead of real-time human-robot interaction. It has been acknowledged in the literature that service quality should be measured after customers have interacted with the services (Choi et al. 2020). Therefore, the study will examine the service quality perceptions after the participants have interacted with the human staff and the social robot staff in a real-time setting. This will reflect the actual guest experience of interacting with social robots.

Chiang and Trimi (2020) explored the service quality provided by robots using the SERVQUAL framework after the guests experienced the service. However, their study did not use a social robot and researchers have acknowledged that users have higher expectations of anthropomorphic robots or humanoid robots (Choi et al. 2020; Ziemke & Thill 2014). Anthropomorphism significantly influences customers' adoption intention and customers have higher social expectations from them (Tussyadiah & Park 2018; Ziemke & Thill 2014). Social robots have anthropomorphic characteristics which help elicit joy and sympathy (Hegel et al. 2008). Secondly, this was not a comparative study where the service quality of service robots was compared with that of a human. Therefore, it failed to provide a comparison and failed to indicate how the robot compares to the human service quality. Morita et al. (2020) used humanoid robots in a multi-robot café to evaluate the service quality. Their questionnaire items were based on SERVQUAL and include entertainment. However, they evaluated the service quality and customer satisfaction, not emotional or social engagement. Emotional and social engagement is critical for the adoption of the technology and their research failed to address how this variable influences the social robot's service quality. Thus, a scale needs to be developed to identify the service quality of social robots in front line service settings and compare it with that of a human.

Research Question 1*:* What are the key measures of social robots' service quality?

2.9.2 Empirical studies with ecological validity

A review of the literature shows that most of the studies about robots in services are conceptual and only a handful of them present empirical findings of service quality which is typical for an emerging topic (Čaić et al. 2019; Chiang & Trimi 2020; Lu et al. 2020). Social robotics is also

an emerging field in robotics and forms only 2.3% of the larger robotics knowledge base. Even though social robotics is 'social' in intention, its knowledge base is concentrated in engineering and technology domains with most of the research conducted by field or laboratory experiments (Mejia & Kajikawa 2017; Henschel et al. 2021; Tussyadiah & Park, 2018; Ivanov et al. 2018). It also contributes to the Service 4.0 literature by providing empirical evidence of the effectiveness of service quality of social robot concierge. This represents an opportunity for interdisciplinary collaborations, especially between social sciences, engineering, and technology.

Research Question 2*:* How do social robots perform as concierges in a frontline service setting?

2.9.3 Service Providers: Humans vs Robots

A review of the literature shows that there is a lack of studies comparing the service quality of social robots and comparing it with that of a human in a real frontline service setting (Chiang & Trimi 2020; Choi et al. 2020; Lu et al. 2020). Researchers have acknowledged that further research is required to understand the similarities and differences in human-human versus human-robot value co-creation/destruction practices (Čaić et al. 2018). Additionally, it has been agreed that understanding social-cognitive mechanisms that users use is essential before developing social robots with a set of meaningful cognitive and affective value propositions (Čaić et al. 2018).

Research Question 3*:* What are the key differences between the service quality of social robots and human concierges?

2.10 CONCLUDING COMMENTS

This chapter discussed the literature on social robots, service quality, and technology acceptance models. The literature highlights the importance of evaluating the service quality of social robots and comparing it with that of humans. In addition, it underlines the various variables that impact the acceptance and adoption of social robots in society. Further, the analysis of the literature has identified three research gaps that need to be bridged. In Chapter 3, these gaps will be revisited to generate the research questions and objectives specific to the

study. Chapter 3 will also provide the theoretical framework, theoretical underpinnings and the research model that will help examine these deficiencies.

3 Theoretical Framework

3.1 INTRODUCTION

Based on the literature review undertaken in Chapter 2, this chapter will conceptualise a model that provides a framework to examine the effectiveness of service quality of a social robot and compare it with that of a human. Chapter 3 provides theoretical underpinnings and theoretical framework to evaluate the service quality of social robot concierge. Additionally, it justifies the theories used for this study along with the hypotheses.

The literature showed that multiple variables impact users' acceptance and adoption intention of social robots. Further, multiple service quality dimensions impact the user's emotional and social engagement. Thus, understanding the behavioural intention to use social robots in frontline service settings requires an understanding of not just service quality theories but also of social robotics theories and customer engagement theory. The importance of engaged customers and its impact on behavioural intentions is well established, however, there are no models that examine the impact of service quality dimensions on emotional and social engagement. This research will contribute to the social robots, service quality and customer engagement literature by providing a model that can be used to measure the service quality of social robots and benchmark it with that of a human. This model is grounded in well-established theories and models that will be discussed below.

Four theoretical underpinnings underpin the theoretical framework discussed in this chapter: The Service Quality Model, Customer Engagement, The Technology Acceptance Model and Social Cognition Perspective. Section 3.2 will explain the four theoretical underpinnings and use them to create a theoretical framework and hypotheses to test our model. The theoretical framework along with the hypotheses is explained in section 3.3.

3.2 THEORETICAL UNDERPINNINGS

3.2.1 The Service Quality Model

Service quality is frequently studied in service marketing literature and many researchers have tried to define and measure service quality in the last four decades. Providing quality service is essential for business success and survival in today's competitive environment (Parasuraman

et al. 1988). The quality of service is seen as a strategic variable to achieve efficiency and effectiveness in business operations (Babakus & Boller, 1992). The roots of the SERVQUAL model are in Expectancy-Disconfirmation theory according to which customer satisfaction is determined by the gap between consumer's pre-purchase expectation and post-purchase perception (Oliver 1980).

SERVQUAL model is a reliable, widely applicable, and concise instrument to measure service quality (Parasuraman et al. 1988). According to the SERVQUAL model, a firms' service quality can be measured using a multiple-item scale with five dimensions: **reliability, assurance, responsiveness, empathy and tangibles** (Parasuraman et al. 1988). As suggested by Morita et al (2010), **entertainment** was also added to the model. Entertainment has a positive impact on behavioural and brand engagement. This is because when customers are entertained, they are more engaged and have longer interactions (Lei et al. 2017). Prior studies have explained that service quality may lead to customer engagement (Lee et al. 2019; Ahn & Back 2018). For example, in a study by Abror et al. (2019) when the Islamic bank provided excellent service quality, the customer created emotional bonding with the bank. Customers in the Islamic bank context perceived the service to be excellent when the bank was able to provide a reliable service (no long queues), providing individualized attention to customers and creating a warm relationship with the customers (Abror et al. 2019). Additionally, if customers have a good service experience then they would spread positive word of mouth among friends and peers (Roberts et al. 2003). If the service quality diminishes over time, then customers would be less willing to engage (Van Doorn et al. 2010). Therefore, service quality impacts both emotional and social engagement. If social robots are used as a point of differentiation, then a satisfactory service quality would become a basic criterion for a consumer's decision to visit or pay for a robot-service provider such as a social robot should be able to entertain the customers. Further, the perceptions of users are direct predictors of the quality and nature of engagement with robots, and engagement has a direct impact on the behavioural intention of the users.

As mentioned in the literature review, when evaluating the service quality of social robots, it is not always possible to measure expectations. This is because social robots are still a novel technology and expectations of customers might not have formed (Morita et al. 2020). This is also supported by Iacobucci et al. (1994) according to whom, expectations might not exist or may not have clearly formed enough to serve as a standard for evaluation. SERVQUAL has

been criticized for the use of the gap model as there is little evidence to suggest customers assess service quality in P-E gaps (Buttle 1996b). Thus, evaluating perceptions of service quality of social robot post interactions will be more appropriate to understand first impressions in a low contact service environment.

3.2.2 Customer Engagement

Customer Engagement (CE) is underpinned by the Service-Dominant (S-D) Logic and relationship marketing. The S-D logic moved the orientation of marketing from a "market to" customers philosophy to "market with" customers where the customers and supply chain partners are collaborators in the entire marketing process (Lusch & Vargo 2014). Relationship marketing is widely used in service marketing because of the virtue of its nature, for example, banks, hotels and healthcare organisations provide multiple services to their customers. And because of the simultaneous production and consumption of services, customers interact with employees in person and are able to form interpersonal relationships with the service provider (Buttle 1996a). Relationship marketing is about attracting, developing and retaining customer relationships (Berry 1991).

For customers to be engaged, it is important to provide them with superior service quality. As explained by Gallup (2013), "Simply satisfying customers does not have the same effect as engaging them." In frontline service settings, employees play an integral role in engaging customers while delivering service. During the interaction with frontline employees, customers form strong emotions about the organization and these emotions strongly influence their buying decisions (Gallup 2013). Thus, it has been advised that recruitment and training programs focus on stimulating empathetic and responsive staff behaviour (Islam et al. 2019). This is because even though the technical quality of service can be the same, **the human component of a service is what helps organisations differentiate themselves from competitors**. For example, all flight attendants have different traits and personalities which influence their service delivery and interactions with customers, and thus, the service delivered by flight attendants of one airline would be different from another airline (Prentice et al. 2019b). This service delivered by flight attendants will help organisations get a competitive advantage. If the service quality is favourable, it will then have a favourable influence on customer engagement (Prentice et al. 2019b).

Customer engagement is considered important for an organisations' long-term success and it has a positive influence on behavioural intentions (Pap et al. 2017; Vivek et al. 2014). If the

customers are engaged, they are more likely to engage in word-of-mouth, for example, in a social media context, if the user is entertained, they are more likely to recommend YouTube videos to others (Khan 2017). In the hospitality context, they would be more likely to use the services again, for example, if customers are engaged, they would be more likely to revisit the hotel (Islam et al. 2019). **In short, when the customer experience is positive and they are engaged with the brand, they continue purchasing the same brand and also recommending the brand to others.** Therefore, organisations should focus on providing superior service quality to customers to keep them socially and emotionally engaged, which in turn will influence their intention to use the services again.

As social robots were used in the COVID-19 pandemic in hotels and restaurants, customers started to engage with these robots, and this was termed customer-robot engagement. Wu et al. (2021) defined customer-robot engagement as customer's personal connection with social robots that goes beyond transactions. It consists of attention, enthusiasm and interaction. Attention refers to the attention paid by customers to the social robot, enthusiasm refers to how interested and excited customers are by the robot and interaction refers to how customers share service robots with others and participate in online and offline activities (Wu et al. 2021). With the risks associated with COVID-19, customers will be more likely to engage with social robots and thus, providing high service quality will be paramount for continued engagement with social robots. For example, if social robots are used in hospitality, they will need to have the same characteristics as hotel staff such as showing politeness, emotion, welcoming guests, providing an atmosphere of comfort and maintaining an emotional connection with them (Kim et al. 2021).

3.2.3 TAM and UTAUT Model

TAM is a widely used and parsimonious theoretical model used for explaining and predicting an individual's acceptance of information systems (Lee et al. 2003). Acceptance is the positive evaluation of a robot which eventually leads to intention to use the technology and the eventual act of using the technology. TAM can help identify how much a population is intending to use a specific technology and what was its actual use (Piçarra & Giger 2018). As per TAM, users' acceptance is dependent upon two variables: Perceived Usefulness and Perceived Ease of Use (Davis 1989). In robotics, usefulness would be defined as the user's belief about how the robot

can enhance their daily activities and ease of use would be defined as the user's belief that using the robot will be free from effort (Heerink et al. 2010a).

UTAUT was designed to predict technology acceptance in organizational settings (Chang 2012). Performance expectancy of UTAUT is rooted in the Perceived Usefulness construct of TAM. Effort Expectancy of UTUAUT is the degree of ease associated with the use of the system and is rooted in the Perceived Ease of Use construct of TAM. Both performance expectancy and effort expectancy were found to influence behavioural intention to use a technology (Venkatesh et al. 2016). Specifically, performance positively affects the intention to use new technology and is the strongest predictor of behavioural intention (Lin et al. 2020; Lu et al. 2019). Research has shown that there is a positive relationship between performance and customer engagement. Performance also contributes to overall quality perceptions which influence engagement (Prentice et al. 2020b). If the robot does not perform as promised, it can lead to disappointment and dissatisfaction with the robot (Choi et al. 2020).

In a frontline service setting, robots must be competent in task performance as it impacts perceived service quality and customer experience (Lu et al. 2019). **Reliability has also been presented as a subdimension of the performance construct of TAMS** (Park 2020) **and is considered to be the strongest determinant of perceived usefulness** (Meyer-Waarden et al. 2020). Because robot employees do not suffer from human fatigue, moods and short-lived attitudes, they behave identically across a service delivery system, providing predictable and homogenous service interactions (Wirtz et al. 2018), thus increasing the perceived usefulness of service robots and thus, reliability of the service. When the performance of the social robot is reliable, it then influences customer engagement.

Perceived Usefulness or Performance Expectancy or Relative Advantage are the most important variable for social robot acceptance. **This demonstrates that social robots' ability to perform reliably (i.e., performance expectancy) is important**. Thus, the TAM model provides a strong underpinning to evaluate the service quality of a social robot. It is important to note that both these theories are developed for utilitarian systems and not hedonic systems. Therefore, these theories are combined with SERVQUAL theory to evaluate the effectiveness of social robots which are both utilitarian and hedonic systems.

3.2.4 Social Cognition Perspective

Perceived Warmth and Competence have been established as two universal dimensions of social cognition, both at individual and at a group level (Fiske et al. 2007). The support for these dimensions come from experimental social psychology, cross-cultural comparisons and election polls (Judd et al. 2005; Fiske et al. 2007). Warmth and Competence are the two basic dimensions as per which people characterize others. Social cognition shapes behavioural outcomes (Fiske et al. 2007). Just like humans ascribe minds to other humans, they do so t non-human agents as well such as computers, robots and gadgets (Čaić et al. 2019). Thus, when people interact with cognitively and affectively endowed social robots, they judge them based on Warmth and Competence (Čaić et al. 2019).

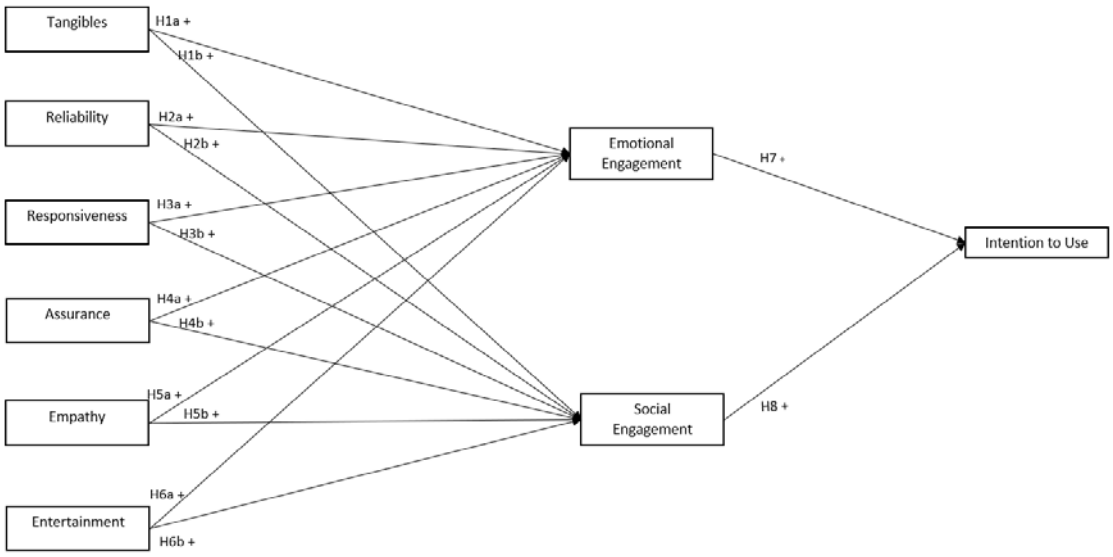
It is important to understand how humanoid social robots influence expected service quality in a frontline service setting. Anthropomorphizing social robots positively impact service quality because the human-like features of social robots such as Pepper enhance their ability to manifest high ASP (Yoganathan et al. 2021). This creates new opportunities for enhanced social engagement with users (Van Doorn et al. 2017). **One of the ways of doing this is by mimicking human emotions such as empathy and behaviours** (Tielman et al. 2014). For example, if a service technology does not have human-like characteristics, it may be perceived by consumers as less empathetic which in turn affects adoption intention. Researchers have also recognized that empathy affects tourists' adoption behaviour (de Kervenoael et al. 2020). **Additionally, the human-like characteristics may make the technology look more capable, for example, service robots are considered to be more reliable with respect to functional task**s (Huang & Rust 2018). Another reason for that is that social robots can have a personality that can influence social interactions (Lee et al. 2006). Thus, high levels of ASP can ultimately increase trust and influence users' adoption behaviour (Wirtz et al. 2018). Further, it also increases warmth and competence perception which then engages customers and shapes consumers behavioural intentions.

Humanoid social robots can reduce performance ambiguity as they facilitate smoother transactions and trust in their performance through their relationship-building capabilities (Huang & Rust 2017; Verma et al. 2016). Reduced performance ambiguity affects technology adoption and purchase behaviour (Huang & Rust 2017; Yoganathan et al. 2021). Consumers expect the performance of a humanoid robot to be comparable with that of the human staff

leading to a rise in service quality expectations, especially when compared to self-service machines (Yoganathan et al. 2021). Social Cognition theory is used to understand whether social cognition is activated during human and social robot interaction in a particular context or not. Further, it helps to understand whether cognitive resources such as Competence or affective resources such as Warmth or Empathy are considered more important by the user (Čaić et al. 2019).

3.3 THEORETICAL FRAMEWORK

Figure 18: The SERVBOT Model



Service Quality and Emotional Engagement: Previous studies have provided empirical evidence of a firm's service quality influencing customers' attitudes and behaviours (Zeithaml et al. 1996; Al Azmi et al. 2012; Suh & Youjae 2006). It has been proven that enhanced service quality is crucial for enhancing future customer engagement with the brand (Islam et al. 2019; Prentice et al. 2019b). Service quality is a significant determinant of the firm customer relationship and customer experience (Roy et al. 2018). As customers receive quality service over each encounter, it enhances their brand experience which leads to emotional attachment with the brand and subsequent engagement behaviours are manifested thereafter such as purchase, referring and spreading word-of-mouth communication (Prentice et al. 2019b). This was also corroborated by Bell (2019) who found that service quality increases customer engagement in the co-creation of value. Individuals who are emotionally engaged behave

differently to those who are merely rationally satisfied. Emotionally engaged customers spend more money (Gallup Consulting 2009 cited in Sashi 2012), are less price-sensitive, and are more likely to get through a problem than customers who are not so engaged. When customers display high levels of emotional bonds with organisations, they develop affective commitment towards the company. Engaged customers are willing to go out of their way for a business and act as advocates. Such customers with high affective commitment are known to engage in word-of-mouth communication (Bowden 2009; Harrison-Walker 2001) and therefore, help in building more business (Tripathi 2014). The relationship between engagement and service quality is also supported by SERVQUAL, TAMS and Social Cognition Perspective. Based on these findings the study proposes:

Hypothesis 1a-6a: SERVBOT dimensions will be positively linked to users' emotional engagement with the social robot in a service setting.

H1a: There is a positive relationship between tangibles and emotional engagement
H2a: There is a positive relationship between reliability and emotional engagement
H3a: There is a positive relationship between responsiveness and emotional engagement
H4a: There is a positive relationship between assurance and emotional engagement
H5a: There is a positive relationship between empathy and emotional engagement
H6a: There is a positive relationship between entertainment and emotional engagement

Service Quality and Social Engagement: Social engagement is composed of social connection (Customer Engagement) and social influence (TAMS). A social connection is formed with a brand after they have received a satisfactory service quality. If the customer forms a social connection with the brand, they are more likely to share it with their friends and family (social influence) to get their approval to use the technology. For example, the deployment of social robots in hotels is driven by consumers wanting to show off their experiences of interacting with the robot (Kim et al. 2021). Additionally, social robots can facilitate social engagement by facilitating contact with other humans (Čaić et al. 2018).

Service quality is a significant antecedent of social engagement (Abror et al. 2019). Researchers have found if customers do not receive a high-quality service then they would be less willing to be engaged (Van Doorn et al. 2010). But if the customer does receive a good service, they would recommend it to others (Gogoi 2021). Engaged customers are not only a more credible voice of the brand but they also help others see how the brand can help them

meet their needs (Vivek et al. 2014). For example, if a social robot provides superior service quality as a concierge and is entertaining, users will be more comfortable recommending it to others and using it with their friends and family. For a low contact service environment, social robots should be able to smoothly deliver quality and standardized service that is equivalent or superior to human delivery (Tuomi et al. 2021). Based on these findings the study proposes:

Hypothesis 1b-6b: SERVBOT dimensions will be positively linked to users' customer engagement with the social robot in a service setting.

H1b: There is a positive relationship between tangibles and social engagement
H2b: There is a positive relationship between reliability and social engagement
H3b: There is a positive relationship between responsiveness and social engagement
H4b: There is a positive relationship between assurance and social engagement
H5b: There is a positive relationship between empathy and social engagement
H6b: There is a positive relationship between entertainment and social engagement

Emotional Engagement and Behavioural Intentions: This study focuses on the emotional engagement dimension, which refers to the affective state (e.g., interest, happiness, pleasure) experienced by users while interacting with technology (Schodde et al. 2017), such as a social robot. When an individual is emotionally engaged in his/her interactions with a social robot, the person goes through a psychological process (Bowden 2008). In this engaged state, the user is 'occupied, fully-absorbed or engrossed' (Higgins et al. 2009, p. 7). Such levels of involvement promote a connection to the target object and others who may also be present during the interaction (Kahn 1990). It is well-established in the literature that individuals who are emotionally engaged with an entity will not just be satisfied with their experience but also delighted by it (Santos & Boote, 2003). Subsequently, this leads to more positive outcomes for the service provider. It has been empirically tested that once the consumer is engaged with a brand, their emotive relationship has a direct impact on their intention to undertake brand-related behaviours (e.g., Dwivedi 2015). Based on these findings the study proposes:

Hypothesis 7: Higher levels of emotional engagement with a social robot in a service setting will result in greater intention to use the robot.

Social Engagement and Behavioural Intentions: Researchers have identified that social engagement has a positive influence on behavioural intentions (Pap et al. 2017; Vivek et al.

2014). Positive engagement behaviours influence purchase behaviour and customer loyalty and in turn, increase profitability for the firm (Prentice et al. 2018). It involves both transactions (e.g., purchases) and non-transactions (e.g., going beyond purchases) behaviours (Kumar et al. 2010). Social engagement does not just impact behavioural intention of the current users but also of future users due to social influence and connection (Zhao et al. 2008). This is supported by the Diffusion of Innovation Theory which states that adoption of technology spreads between and within the communities. Thus, social compatibility and engagement are integral to understanding behavioural intention of users. When a customer establishes a social connection with the company, it is reflected in their intentions and actual Behaviour (Prentice et al. 2019a). Social engagement can help marketers understand how much customer effort is expended in simply using or being engrossed in the use of the brand along with how much social connection with others relative to this use or interest is desirable (Vivek et al. 2014). Based on these findings the study proposes:

Hypothesis 8: Higher levels of social engagement with a social robot in a service setting will result in greater intention to use the robot.

3.4 CONCLUDING COMMENTS

The literature review highlighted multiple gaps that need to be filled and presented three research questions. This chapter provided an overview and justification of the four key theoretical underpinnings: The Service Quality Model, Customer Engagement, TAM and UTAUT Model and Social Cognition Perspective. After the theoretical justification, hypotheses H1a-H6a, H1b-H6b, H7 and H8 were stated, and the theoretical model was presented. The theoretical model will be used to answer the three research questions. The next chapter will review the SERVBOT model and the research methodology.

4 Methodology

4.1 INTRODUCTION

The objective of this master's project is to evaluate the effectiveness of the service quality of social robots and compare it with that of humans. To test the hypothesis on the effectiveness of service quality of social robots, a research study was conducted with undergraduate business students. It has been noted several times in the research that having a CONTROL group helps compare results between experimental and CONTROL groups (Chu et al. 2017). Therefore, in this study, the results of the CONTROL group were compared to understand which dimensions contribute to the effective service quality of a social robot concierge versus a human concierge.

This chapter will describe and justify the research design selected to collect and analyse the data to address the research objectives and to test the underlying hypotheses. It also justifies the use of Pepper, the social humanoid robot, as a concierge. The chapter also presents details of the exploratory research undertaken after which the quantitative stage of the study is explained. The ethical issues considered before the commencement of the study are also discussed.

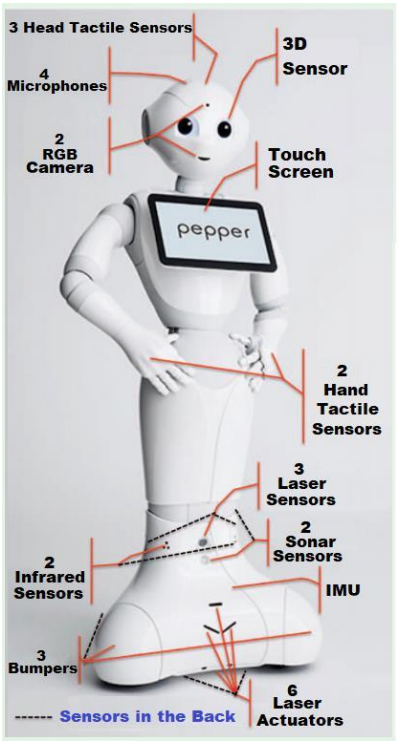
4.2 PEPPER, THE WORLDS' FIRST SOCIAL HUMANOID ROBOT

The research study was conducted using the Pepper robot, the worlds' first social humanoid robot (Softbank Robotics). We used Pepper for two reasons. First, it's the most widely used social robot for academic purposes (Pandey & Gelin 2018). Secondly, Pepper is optimised for human interaction and can engage people through conversations and its touch screen. Additionally, Pepper does not fall into the Uncanny Valley theory, and it is specifically designed to be a personal and service robot. It can exhibit body language, perceive and interact with its surroundings and move around (Pandey & Gelin 2018). As mentioned earlier, gender and personality stereotypes impact how users perceive robots. Therefore, for this study, we are using Pepper that is gender-neutral and has an androgynous and childlike voice. This will help us eliminate stereotypes related to voice pitch, gender, culture and religious variables on service delivery. Further, Pepper can maintain eye gaze during face-to-face communication with the

participants which enhances social engagement. It can also hear sounds and turn its head to interact with the person speaking.

Pepper is equipped with facial recognition technology which helps it recognise faces and basic human emotions. It is a 1.2 m tall, wheeled humanoid robot. Its 27 joints help it move around smoothy and last for approximately 12 hours at a stretch (Pandey & Gelin 2018) It also has 20 degrees of freedom for natural and expressive movement along with speech recognition and perception modules helping it recognise and engage with the person talking to it (see Figure 5). To enhance its functionality and usability, it comes equipped with a tablet attached to its chest that can help display and highlight important information. For example, when Pepper was deployed at the concierge desk, it was able to use its tactile head and hands along with eye gaze to engage with the user. It also has four microphones to help provide sound localisation. These natural multimodal interactions are integral to the successful deployment of robots in human environments (Pandey & Gelin 2018). Pepper is also known as an "emotionally intelligent" robot because of its ability to detect emotions and respond appropriately using its latest voice and emotional recognition algorithms (Engel 2018; Pandey & Gelin 2018). To make it safer for human use, there are no sharp edges, and its size and appearance makes it appropriate for a public space human-robot interaction (Pandey & Gelin 2018).

Figure 19: Pepper Robot by SoftBank Robotics



4.3 RESEARCH DESIGN

The research paradigm used in this research is a positivistic approach. The positivistic approach provides the framework within which the research work was carried out. The goal of this study, examining the effects of service quality dimensions on social engagement, emotional engagement and intention to use, rely on measurable and generalisable instruments of the positivistic approach. The correlational design of positivism can be useful for analysing relationships between variables (Kim 2005). Analysis of the relationships between different variables, and identification of the direction and the degree of associations between them, was accomplished by utilising a correlational design. The use of a positivistic approach is strongly recommended for any study, which can produce applicable knowledge that is externally valid (Kim 2003). If the researchers are certain that the findings from the study will lead to tangible, positive and long-term returns for organisations in general, application of the positivistic paradigm is seen as relevant (Scheirer and Rezmovic 1983). The research used quantitative methods

To conduct the research a 2 x 1 (CONTROL vs SERVBOT) x (Concierge) between-subject experiment was undertaken from August 2019 – December 2019 at Western Sydney University Parramatta City Campus. The study was conducted using two conditional scenarios, CONTROL and SERVBOT, which are explained in the below section (Section 4.5). A seven-point Likert scale was used to measure all the items. A seven-point Likert scale (from 1= Strongly Disagree to 7= Strongly Agree) is considered to be more accurate and a better reflection of a respondent's true evaluation specifically unsupervised and electronically distributed usability questionnaires (Finstad 2010). Pepper was used as the concierge for the SERVBOT condition. The experimental protocol and procedure were approved by the university's ethical review board.

4.4 MEASURES

The study's items were adopted and adapted from well-established sources to ensure the reliability and validity of measures. The questionnaire consists of measures for tangibles, reliability, responsiveness, assurance, empathy, and entertainment. Each variable was drawn after an extensive literature review and only the constructs that have been validated in other studies were used. However, some SERVQUAL items had to be adapted to social robots. These variables are well established in services marketing and human-robot interaction research. The

definitions used for this research study's constructs were taken from existing literature. Table 5 gives the theoretical definition for each construct used in this research. The questionnaire uses a **seven-point Likert scale** (from 1= Strongly Disagree to 7= Strongly Agree). Each construct's indicators or measures have also been identified. All indicators used in this research study are well-established in the marketing and management literature. Thus, the measures align well with the conceptualised definitions of the constructs. The initial questionnaire was checked by three academic staff and refinements were made to increase its relevance.

Table 4: Variables, their definitions and their measures

Constructs	Conceptual Definition	CONTROL Survey Questions	SERVBOT Survey Questions	Scales
Tangibles (Parasuraman et al. 1988)	physical facilities, equipment, and appearance of personnel (Parasuraman et al. 1988, p. 23)	1) The concierge has access to the latest technology 2) The concierge is visually appealing 3) The concierge seems to be very capable 4) The concierge is professional	1) Pepper demonstrates the latest technology 2) Pepper is visually appealing 3) Pepper is very capable 4) Pepper is professional	Seven-point Likert Scale
Reliability (Parasuraman et al. 1988)	ability to perform the promised service dependably and accurately (Parasuraman et al. 1988, p. 23)	1) The concierge is capable of doing tasks in time 2) The concierge appears to be smart and reassuring 3) The concierge is dependable 4) The concierge provides timely services	1) Pepper is capable of doing tasks in time 2) Pepper appears to be smart and reassuring 3) Pepper is dependable 4) Pepper provides timely services	Seven-point Likert Scale
Responsiveness (Parasuraman et al. 1988)	willingness to help customers and provide prompt service (Parasuraman et al. 1988, p. 23)	1) I do not think the Concierge can perform well at the front desk 2) The concierge does not provide good service 3) I do not think the concierge can help customers 4) The concierge is inarticulate when responding to people	1) I do not think Pepper can perform well at the concierge 2) Pepper does not provide good service 3) I do not think Pepper can help customers 4) Pepper is inarticulate when responding to people	Seven-point Likert Scale

Assurance (Parasuraman et al. 1988)	knowledge and courtesy of employees and their ability to inspire trust and confidence (Parasuraman et al. 1988, p. 23)	1) I can trust the concierge 2) I feel safe with the concierge 3) I think the concierge is polite 4) The concierge can do a good job	1) I can trust Pepper 2) I feel safe with Pepper 3) I think Pepper is polite 4) Pepper can do a good job at the concierge	Seven-point Likert Scale
Empathy (Parasuraman et al. 1988)	Caring, individualized attention the firm provides its customers (Parasuraman et al. 1988, p. 23)	1) The concierge provides caring and individualised attention to customers 2) The concierge does not give me personal attention 3) The concierge does not know what my needs are 4) The concierge does not have my best interest at heart 5) The concierge is not available when customers need it	1) Pepper provides caring and individualised attention to customers 2) Pepper does not give me personal attention 3) Pepper does not know what my needs are 4) Pepper does not have my best interest at heart 5) Pepper is not available when customers need it	Seven-point Likert Scale
Entertainment (Ducoffe, 1996)	activities that people enjoy and look forward to doing, hearing or seeing (Vogel 2020, p.:xix-xx)	1) The concierge is Entertaining 2) The concierge is Enjoyable 3) The concierge is Pleasing 4) The concierge is Funny	1) Pepper is Entertaining 2) Pepper is Enjoyable 3) Pepper is Pleasing 4) Pepper is Fun to use/watch	Seven-point Likert Scale
Emotional Engagement (Fredricks et al. 2004)	amount of subconscious 'feeling' experienced during an activity or an interaction (Heath 2009).	1) I felt happy with the Concierge 2) I felt bored with the Concierge 3) I felt excited by the Concierge 4) I liked hanging out with the Concierge 5) I am interested in the work being done by the concierge	1) I felt happy watching Pepper the Robot 2) I felt bored with Pepper the Robot 3) I felt excited by Pepper the Robot 4) I liked hanging out with Pepper the Robot 5) I am interested in the work being done by Pepper the Robot	Seven-point Likert Scale

Social Engagement (Vivek et al. 2014)	enhancement of the interaction based on the inclusion of others with the focus on engagement, indicating mutual or reciprocal action in presence of others (Vivek et al. 2014, p. 407)	1) I would love to show new tech to my friends 2) I would enjoy sharing new technology even more when I am with others 3) Interacting with new technology will be more fun when other people around me do it too	1) I would love to show this robot to my friends 2) I would enjoy this robot even more when I am with others 3) Interacting with this robot will be more fun when other people around me do it too	Seven-point Likert Scale
Intention to use (Huang and Hsu, 2009)	the strength of one's intention to perform a specified Behaviour (Fishbein and Ajzen, 1977, p. 288).	1) To use the concierge's services 2) To plan on using the concierge's services 3) To desire the concierge's services	1) To use Pepper the robot's services 2) To plan on using Pepper the Robot's services 3) To desire Pepper the Robot's services	Seven-point Likert Scale

4.5 SAMPLING STRATEGY AND PROCESS

This section explains the process used to determine which subjects to survey to obtain the relevant information for the research problem. The four steps undertaken at this stage were in line with the recommendations made by Malhotra (2012).

Step 1: Defining the target population

To be able to accurately select a sample, the target population must be defined. In this research, the target population consisted of undergraduate students studying at Western Sydney University. Student Sampling is appropriate for this study. Many of the studies in HRI have used student samples to test the adoption of social robots (Naneva et al. 2020; Zhu & Deng 2021). To be eligible for the first stage, the students should have had interacted with the human concierge in the last three months. To be eligible for the second stage, the students should not have interacted with a social robot earlier.

Western Sydney University Parramatta City Campus is a vertical campus that is located in a major urban centre, has nine floors and is one of the most technologically advanced teaching and research spaces. It has three coffee shops, a restaurant and it has close access to public transport (train and bus stations). The precinct offers interactive technology-enabled learning studios and houses the Sydney Graduate School of Management (SGSM). Further, the building is shared with Price Waterhouse Cooper and WaterNSW.

Step 2: Determining the sampling frame

The study was undertaken in two stages: Stage 1 was CONTROL condition and Stage 2 was SERVBOT condition. For stage 1, students who attended the campus during office hours (9-5) were selected. For Stage 2, a proportion of students from a large undergraduate business unit were selected. Participants were informed of the confidentiality and anonymity of the collected data.

An online questionnaire was developed for this study to compare the performance of a robot concierge (SERVBOT) with a human concierge (CONTROL). The online questionnaire was provided to the sample after they had interacted with the human concierge or the robot concierge. The respondents only received the SERVBOT or the CONTROL questionnaire, not

both. The online questionnaire was developed using Qualtrics, an online cloud-based survey platform. The scale was adapted and adopted from previous studies (Davis 1989; Parasuraman et al. 1988; Vivek et al. 2014; Ducoffe 1996; Fredricks et al. 2004).

Step 3: Determining the sample size

The total sample size was 232 responses, 138 responses from Stage 1 and 94 responses for stage 2. The sample size is considered adequate for studies in consumer research and human-robot interaction (Niculescu et al. 2013; Chiang & Trimi 2020; De Graaf & Allouch; 2013). Chiang & Trimi (2020) collected data from 201 hotel guests to explore the service quality provided by robots in a hotel setting. In De Graaf and Allouch's (2013) study, 60 students participated when they explored variables that influence acceptance of social robots.

Step 4: Selecting a sampling technique

The data for this study were collected in two stages, CONTROL and SERVBOT, both at WSU Parramatta City Campus. A purposive sampling technique was used and therefore, only WSU Business students were recruited.

In Stage 1 (CONTROL), a systematic sampling approach was used to randomly collect data. Data were collected from students in the Parramatta City Campus. The researcher stood in front of the concierge desk and every third student was selected from the larger population at multiple time points to generate a representative sample. As a screening question for Stage 1, students were asked if they had interacted with the human concierge in the last three months. If they had, they were asked to participate in the study. If they agreed to participate in the study, the respondent was asked to reflect on their last interaction with the concierge. To ensure confidentiality and avoid pressure on the respondents, an iPad was provided to the respondents to complete the questionnaire. The respondents were given time and space to complete the questionnaire on their own. It took approximately 10 minutes to complete the questionnaire.

In Stage 2 (SERVBOT), a pool of undergraduate students was asked to complete the questionnaire after a casual interaction with the robot concierge. Student participants were told to imagine that the service robot was at a concierge desk. The scenario for Stage 2 is discussed in section 4.5.1 and the survey structure is presented in Table 4. The interactions lasted between 5-10 min and completion of the survey took approximately 10 minutes to complete.

4.5.1 Scenario

In Stage 2, the robot was placed at the front of the class and students volunteered to interact with the concierge robot. Participants were provided with possible questions to ask the robot. The procedure for stage 2 was as follows:

1) Pepper was brought into a room by a research assistant where the students were present. The robot was placed at the front of the class.
2) The students were asked to imagine that the robot is at the concierge desk after which the students were then given an opportunity to ask a series of questions to the concierge robot.
3) Participants were provided with the possible questions to ask the robot. For example, "where is the train station?", "where is the closest bus stop?", "how do I access the lifts?", "where is the event?", etc. These questions are typically asked at the concierge desk and Pepper was pre-programmed to answer these questions.
4) Students volunteered to come up to the concierge robot and ask questions. They were encouraged to have a 'realistic' interaction with the robot and were told that there were no right or wrong answers. This ensured the participants did not provide socially desirable responses.
5) For the entertainment dimension, Pepper was designed to narrate jokes such as,
   ***Student**: I am in a rush. Is there a shortcut to the train station?*
   ***Pepper**: Based on my calculations this is the fastest route to the train station. If you run really fast, you can get there in 1.5 minutes. I've done it myself and it's a very good exercise.*
6) Immediately after the interaction, the students completed the SERVBOT questionnaire including demographic information. Qualtrics online survey was used to collect the data for both conditions.

Table 5: Survey Structure

Survey Structure
1. Scenario
2. Robot's Service Quality (SERVBOT items)
3. Social Engagement
4. Emotional Engagement
5. Intention to use
6. Demographics

4.6 ANALYSIS TECHNIQUES

4.6.1 Tests for Reliability and Validity

The data was analysed using SPSS 25.0. Exploratory Factor Analysis (EFA) and Cronbach Alpha tests were conducted to ensure the measures were valid and reliable respectively. EFA was conducted using Factor Analysis on SPSS 25 using *Principal Component Analysis and Varimax Rotation with Kaiser Normalisation.* A reliability test was conducted by calculating *Cronbach Alpha.*

4.6.2 Tests for the theoretical model

A *multiple regression analysis* was conducted to test the theoretical model. A multiple regression analysis was used to examine (a) the influence on service quality dimensions on emotional and social engagement (b) the influence of emotional and social engagement on intention to use human and social robot concierge.

4.7 ETHICS AND LIMITATIONS

The participants in this study were told about the purpose of the study and any risks involved beforehand. A participant information sheet was provided to them before they signed the consent form to participate in the study. The participant information sheet and consent form were part of the survey experience.

This research has received ethics approval from Western Sydney University Human Research Ethics Committee. The HREC approval number for "Social robots as a 'medium' of communication' is H13082. Dr Aila Khan is the principal researcher of this project. The consent form that was used to take consent from the respondents can be referenced in Appendix A.

4.8 CONCLUDING COMMENTS

This chapter described the research design for the project undertaken. It outlined the research plan and gave details of the two stages of data collection. The chosen sampling strategy was justified. The conceptual definitions underlying all the model constructs were explained. To achieve the aims of this research, the support and appropriateness of the measures and methods were discussed. Finally, ethical considerations undertaken during the data collection stages were identified.

The next chapter presents an analysis of the collected data, the findings, their discussion and implications.

5 *Results, Discussion and Implications*

5.1 INTRODUCTION

This chapter presents the results of the data analysis undertaken to examine the effectiveness of the service quality of social robots and compare it with that of humans. It shows the comparison between the effectiveness of service quality delivered by a human concierge and a social robot concierge. Further, it presents insights into the first impression of users' interaction with the social robot concierge.

Section 5.2 explains the procedure that was undertaken for data preparation. Section 5.3 provides the profile of the respondents for both CONTROL and SERVBOT. Section 5.4 provides the results of the validity and reliability test. After that, section 5.5 discusses the results of CONTROL followed by a discussion of those results. Section 5.6 discussed the results of SERVBOT followed by a discussion of those results. Following the discussion of the results, the academic and managerial implications are presented. This section shows that the research questions raised in the literature review section have now been answered. Finally, it presents concluding comments on the overall findings.

5.2 DATA PREPARATION

Before analysing the data, the data set was prepared using the following strategies. Firstly, incomplete and dummy responses were removed. Secondly, a descriptive analysis was conducted to check for means and standard deviation for each scale.

Four items of responsiveness, three items of empathy and one item of emotional engagement were reverse coded (see Table 7 and Table 8). Before the analysis was conducted, these items were recoded into a positive valence. To yield quality data, the raw data was cleaned by removing unengaged responses.

All the responses were safely stored on a secure online server, the researcher was the only person who had access to the data to ensure the data privacy and confidentiality of the respondents.

5.3 RESPONDENT PROFILE

A systematic sampling approach was used to randomly collect data for stage 1 at Parramatta City Campus. Undergraduate students from the Faculty of Business of Western Sydney University were recruited to participate in the study for stage 2. Student participants did not receive any incentive to participate in the study. A total of 138 responses were collected for stage 1 from students with 72% of the students between 18-24 years old. An equal distribution of gender was almost accomplished with 55% male participants and 45% female participants. Table 6 shows the demographic characteristics of the participants.

A total of 94 responses were collected for stage 2 from students with 86% of the students between 18-24 years old. An equal distribution of gender was almost accomplished with 46% male participants and 54% female participants. Table 6 shows the demographic characteristics of the participants. The sample sizes are considered sufficient to test the hypothesis in the study (Niculescu et al. 2013; Chiang & Trimi 2020; De Graaf & Allouch 2013).

Table 6: Respondent's Profile

	Age	**Gender**	**Marital Status**	**Occupation**	**Household Income**
CONTROL	18-24 (72%)	Male (55%) Female (45%)	Single (90%)	Student (97%)	A$0 - A$7,999 (46%) A$7,800 - A$15,599 (15%) A$15,6000 - A$20,799 (7%)
SERVBOT	18-24 (86%)	Male (46%) Female (54%)	Single (87%)	Student (88%)	A$0 - A$7,999 (30%) A$7,800 - A$15,599 (14%) A$15,6000 - A$20,799 (13%)

5.4 VALIDITY AND RELIABILITY

The researchers undertook the test for the adequacy of sample size – KMO. The KMO measure of sampling adequacy indicates the proportion of variance in variables that might be caused by

underlying factors (IBM). For example, a high value (close to 1.0) indicates that a factor analysis might be beneficial for the data whereas values less than 0.50 indicates that factor analysis would not be very useful (IBM). All resulting scores (see tables 8 and 9) indicated that the sample size was sufficient for carrying out the required analysis.

Tangibles, Reliability, Responsiveness, Assurance and Empathy were derived from the original SERVQUAL framework in the marketing literature (Parasuraman et al. 1988). Four items for the 'responsiveness' and 'empathy' dimensions were reverse-coded. Items for the additional dimensions of social engagement and emotional engagement were taken from a well-cited study (Fredricks et al. 2004). One item for 'emotional engagement' was reverse coded. Items for "entertainment" were taken from a well-cited study (Ducoffe 1996). Items for 'intention to use' were taken from Huang and Hsu (2009).

A reliability test was conducted on both CONTROL and SERVBOT to verify their internal consistency (see Table 7 and 8). Cronbach's alpha normally ranges between 0 and 1 and the close Cronbach's alpha is to 1.0 the greater is the internal consistency of the items in the scale (Gliem and Gliem 2003). For both the scales, Cronbach's alpha was greater than 0.7 for all scale items, showing internal consistency. Table 7 and Table 8 show the Cronbach values for both scales.

Exploratory Factor Analysis was conducted using Factor Analysis on SPSS 25 using Principal Component Analysis and Varimax Rotation with Kaiser Normalisation. Item loading of 0.50 was used as an indicator to determine internal consistency (Wolfinbarger and Gilly 2003). All scale items had a factor loading of more than 0.50 (see tables 7 and 8).

Table 7: CONTROL Factor Analysis & Reliability Test

Variable	**Factor Loading**	**KMO**	**Reliability (Cronbach's Alpha**
Tangibles		.741	.829
The concierge has access to the latest technology	.783		
The concierge is visually appealing	.783		
The concierge seems to be very capable	.856		
The concierge is professional	.850		

Reliability		.820	.887
The concierge is capable of doing tasks in time	.872		
The concierge appears to be smart and reassuring	.878		
The concierge is dependable	.837		
The concierge provides timely services	.882		
Responsiveness		.814	.881
I do not think the concierge can perform well at the concierge (reverse-coded)	.794		
The concierge does not provide good service (reverse-coded)	.893		
I do not think Concierge can help customers (reverse-coded)	.888		
The concierge is inarticulate when responding to people (reverse-coded)	.878		
Assurance		.684	.883
I can trust the concierge	.852		
I feel safe with the concierge	.852		
I think concierge is polite	.836		
The concierge can do a good job	.905		
Empathy		.738	.766
The concierge provides caring and individualised attention to customers*	.533		
The concierge does not give me personal attention (reverse-coded)	.785		
The concierge does not know what my needs are (reverse-coded)	.833		
The concierge does not have my best interests at heart (reverse-coded)	.827		
The concierge is not available when customers need it (reverse-coded)	.578		
Entertainment		.817	.891
The concierge is entertaining	.885		
The concierge is enjoyable	.924		
The concierge is pleasing	.815		
The concierge is funny	.853		
Social Engagement		.728	.886
I would love to show new tech to my friends	.894		
I would enjoy sharing new technology even more when I am with others	.930		
Interacting with new technology will be more fun when other people around me do it too	.887		

Emotional Engagement		.723	.744
I felt happy with the concierge	.770		
I felt excited by the concierge	.787		
I liked hanging out with the concierge	.729		
I am interested in the work being done by the concierge	.732		
I felt bored with the concierge (reverse coded)	.512		
Intention to use		.750	.941
To use the concierge's services	.925		
To plan on using the concierge's services	.961		
To desire the concierge's services	.951		

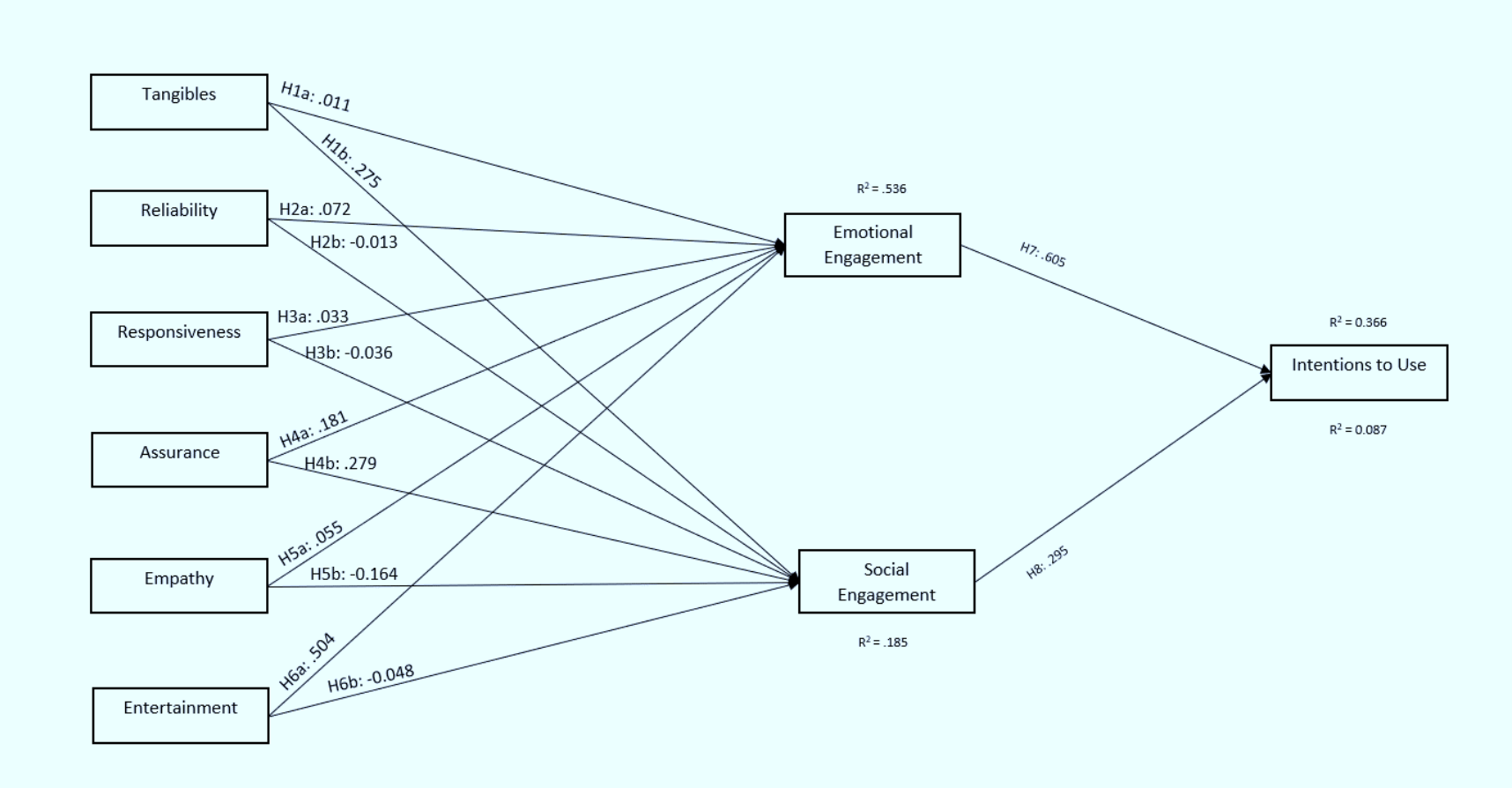
Table 8: SERVBOT Factor Analysis & Reliability Test

Variable	**Factor Loading**	**KMO**	**Reliability (Cronbach's Alpha**
Tangibles		0.759	.747
Pepper demonstrates the latest technology	.818		
Pepper is visually appealing	.733		
Pepper seems to be very capable	.685		
Pepper is professional	.811		
Reliability		.821	.868
Pepper provides timely services	.889		
Pepper appears to be smart and reassuring	.867		
Pepper is capable of doing tasks in time	.856		
Pepper is dependable	.788		
Responsiveness		.815	.849
I do not think Pepper can perform well at the concierge (reverse-coded)	.864		
Pepper does not provide good service (reverse-coded)	.863		
I do not think Pepper can help customers (reverse-coded)	.783		
Pepper is inarticulate when responding to people (reverse-coded)	.817		
Assurance		.674	.772
I can trust Pepper	.885		
I feel safe with Pepper	.854		
Pepper can do a good job as the concierge	.718		
I think Pepper is polite	.593		
Empathy		.757	.761

Pepper does not have my best interests at heart (reverse-coded)	.811		
Pepper is not available when customers need it (reverse-coded)	.791		
Pepper does not know what my needs are (reverse-coded)	.700		
Pepper does not give me personal attention (reverse-coded)	.686		
Pepper provides caring and individualised attention to customers	.578		
Entertainment		.853	.965
Pepper is enjoyable	.971		
Pepper is pleasing	.955		
Pepper is entertaining	.947		
Pepper is fun to use/watch	.931		
Social Engagement		.693	.818
I would love to show this robot to my friends	.803		
I would enjoy this even more when I am with others	.880		
Interacting with this robot will be more fun with other people around me do it too	.886		
Emotional Engagement		.844	.903
I felt happy watching Pepper the robot	.897		
I felt excited by Pepper the robot	.896		
I liked hanging out with Pepper the robot	.803		
I am interested in the work being done by Pepper the robots	.881		
I felt bored with Pepper the robot (reverse coded)	.790		
Intention to use		*.771*	.968
To use Pepper the robot's services	.972		
To plan on using Pepper the robot's services	.977		
To desire Pepper the robot's services	.960		

5.5 RESULTS AND DISCUSSION FOR CONTROL

Figure 20: CONTROL Model



5.5.1 Results for H1a-H8 for CONTROL – Emotional Engagement

Table 9 shows the key results for the CONTROL condition. The results present some new findings, such as entertainment having a significant impact on emotional engagement when a service is delivered by a human concierge. For example, the concierge working at the front desk should have certain characteristics such as being funny, pleasing, entertaining and enjoyable. The following are some of the key findings:

1) **H1a**: There is no significant relationship between tangibles and emotional engagement and thus, H1a is rejected. Previous studies have not explored this relationship; however, scholars have suggested that there is a significant relationship between tangibles and customer engagement (Puriwat and Tripopsakul 2014). As mentioned in the literature review, scholars have explained cognitive, emotional and behavioural dimensions as three dimensions of customer engagement (Islam et al. 2019; Brodie et al. 2011). Therefore, the results provide new insight and suggest that there is a significant difference between emotional and customer engagement.

2) **H2a**: There is no significant relationship between reliability and emotional engagement and thus, H2a is rejected. Based on an extensive review of the literature, there are no empirical studies that examine this relationship. Previous studies have looked at the influence of reliability on customer engagement (Puriwat and Tripopsakul 2014). In that study, customer engagement consisted of cognitive engagement, emotional engagement and behavioural engagement, but the researchers treated customer engagement as one construct and only examined the relationship between reliability and customer engagement. Other researchers found service quality to be a significant antecedent of customer engagement, however, they treated customer engagement and service quality as one construct (Abror et al. 2019). As mentioned in the literature, service quality and customer engagement *both are multi-dimensional*. Thus, the findings add to customer engagement literature by showcasing the difference between customer engagement and emotional engagement. Further, it highlights the importance of examining the relationship between different service quality dimensions and customer engagement dimensions.

3) **H3a**: There is no significant relationship between responsiveness and emotional engagement and thus, H3a is rejected. Similar to reliability and tangibles, previous studies did not test the relationship between responsiveness and emotional engagement. The studies only looked at the influence of service quality on customer engagement (Abror et al. 2019). They treated service quality and customer engagement as one construct. However, customer engagement is multi-dimensional, and the findings suggest there is a difference between emotional engagement and customer engagement, and thus, they should be assessed separately in a frontline service setting.

4) **H4a**: There is no significant relationship between assurance and emotional engagement and thus, H4a is rejected. Previous researchers looked at the impact of assurance on emotional engagement (Lo et al. 2015). They found it to have an insignificant impact on affecting positive customer emotions. The reason was that customers 'expect' the assurance attributes from a five-star hotel resort and hotel spas (Lo et al. 2015). The results of this study align with previous research as the findings indicate that customers expect the human concierge of the vertical campus to be assuring and thus, it had no impact on their excitement and happiness levels. Izogo (2017) looked at assurance and reliability as the two constructs of service quality, but they examined their influence on customer loyalty. Additionally, they did not find an assurance to be a predictor of customer loyalty (Izogo 2017). Thus, the findings align with previous research and show that assurance has no impact on emotional engagement when the service is delivered by a human concierge.

5) **H5a**: There is no significant relationship between empathy and emotional engagement and thus, H5a is rejected. Previous studies have emphasised that empathy is essential to build a relational connection between front line service employees and the customer (Gorry and Westbrook 2011; Ngo et al. 2020). It is considered to be the most important characteristic of frontline employees (Varca 2009). Other researchers found empathy to have a significant impact on consumers' positive emotions in a spa environment (Lo et al. 2015). Our findings contradict previous studies as they indicate that customers do not expect empathy in low contact service environments (e.g., convenience stores). This could be because, in low contact service, the human interaction is limited due to the presence of machines providing standardised service to customers (Izogo 2015). Thus, the finding highlights the importance of considering the strategic service design and delivery approach while analysing the service perceptions of customers (Murray et al. 2019).

6) **H6a**: The results show a significant relationship between the entertainment dimension (b=.504, p=0.000) and emotional engagement. Thus, H6a is accepted. Previous studies have acknowledged the influence of entertainment on customer engagement from an airline's in-flight entertainment point of view (Hapsari et al. 2017). But the focus was not on the interaction between the airline crew and the passengers. However, the results indicate that an entertaining human frontline service employee can also emotionally engage customers. Further, researchers have studied entertainment as a dimension of electronic service quality and for virtual service agents but not for traditional face-to-face interactions (Chung et al. 2020; Loiacono et al. 2007). Since entertainment is a driver of emotional engagement, the result indicates that it is also applicable in human-human interaction, not just in e-service quality contexts. This finding is a key contribution to the service quality literature and emphasises the importance of including entertainment as a dimension of service quality.

7) **H7**: There is a significant relationship between Emotional Engagement (b=.605, p=0.000) and Intention to Use. Therefore, H7a is accepted. This is in line with previous studies for example Gallup Consulting (2009) and Sashi (2012) shows that emotional engagement is a predictor of behavioural intention.

Table 9: CONTROL Multiple Regression: Emotional Engagement

Variables	**Regression (beta)**	**R^2**	**t**	**Sig.**
		0.536		
Tangible→ Emotional Engagement	0.011		0.116	0.908
Reliability→Emotional Engagement	0.072		0.754	0.452
Responsiveness→Emotional Engagement	0.033		0.453	0.652
Assurance→ Emotional Engagement	0.181		1.859	0.065
Empathy →Emotional Engagement	0.055		0.719	0.473
Entertainment →Emotional Engagement	0.504		6.036	0.000***
Emotional Engagement →Intention to use	0.605	0.366	8.855	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

5.5.2 Results for H1b-H8 for CONTROL – Social Engagement

Table 10 shows the key results for the CONTROL condition. The results present some new findings, for example, visual appeal of the service environment, professionalism of the employees and latest technology are important to socially engage customers. The following are some of the key findings:

1) **H1b**: There is a significant relationship between tangibles and social engagement and thus, H1b is accepted. This support previous findings that tangibles contribute significantly to positive WOM communication (Sivakumar & Srinivasan 2010). Results of this study indicate that participants found the tangible service quality to be exciting, so much so that they wanted to share it with their friends. Literature has shown that tangible physical surroundings are closely related to the affective responses and are aesthetic in nature such as excitement (Wakefield & Blodgett 1999). These results are consistent with past studies which have shown that guests who experience excellent service quality are more likely to share their experience with other individuals (Rather & Camilleri, 2019; Islam et al. 2019).

2) **H2b**: There is no significant relationship between reliability and social engagement and thus, H2b is rejected. There is limited empirical support to the significance of the relationship. Previous studies have looked at the influence of service quality on customer engagement (Islam et al. 2019; Abror et al. 2019) or the influence of service quality on e-engagement (Promtep et al. 2019). Promtep et al. (2019) used focused attention and satisfaction as dimensions of e-engagement but not social engagement as a dimension of engagement. After an extensive literature review, it was found that there are no studies that have tested the influence of reliability and social engagement. As mentioned in the literature customer engagement is multi-dimensional and social engagement is one of those dimensions. Thus, the findings indicate that influence of service quality dimensions on social engagement must be tested instead of just testing customer engagement.

3) **H3b**: There is no significant relationship between responsiveness and social engagement and thus, H3b is rejected. Similar to reliability and tangibles, previous studies did not test the relationship between responsiveness and social engagement. The studies only looked at the influence of service quality on customer engagement (Abror et al. 2019). However, customer engagement is multi-dimensional, and the findings suggest there is a difference between social

engagement and customer engagement, and social engagement should be tested separately in a service environment.

4) **H4b**: There is a significant relationship between assurance and social engagement and thus, H4b is accepted. As has been shown in the literature, hotel guests expect a certain level of service that symbolises hotel quality and this is manifested in employees' dependence and credible skills (Prentice et al. 2020a). Once they are assured about service quality, they are more likely to share their experience with others. In a study by Rao and Shu (2013), it was observed that front office staff should be proficient in using advanced technology to improve their performance such as making room reservations. This inspires trust and credibility in the customers (Rao and Sahu, 2013). Thus, the findings align with previous findings as it shows that assurance is an important dimension in customers' evaluation of service quality. Further, the findings add to the customer engagement literature by highlighting the difference between customer engagement and social engagement and underlining the positive influence of assurance on social engagement.

5) **H5b**: There is no significant relationship between empathy and social engagement and thus, H5b is rejected. Although empathy has been shown to impact emotional engagement, there is very little empirical support for empathy and social engagement relationships in the service quality literature. Previous studies have found that empathy has a positive effect on patients' loyalty and customer Behaviour in a hospital (Zhang et al. 2018). However, the focus of this study was on how empathy influences patients' Behaviour to revisit the hospital for their treatment, not on whether they would share their perception about the hospital with others (Zhang et al. 2018). Thus, this finding advances the understanding of empathy by exploring its relationship with social engagement. It differentiates between social engagement and customer engagement, and social engagement and emotional engagement.

6) **H6b**: The results show no significant relationship between entertainment and social engagement. Thus, H6b is rejected. Some studies found entertainment to be positively related to social media brand engagement (Chahal et al. 2020) and intentions to revisit social networking sites (Farook & Abeysekara, 2016). It was found that in a social media setting, entertainment is a key motivator for consumers to share user-generated content (Liu et al. 2019). However, there are no studies that examine the influence of entertainment on social engagement in human-human interaction (Theng et al. 2012). Thus, this finding adds to the

entertainment and social engagement literature by showing the difference between customer engagement and social engagement, and the importance of examining the relationship between entertainment and social engagement when service is delivered by a human concierge.

7) **H8**: There is a significant relationship between social engagement and intention. Therefore, H7b is accepted. Literature has shown that memorable experiences enable attendees to connect with others, the community and the world (Carissa et al. 2020). These memorable experiences have a positive influence on behavioural intention (Carissa et al. 2020). Further, it was found that social engagement influences individual and community level behavioural change (Molina et al. 2018). Thus, the finding confirms that social engagement impacts behavioural intention.

Table 10: CONTROL Multiple Regression: Social Engagement

Variables	**Regression (beta)**	**R^2**	**t**	**Sig.**
		0.185		
Tangible→ Social Engagement	0.275		2.210	0.029**
Reliability→ Social Engagement	-0.013		-0.101	0.920
Responsiveness→ Social Engagement	-0.036		-0.373	0.709
Assurance → Social Engagement	0.279		2.163	0.032**
Empathy → Social Engagement	-0.164		-1.616	0.109
Entertainment →Social Engagement	-0.048		-0.430	0.668
Social Engagement → Intention to use	0.295	0.087	3.599	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

5.5.3 Discussion of results for the CONTROL condition

Entertainment and Emotional Engagement: Entertainment was not an original dimension of service quality. However, the results indicate that an entertaining human concierge can emotionally engage customers. The use of affective components by frontline service employees improves customer experiences (Chiew et al. 2019). Previous studies have shown that humour is the most common way to boost trust and produce a positive affect on others (Niculescu et al. 2013). It is an effective communication tool that enables employees to connect readily with

customers and generate positive behaviours in receivers (Chiew et al. 2019). Psychology literature shows that humour induces feelings of closeness, elicits liking and promotes affiliation (Chiew et al. 2019). Additionally, the use of humour by employees lead to a memorable service experience and a lasting impression in customers mind about the brand (Mathies et al. 2016). For an effective customer service interaction, frontline service employees should be entertaining and the easiest to be entertaining is to be humourous. Therefore, managers must consider this personality trait during the recruitment of front-line service employees.

Tangibles and Social Engagement: Tangibles had a significant impact on social engagement in the CONTROL condition. Tangibles refer to the appearance of the physical facilities, personnel, and communication materials. As seen in Figure 21 below, the location in which the study was conducted, there is an interactive digital display and a sleek marble bench at the concierge desk. The tangibles also include lift touchpads (Figure 22) and digital kiosk (Figure 23) which allows individuals to find out information about the building, public transport, and their surroundings such as weather. Tangibles are essential for customers to perceive the true value of the service (Panda & Das, 2014), and it produces effects on positive word-of-mouth (Wakefield & Blodgett, 2016).

With the advancement in technology, customers do not just interact with human employees at the concierge desk but also have access to innovative technologies such as apps and WI-FI. These tools are included to make the customers experience more memorable, worthwhile and interactive which make the customers more engaged (Prentice & Nguyen, 2020). If a customer has good experience with these tools, it motivates them to have a more social engagement with the firm (Carù & Cova, 2003). Results of this study indicate that participants found the tangible service quality to be exciting, so much so that they wanted to share it with their friends. Literature has shown that tangible physical surroundings are closely related to the affective responses and are aesthetic in nature such as excitement (Wakefield & Blodgett, 1999). These results are consistent with past studies which have shown that guests who experience excellent service quality are more likely to share their experience with other individuals (Rather & Camilleri 2019; Islam et al. 2019). Thus, the concierge desk must provide their customers with technologically advanced tools to find out information. This will especially be useful for digitally advanced customers who expect more technologically driven

solutions (digital kiosks, mobile applications etc) and personalised experiences (Ramos & Brito 2020; Ivanov, 2020). Further, this will help organisations cut operational costs.

Figure 21: Concierge desk at Western Sydney University

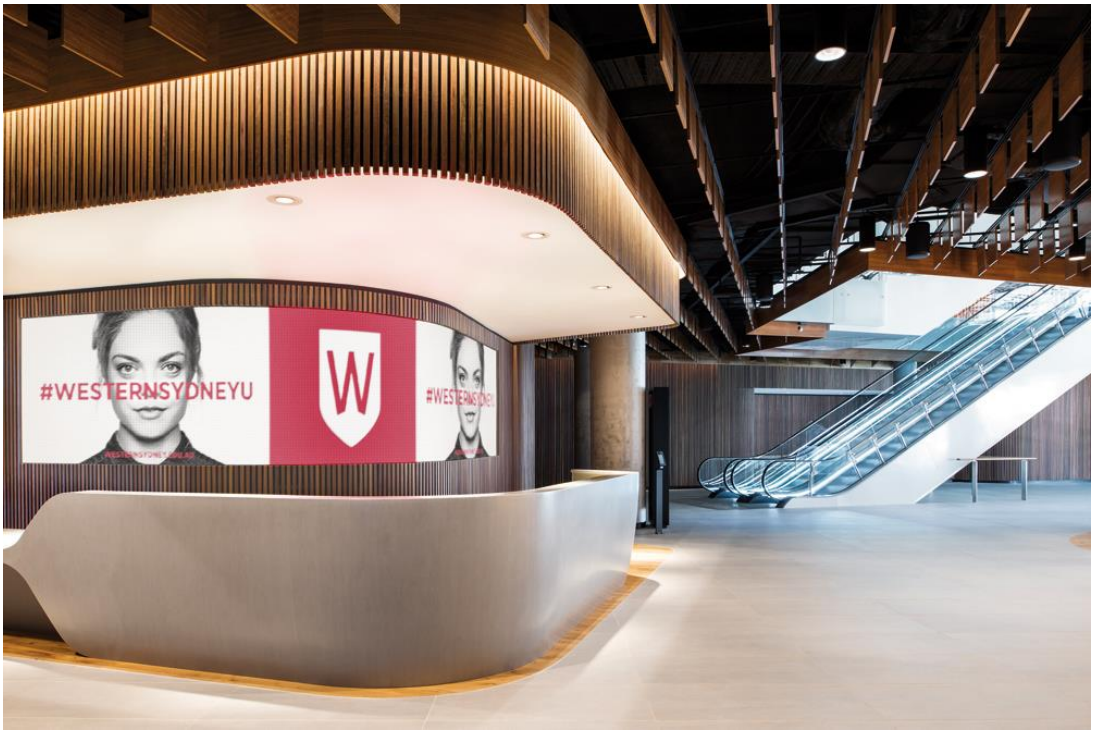


Figure 22: Lift Touch Pads

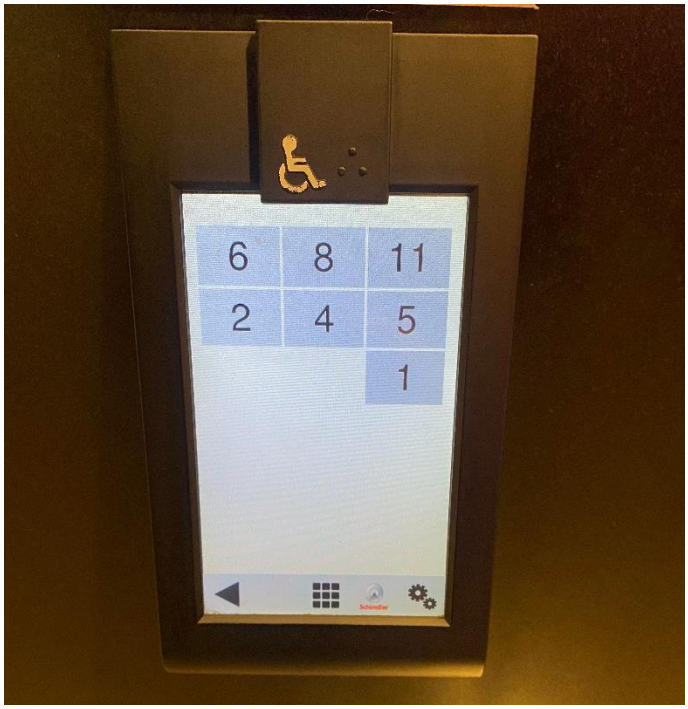


Figure 23: Digital Kiosk

Assurance and Social Engagement: Assurance had a significant influence on social engagement for the CONTROL condition. Being trustworthy and being polite is important for human concierges and has an impact on social engagement. This could be possible because along with human staff, a concierge desk usually also has a digital board (digital assistance) through which customers can find information. Therefore, when participants evaluated the service quality of human concierge staff, they also considered the digital boards in their evaluation. This indicates that the professionalism, credibility and friendliness of the human staff along with the performance of technologically advanced tools influence users' evaluation of service quality. This then makes the users comfortable enough to share their passion for the technology available at the concierge desk with their friends. In a study by Rao and Shu (2013), it was observed that front office staff should be proficient in using advanced technology to

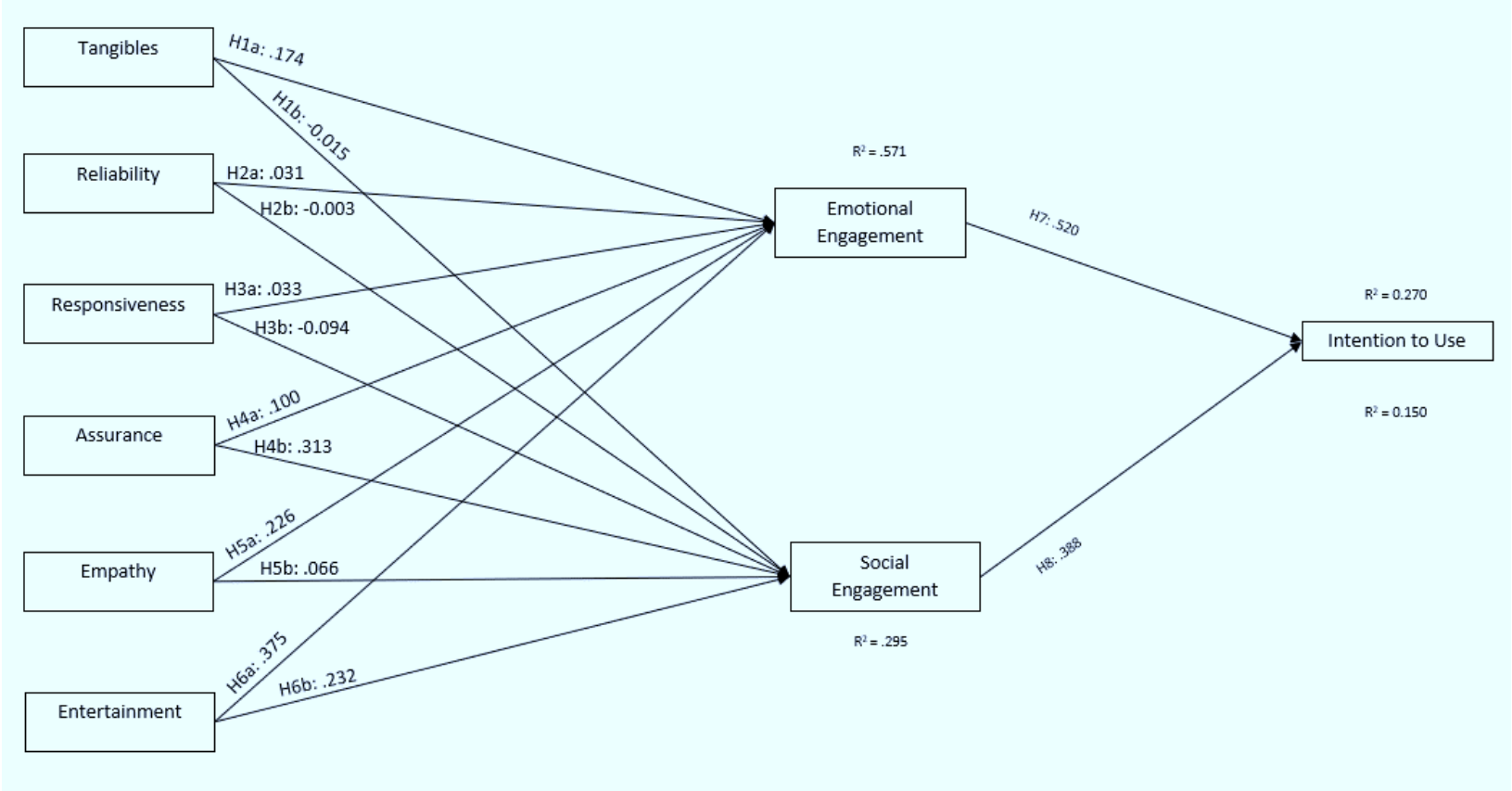
improve their performance such as making room reservations. This inspires trust and credibility in the customers (Rao and Sahu, 2013). Thus, organisations should offer customers a wide variety of communication channels at the front desk such as digital boards and ipads to match the preference of a diverse customer population. Additionally, frontline service employees must be provided with adequate training to use these digital resources.

Emotional Engagement and Intention to use: As expected, emotional engagement is strongly linked with users' intention to use the concierge services. This means if the consumers are emotionally invested in an organisation then they are more likely to reuse their services. Literature has shown emotions to have a significant influence on consumers' behavioural intention (Ratnasari et al. 2020). As per social cognition theory, if a person is perceived as warm, they are more likely to evoke positive emotions (Van Doorn et al. 2017). Thus, managers must ensure they pay close attention to the emotions that are evoked during service interaction (Yang et al. 2021). They must train the frontline service employees to be empathetic and entertaining to emotionally engage customers. Additionally, during the recruitment process, empathy should be a key consideration in the hiring of frontline employees.

Social Engagement and Intention to use: Behavioural intentions are not just the intention to use the services but also include telling others about their experience with a product or service. Recommendations made to others are largely influenced by customers' satisfaction, and they are satisfied when the service quality meets their expectations (Ratnasari et al. 2020). Thus, providing superior service quality is key to socially engaging the customers. One way of providing superior service quality is by assuring the customers about the quality of the service. By incorporating these variables in service quality, managers will be able to ensure that customers are socially engaged and would use the human concierge services

5.6 RESULTS AND DISCUSSION FOR SERVBOT

Figure 24: SERVBOT Model



5.6.1 Results for H1a-H8 for SERVBOT – Emotional Engagement

Table 11 shows the key results for the SERVBOT condition. The results are partly in line with past research, for example, a social robot concierge should be able to assure customers about service quality and it should be able to entertain them to engage them emotionally. The following are some of the key findings:

1) **H1a**: There is no significant relationship between tangibles and emotional engagement and thus, H1a is rejected. Previous studies have not explored this relationship; however, scholars have suggested that there is a significant relationship between tangibles and customer engagement (Puriwat & Tripopsakul 2014). As mentioned in the literature review, scholars have explained cognitive, affective, behavioural and social as dimensions of customer engagement (Islam et al. 2019; Brodie et al. 2011). Therefore, the results provide new insight and suggest that there is a significant difference between emotional and customer engagement.

2) **H2a**: There is no significant relationship between reliability and emotional engagement. Thus, H2b is rejected. Based on an extensive review of the literature, there are no empirical studies that examine this relationship. The 'reliability' of a service provider is viewed as an underlying factor leading to engagement. However, in the case of the social robot being reliable does not translate into a state of emotional engagement for the users. Thus, users might find Pepper robot to '*be capable of doing tasks in time*', but that may not be sufficient to get concierge-users 'involved' or 'fully absorbed' in the interaction and drive emotional engagement. The robot is "expected" to complete the task efficiently especially the simple tasks, for example, quick service characterised with low expectations (Tuomi et al. 2021). This extends on the current literature and suggests that while all the SERVQUAL dimensions are important in influencing customer satisfaction, they have limited impact in influencing emotional and social engagement

3) **H3a**: There is no significant relationship between responsiveness and emotional engagement and thus, H3a is rejected. Similar to reliability and tangibles, previous studies did not test the relationship between responsiveness and emotional engagement. The responsiveness of the service provider (i.e., how quick are they at helping customers and responding to their needs or requests) is linked to customer engagement (Roy et al. 2020). For example, in a hotel, if a

bell boy came running to help the customer during rain, gave them an umbrella and help them dry, the customer would feel happy and cared for. They would appreciate that the bell boy was so quick at helping them. However, the study shows that the responsiveness of the robot does not shape emotional engagement because a robot is 'expected' to be responsive. And the results indicate this does not drive engagement as it is considered as completing a "task". It is important to remember that Pepper is also not advanced enough to be able to help the customers like the bell boy would and the respondents would have been able to perceive that. Thus, they only considered it to fulfil simple tasks (Tuomi et al. 2021).

4) **H4a**: There is no significant relationship between assurance and emotional engagement and thus, H4a is rejected. Previous researchers looked at assurance as a tool to enhance emotional engagement (Lo et al. 2015). They found assurance to have an insignificant impact on affecting consumers' positive emotions because attributes of assurance are the basic expectation that customers of hotel spas and five-star hotel resorts have (Lo et al. 2015). Similarly, customers expected the human concierge to provide an assurance of safety, privacy and quality service which increases their trust in the service provider. Thus, it did not lead to feelings of happiness, excitement and fulfilment. Izogo (2016) looked at assurance and reliability as the two constructs of service quality but they examined their influence on customer loyalty. Additionally, they did not find an assurance to be a predictor of customer loyalty (Izogo, 2017). Thus, the findings provide a new contribution to understanding the relationship between the two constructs, assurance and emotional engagement.

5) **H5a**: There is a significant relationship between empathy (b= 0.226, p=0.020) and emotional engagement and thus, H5a is accepted. Previous research shows emotional engagement is driven by being empathetic and it is often a dependent variable in a service interaction context (Leite et al. 2011). Previous studies have emphasised that empathy is essential to building a relational connection between front line service employees and the customer (Varca 2009) (Gorry & Westbrook, 2011). If social robots are employed as concierges, then they will be expected to interact with humans in an empathetic way as well and possess the same capabilities as the human concierge (Niculescu et al. 2013).

6) **H6a**: The results show a significant relationship between entertainment (b=0.375, p=0.000) and emotional engagement. Thus, H6a is accepted. In hospitality, service robots are employed to provide basic information and to entertain guests (Mele et al. 2020). The interaction then

evokes a positive feeling. This is also supported by studies in advertising where entertainment is treated as a predictor of emotional response (Jung et al. 2011). These finds are consistent with those of Ostrowski et al (2021) and confirm that social robots are effective in emotionally engaging users. This study further adds to the literature as previous researchers have called for studies with entertaining and useful interaction scenarios and understanding customers understanding of the robot (Aaltonen et al. 2017).

7) **H7**: There is a significant relationship between emotional engagement (b=.520, p=0.000) and intention. Therefore, H7a is accepted. This is in line with previous studies. Previous studies have shown that emotional engagement is a predictor of behavioural intention (Gallup Consulting 2009 cited in Sashi 2012).

Table 11: SERVBOT Multiple Regression: Emotional Engagement

Variables	**Regression (beta)**	**R^2**	**t**	**Sig.**
		0.571		
Tangible → Emotional Engagement	0.174		1.497	1.380
Reliability → Emotional Engagement	0.031		0.304	0.762
Responsiveness → Emotional Engagement	0.033		0.340	0.735
Assurance → Emotional Engagement	0.100		1.011	0.315
Empathy → Emotional Engagement	0.226		2.366	0.020**
Entertainment → Emotional Engagement	0.375		3.948	0.000***
Emotional Engagement → Intention to use	0.520	0.270	5.833	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

5.6.2 Results for H1b-H8 for SERVBOT – Social Engagement

Table 12 shows the key results for the SERVBOT condition. The results confirm some new findings, for example, H1b and H4b have a significant relationship with social engagement when a service is delivered by a human concierge. The following are some of the key findings:

1) **H1b**: There is no significant relationship between tangibles and social engagement and thus, H1b is rejected. Some scholars have suggested that there is a significant relationship between tangibles and customer engagement (Puriwat & Tripopsakul 2014). However, they treated customer engagement as one construct but the literature review shows that customer engagement is multidimensional and consists of cognitive, affective, behavioural and social (Vivek et al. 2012). Other scholars have looked at the influence of service quality on customer engagement (Islam et al. 2019). However, they also treated service quality as one construct, but the literature review shows that service quality is multidimensional. Thus, the findings provide a new contribution to understanding customer engagement, service quality and their relationship. The findings indicate that both customer engagement and service quality should be treated as multi-dimensional in a front line service setting.

2) **H2b**: There is no significant relationship between reliability and social engagement and thus, H2b is rejected. There is limited empirical support to the significance of the relationship. Previous studies have looked at the influence of service quality on customer engagement (Islam et al. 2019; Abror et al. 2019) or the influence of service quality on e-engagement (Promtep et al. 2019). E-engagement consisted of focused attention and satisfaction but not social engagement (Promtep et al. 2019). There are no studies that have tested the influence of reliability and social engagement. As mentioned in the literature customer engagement is multi-dimensional and social engagement is one of those dimensions. Thus, the findings indicate that influence on social engagement must be tested instead of just testing customer engagement.

3) **H3b**: There is no significant relationship between responsiveness and social engagement and thus, H3b is rejected. Similar to reliability and tangibles, previous studies did not test the relationship between responsiveness and social engagement. The studies only looked at the influence of service quality on customer engagement (Abror et al. 2019). However, customer engagement is multi-dimensional, and the findings suggest there is a difference between emotional engagement and social engagement. Thus, the influence of service quality on social engagement must be studied.

4) **H4b**: There is a significant relationship between assurance (b=0.313, p=0.010) and social engagement and thus, H4b is accepted. Hotel guests expect a certain level of service that symbolises hotel quality and this is manifested in employees' dependence and credible skills

(Prentice et al. 2020a). Once they are assured about service quality, they are more likely to share their experience with others. In a study by Rao and Shu (2013), it was observed that front office staff should be proficient in using advanced technology to improve their performance such as making room reservations. This inspires trust and credibility in the customers. Thus, the findings align with previous findings as it shows that assurance is an important dimension in customers' evaluation of service quality and service robots are able to provide that assurance to customers. Further, the findings add to the customer engagement literature by highlighting the difference between customer engagement and social engagement and underlining the positive influence of assurance on social engagement.

5) **H5b**: There is no significant relationship between empathy and social engagement and thus, H5b is rejected. Although empathy has been shown to impact emotional engagement, there is very little empirical support for empathy and social engagement relationships in the service quality literature. Previous studies have found that empathy has a positive effect on patients' loyalty and customer Behaviour in a hospital (Zhang et al. 2018). However, the focus of this study was on how empathy influences patients' Behaviour to revisit the hospital for their treatment, not on whether they would share their perception about the hospital with others (Zhang et al. 2018). Thus, this finding advances the understanding of empathy by exploring its relationship with social engagement. It differentiates between social engagement and customer engagement and social engagement and emotional engagement.

6) **H6b**: The results show a significant relationship between entertainment (b=0.232, p=0.046) and social engagement. Thus, H6b is accepted. Literature has shown that enjoyment is crucial for creating engagement and connectedness (Perski et al. 2017; Csikszentmihalyi & Csikzentmihaly 1990). Past research shows that eye contact, gaze and gestures are forms of communication that drive engagement (Ahmad et al. 2017). The findings indicate that non-verbal communication of social robot concierge such as eye contact, gesture etc., used to evoke enjoyment was successful in entertaining the users. When the social robot concierge delivered the service, verbal communication (use of humour) also created a feeling of enjoyment. These results align with the past research which shows humour to be a significant tactic to produce positive affect and social cohesion in others (Ge & Gretzel 2018). Thus, entertaining customers by using verbal and non-verbal communication is a useful tactic to entertain customers by social robot concierges.

7) **H8**: There is a significant relationship between social engagement (b=0.388, p=0.000) and intention. Therefore, H7b is accepted. Literature has shown that memorable experiences enable attendees to connect with others, the community and the world (Carissa et al. 2020). These memorable experiences have a positive influence on behavioural intention (Carissa et al. 2020). Further, it was found that social engagement influences individual and community level behavioural change (Molina et al. 2018). Thus, the finding confirms that social engagement impacts behavioural intention

Table 12 SERVBOT Multiple Regression: Social Engagement

Variables	**Regression (beta)**	**R^2**	**t**	**Sig.**
		0.295		
Tangible → Social Engagement	-0.015		-0.105	0.917
Reliability → Social Engagement	-0.003		-0.026	0.979
Responsiveness → Social Engagement	0.094		0.810	0.420
Assurance → Social Engagement	0.313		2.621	0.010**
Empathy → Social Engagement	0.066		0.568	0.572
Entertainment → Social Engagement	0.232		2.023	0.046**
Social Engagement → Intention to use	0.388	0.150	4.033	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

5.6.3 Discussion of results for SERVBOT

Empathy and Emotional Engagement: Empathy and emotional engagement had a significant relationship with SERVBOT. The results indicate that for a social robot, being empathetic is essential to emotionally engage its users. Previous research shows emotional engagement is driven by being empathetic and it is often a dependent variable in a service interaction context (Leite et al. 2011). Context is important as empathy is "an ability to understand a person's emotional reaction with the context (Deutsch & Madle 1975). If social robots are employed as concierges, then they will be expected to interact with humans in an empathetic way and possess the same capabilities as the human concierge (Niculescu et al. 2013). This is supported

by Social Cognition Theory according to which if a social robot is being helpful and caring, it will positively influence the users' behaviour. Empathy is integral to successful human-robot interactions as it facilitates the creation and maintenance of social relationships (Paiva et al. 2018). Moreover, it is not just important for social robots to understand the users' emotions but also share their own, just like Pepper did in this study (Paiva et al. 2018). Literature has shown that social robots that have human-like features are perceived as more sociable and are easier to connect with emotionally (Kim et al. 2013). An affective robot may use facial expressions and non-verbal expressions to facilitate emotional communication (Cano et al. 2021).

Since social robots are treated as another social entity, it is easier for participants to emotionally connect with them during interactions. In this study, Pepper showed empathy by providing individualised attention to the participants and providing accurate responses to their questions. Further, after answering questions, Pepper asked the participants if there is anything else it could help them with, showcasing that it cared for the participant needs. Pepper has advanced voice recognition which meant it understood the questions asked by all the participants clearly and provided the correct answers. Additionally, it added “Hope that helps” after answering a question showcasing that it truly wanted to help the participant. Pepper made the participant feel at ease when the participant asked a simple question by responding empathetically. For a customer this is important as the concierge should not only be able to provide a good service but also be polite and friendly (Niculescu et al. 2013). The helpfulness or willingness of employees to spend extra time and effort to help a customer is a cause of delight and customer delight forms the basis on which front-line employees’ performance is assessed (Brady & Cronin Jr 2001). Thus, this finding must be noted by managers looking to create empathetic experiences for their customers. Additionally, social robot designers must keep this in mind while designing robots for frontline service settings.

Entertainment and Emotional Engagement: Entertainment had a significant influence on emotional engagement for SERVBOT. This is expected as entertainment depends upon generating emotional engagement with audiences such as laughter, sadness or thrills (McKee et al. 2014). In hospitality and retail, service robots are employed to provide basic information and to entertain guests (Mele et al. 2020; Niemelä et al. 2017). The human-robot interaction then evokes a positive feeling This is also supported by studies in advertising where entertainment is treated as a predictor of emotional response (Jung et al. 2011). For example, entertaining ads evoked more positive feelings. Thus, this shows that entertainment is a

predictor of emotional engagement (Macasero et al. 2015). Additionally, consumers' emotional engagement is at the core of the strategy of using humanoid robots (Langen & Heinrich 2019). Embodied or humanoid robots encourage customers to be more sociable and bond with them (De Gauquier et al. 2021).

In this study, Pepper entertained the participants by conversational and non-verbal communications. It evoked humour using gestures to keep the participants entertained and engaged during the interaction. The scenario used in the study was designed keeping in mind the above-mentioned assumptions. It incorporated the use of humour to keep the participants entertained. The original assessment tool – SERVQUAL – does not include entertainment as a dimension of service quality. However, being entertaining is a key characteristic that is used in robots, especially in retail settings (Aaltonen et al. 2017). Based on these findings, social robots in the frontline service setting should use verbal and non-verbal cues to be entertaining. Verbal cues such as telling jokes to the customers and non-verbal cues such as hand movement, gestures, eye-gaze should be used to entertain customers. Therefore, social robot designers and managers need to consider these factors when developing and deploying social robots for the service environment.

Assurance and Social Engagement: The results suggests that if the social robot is assuring, it means participants trust the robot to be safe and social robots can provide a good service. This is because robots can develop a sense of trust with customers in the technical quality of the service i.e., the core service will be delivered effectively, efficiently, and correctly (Lu et al. 2020). A social robot needs to follow rules acceptable in human-human interactions such as being polite. In fact, if service robots use literal language, it is beneficial for the service encounter evaluations as it is more congruent with conversational norms in the service encounter (Choi et al. 2019). As noted in the literature, human beings tend to apply the same conversational norms that govern human communications to social robots. The social robot, Pepper, used in the study was programmed to use literal language instead of figurative language while conversing with the participants. This could also be a reason amongst others for participants to highly evaluate the politeness of the social robot.

Therefore, politeness, trust and safety are key indicators of the robot's assurance and these drive social engagement. This means that users will be more comfortable with including others in the interaction with a social robot if they trust the robot and feel safe with it. Therefore,

instead of using virtual avatars, managers should use social robots to establish trust and connection with the customers (Kidd & Breazeal, 2008).

Entertainment and Social Engagement: Entertainment was also found to have a positive influence on social engagement in SERVBOT. This could be possible because of a combination of two reasons: first, the robot used humour to entertain and engage participants and secondly, the robot maintained eye contact, gaze and used gestures while interacting with the participants. Together, the use of verbal (humour) and non-verbal communication (eye contact, gaze and gestures were successful in socially engaging the participants.

In this study, to evoke entertainment humour was used for the interaction. Humour is one of the most common ways to produce a positive affect on others (Ge & Gretzel, 2018). The use of humour to entertain the participants showed a positive influence on social engagement which means the customers would be more likely to engage with the robot socially. It increases likeability and fosters social cohesion, and it is a form of entertainment in advertising. Humour also leads participants to behave more socially during the interaction (Morkes et al. 1999). In this study, the robot used subtle humour and situation-specific jokes to engage and entertain the participants, which has been proven effective in past research (Ceha et al. 2021). The robot did not overuse humour as it has been shown to negatively impact the participants' experience and can be perceived as distracting (Ceha et al. 2021) Humour was successfully used to create a relaxed social exchange. Additionally, humour was used in the middle of the interaction rather than at the beginning which was the case in Mirnig et al (2017) study where they did not find any significant difference in how funny the participants found their unimodal robot to be. Along with the use of humour, Pepper also maintained eye contact with the participants and used its arms while talking. Thus, managers must consider verbal and non-verbal communication both to make the robot more entertaining and make the interaction with users more social.

Emotional Engagement and Intention to Use: As expected, emotional engagement is strongly linked with users' intention to use the robot for concierge services. Previous research in the use of technologies has demonstrated that when product usage engages participants, they view the technology as original and innovative, and it triggers intrinsic motivations (Shen & Eder 2009). Intrinsic motivation has a deeper impact as it helps change the perceptions of users. It is also effective in bringing about a long-lasting behaviour change (Lee & Doh 2012). Thus,

emotionally engaged users are more likely to use technologically oriented products in the future as well (Huang et al. 2013). Managers must focus on the affective process as it influences behavioural intention. If social robots recognise user emotions through facial expressions, physical gestures, eye gaze and speech recognition and respond with affection, then the user's adoption intentions would increase (Lisetti & Schiano 2000). Additionally, previous findings show that if the robot is entertaining, participants will have a positive emotional engagement with them (Khosla & Chu 2013). Thus, managers should employ social robots that are empathetic and entertaining to emotionally engage their customers, which in turn will have a positive influence on the intention to use the robot.

Social Engagement and Intention to Use: Results indicate that social engagement has a significant relationship with intention to use in SERVBOT conditions. This was expected as previous studies have established linkages between the two variables (Vivek et al. 2014, Pap et al. 2017). Individuals who are engaged with the social robot are more likely to take a break from conversing with the robot to talk to others about the robot. It is through this social system that the diffusion and acceptance of technology take place (Rogers 2010). Social engagement not only impacts the use of social robots by current users but also their social networks especially when they can "observe" their peers doing so. As explained by Diffusion of Innovation Theory and TAM, "Observability" instigates conversations and peer discussions, and if the results are visible, the adoption intentions would increase.

5.7 SUMMARY OF RESULTS

Table 13: Summary of results for emotional engagement

Hypothesis	**CONTROL Sig.**	**SERVBOT Sig.**
H1aTAN → EE	0.908	1.380
H2aREL → EE	0.452	0.762
H3a RESP → EE	0.652	0.735
H4a ASS → EE	0.065	0.315
H5a EMP → EE	0.473	0.020**
H6a ENT → EE	0.000***	0.000***
H7 EE → ITU	0.000***	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

Table 14: Summary of results for social engagement

Hypothesis	CONTROL Sig.	SERVBOT Sig.
H1bTAN → SE	0.029**	0.917
H2bBREL→ SE	0.920	0.979
H3b RESP → SE	0.709	0.420
H4b ASS → SE	0.032**	0.010**
H5b EMP → SE	0.109	0.572
H6b ENT → SE	0.668	0.046**
H8 SE → ITU	0.000***	0.000***

*Dependent variable Emotional engagement **significant at 0.05*

*Dependent variable Intention to use ***significant at 0.000*

5.8 IMPLICATIONS

The findings of this study provided answers the research questions highlighted in the literature review section. It highlighted the key differences between the service quality of social robots and human concierge. The findings provided empirical evidence of the social robot's performance concierge in a low contact service environment and what are the key service quality variables that impact social and emotional engagement. The answers to these questions are discussed in academic and managerial implications.

5.8.1 Academic Implications

The model extends the service quality and HRI literature by providing a conceptual framework to evaluate the service quality of a social robot in frontline service settings. The conceptualisation of the SERVBOT model is the first framework in the field and it provides insights into the first impressions of the participants interacting with the social robot in a service setting. The study provides a benchmark for evaluating the service quality of a social robot vs the service quality of a human. To this date, researchers have not explored a service model to understand the performance of the social robot.

The main contribution of the study to the literature is the evidence it provides of the importance of including entertainment, social engagement, and emotional engagement in the service

quality model. These three factors are critical for the adoption of social robots (e.g., entertainment, emotional engagement, and social engagement). The findings indicate that empathy and entertainment drive emotional engagement when a social robot concierge delivers the service. Additionally, assurance and entertainment significantly influence social engagement in a social robot delivered service environment. The findings also show that both emotional engagement and social engagement drive intention to use the robot.

Another key contribution from the study is, it was able to highlight the differences between the human service quality and the social robot's service quality on social engagement. There is a significant relationship between the **tangibles** and social engagement when the service is delivered by a human concierge but not for a social robot. This indicates that customers evaluate the physical facilities and equipment along with the appearance of the human staff, but this is not important for the social robot concierge. The reason for this is explained by the influence of Uncertainty Reduction Theory. It could be possible that the users' perception of social robots was influenced by science fiction movies and books. The Uncertainty Reduction Theory shows that during first interactions, people try to seek as much information as they can about the other party. This information is then processed and organised as per the social categories which help them make predictions about others. In this study, even though the participants had not previously interacted with the social robot, but their expectations were shaped by science fiction movies and books such as Wall-E, iRobot, etc. That is, the participants expected that robots to have advanced technology such as being able to analyse the human biometrics and understand the individual's emotional state (i.e., happy, sad, angry, excited). Unfortunately, Pepper does not have these functions and participants did not view these tangibles to be appealing enough to share with their peers. Therefore, it adds to the literature by confirming that tangibles such as visually appealing, being capable, having the latest technology and being professional does not impact social engagement when service is delivered by humanoid social robots.

The framework also provides researchers insights into the design of social robots specifically for both verbal and non-verbal communications. The development of the SERVBOT scale and its empirical validation points to the usefulness of evaluating the service quality of social robots in a frontline service setting. The study has methodological significance and contributes to the services marketing literature by providing empirical data with high ecological validity.

5.8.2 Managerial Implications

The findings of this study have implications for service providers and designers who are looking at employing social robots to undertake frontline tasks. The research has highlighted and confirmed aspects of a robot-delivered service that generate emotional and social engagement. In the traditional service setting with a human-delivered service, five dimensions of service quality are assessed. However, to assess the service quality of a social robot concierge, entertainment is added to the five original SERVQUAL dimensions. In the case of social robots as a service provider, being empathic and entertaining is more important to emotionally engage the customer. Additionally, being assuring and entertaining is vital for social engagement. Thus, this study empirically addresses the issue of which service quality dimensions should be prioritised when employing social robots and how to evaluate their service quality over time. This is crucial as carefully planned and strategic deployment of social robots is essential to succeeding and gaining a competitive advantage. Further, it can help managers in optimizing the benefits of using robots, improving efficiency, and preventing service failures.

Previously, there had been unrealistic expectations around the expectation of benefits from using social robots (Pino et al. 2015). The findings demonstrate that in the context of performing frontline tasks in a concierge setting, customers are emotionally engaged due to the robot being **empathetic and entertaining** (Čaić et al. 2019). If a social robot can demonstrate its affective capability and reflect empathic behaviours such as listening or responding appropriately, it creates the scene for building a rapport with the user (key antecedents of emotional engagement) (Gaytan & McEwen 2007). Interestingly, the robot does not have to display its cognitive capabilities to emotionally engage users. This suggests that customers *expect* the robot to be efficient with completing the task and this validates the above discussed findings. Thus, managers must ensure that social robots are empathetic and entertaining when they are employed in a service setting in order to emotionally engage the customers. However, this is in addition to them being "Competent" and providing assurance about a high service quality. This can be achieved by programming the robot to be funny and ensuring empathetic responses are provided to the customers. The social robots' voice and emotion recognition will need to be strong for it to be empathetic and provide accurate and appropriate responses to the customers.

The results indicate that **assurance** is important for social engagement whether that's a human concierge or a social robot concierge. This is a noteworthy finding because being able to provide assurance about the service quality is critical for customers before they share their experience with others. The findings suggest that if a social robot is assuring, users are more likely to share their experience of interacting with the social robot. This is supported by Social Cognition Theory as being Competent is a universal dimension of social cognition and it drives engagement. This is an important finding for managers because if they are employing robots for a certain task then these social robots need to be Competent in fulfilling those tasks. In this study, the results indicate users trusted the robot to perform the tasks competently and as per their expectations in a low contact service setting (i.e., minimal contact with basic questions such as how do I use the lift?). The social robot did not just provide functional benefits but also socio-emotional benefits which made the interaction more engaging and enjoyable. This was achieved using both verbal and non-verbal communication as social engagement can be nurtured through both. It creates a social connection not just between the brand and customers but also in-between customers This study used a multimodal approach by combining visual and task-related features such as eye contact, gaze, arm movement and touching the head to think. This approach was used to socially engage the users, for example, eye contact and gaze have been found to be the most common units for measuring social interaction and communication (Ahmad et al. 2017). Further, gestures drive engagement (Ahmad et al. 2017). Thus, if managers want to employ social robots as concierges, then the social robots must be capable of showing non-verbal communication along with verbal communication. Additionally, they should be able to perform the assigned tasks with expertise.

The findings show that **entertainment** influences social and emotional engagement. This was true not just for the social robot but also for the human concierge. This supports the Computer Are Social Actors (CASA) paradigm of the social robot being treated as another social entity. However, the difference is that when entertainment is used by the human concierge, it influences emotional engagement. Whereas when entertainment is used by social robot concierge, it influences both emotional and social engagement. Therefore, this proves that interaction with a social robot is indeed a social activity for its users and it evokes a positive affect in them (Weiss et al. 2008). Interacting with a social robot creates excitement and users enjoy their interaction with it. At this point, it is important to note that, in this study, the social robot used humour to entertain the participants, but the human concierge may or may not have. This finding suggests that when a social robot uses humour to entertain its users, the social

activity becomes even more enjoyable, and users feel like sharing this excitement with their social network. The result is in line with previous studies where entertainment robots increased socialization and social activity (Tamura et al. 2004) and enhanced emotional engagement (Jones & Deeming, 2007; Neerincx et al. 2021). Thus, managers should program the social robots to be funny and entertaining to make the customer experience more enjoyable which will result in social and emotional engagement.

For human front line service employees, managers should recruit employees who have a natural ability to use humour in conversation and recognize when to use humour in service encounters. Employees should also be trained to use appropriate workplace humour. Using humour to entertain customer will make the customer service experience more enjoyable which in long term provide the firm with a source of competitive advantage.

Shopping malls and retail outlets compete on providing a range of entertainment activities (Lotz et al. 2010). Despite a comprehensive review of entertainment activities (Elmashhara & Soares 2019), not many business researchers in retail marketing have included robots as potential entertainers. Entertainment is strongly linked to customers' positive emotions, which play a critical role in the enactment of consumption-related behaviours, such as purchases (Kim & Ko 2010; Jung et al. 2011). Thus, for experiential services, which provide a hedonic experience, customers will not just make a cognitive evaluation of the service (e.g. reliability, responsiveness and assurance) but also evaluate the entertainment value of the experience. It is worthwhile for managers and social robot designers to use robot-enacted entertainment to trigger positive emotions and increase customer-customer interactions.

It is important to note that this is the first time the participants interacted with the social robot and therefore, **the novelty factor** was quite high. In the long run, when social robots become a common form of communication, the results could be different. Customers can change their perceptions, views, and responses towards the robots after a long-term interaction such as during a first interaction, customers might find Alexa as exciting but the same interaction over a long term would become common and thus, not receive much attention (Lu et al. 2020). To create a less alienating and more human-like experience, social robots will have to be reliable, human-like, responsive, assuring, empathetic, and entertaining. The extent to which social robots can excel at these will be the determining factor in their adoption and acceptance.

5.9 CONCLUDING COMMENTS

The analysis of results in this chapter shows a considerable amount of empirical evidence to treat social engagement and emotional engagement independently. The analysis of the results was rigorous and shows that by maximising emotional and social engagement, managers can positively influence the intention to use the social robot. Additionally, the results also indicate the different service quality variables that have a positive influence on social and emotional engagement when the service is delivered by a human concierge and a social robot concierge. For example, an entertaining human concierge will be able to emotionally engage the customers which in turn will impact their intention to use the concierge favourably. This is an important finding for the service quality literature as entertainment was not included in the original SERVQUAL dimensions. Thus, managers must keep this factor in mind while recruiting front line service employees. As technology advances, technologically advanced customers expect to interact with digital interfaces such as chatbots and digital kiosks in the frontline service environment. Therefore, apart from maintaining a high service quality standard and professionalism of employees, managers must also provide customers with alternative ways of receiving information.

Further, the results indicate that social robots need to be empathetic and entertaining to emotionally engage their users. Thus, designers and managers must incorporate the technology that enables social robots to understand human emotions and respond appropriately. Additionally, social robots must be able to entertain their users, for example, by cracking appropriate jokes during the interaction. Further, if the social robot is perceived as entertaining then the users are more likely to discuss the social robot with their peers and refer it to their friends and family. However, the evidence shows that along with being entertaining, assurance of service quality is also necessary for social engagement. Thus, managers must not neglect the importance of assuring the customers about a high-quality service standard even though the service is delivered by social robots.

This chapter has provided an in-depth discussion of the results obtained from the data analysis. It also provided implications of the results in two categories, conceptually and managerially. Chapter 6 will provide a conclusion to this master's research project along with limitations and future research directions.

6 Conclusion

The study investigated service quality using SERVBOT dimensions and found empathy and entertainment as key to driving emotional engagement. Additionally, assurance and entertainment is key to socially engaging customers. In contrast, when the service is delivered by human concierge, it is entertainment that influences emotional engagement and assurance that influences social engagement. Consequently, emotional engagement and social engagement have a significant impact on intention to use the social robot and human concierge in a frontline service setting. Therefore, the SERVBOT model is a theoretical model that could be used to measure social robots' service quality and compare it with that of humans. This study is the first to propose a model to measure how the social robot has performed in providing the service (e.g., hotels that use social robots to checkout customers should use SERVBOT to evaluate the quality of the service).

This study presents a framework for managers to understand the strengths and weaknesses of employing social robots and the areas they can be used in to enhance organisational efficiency and improve customer engagement. This provides businesses with opportunities to track the quality of the robot's service delivery over time. Thus, the study suggests that less complex tasks such as providing information at the concierge desk can be completed by robots like Pepper (e.g., customers are likely to use the robot in the future at the concierge desk).

Like other studies in the field, there are methodological and implied ***limitations*** within the study. The study is limited to only one setting (university campus) with undergraduate students. Additionally, this study focused on service quality provided by a specific type of social robot (e.g., Pepper). Moreover, this study was based on the perception of a sample of students at a given point in time. The students have never seen or interacted with Pepper, and the novelty effect may have influenced the results. Since the sample included young and university-educated individuals, it could affect the generalisability of the results. It could have also led to the Hawthorne effect which means the participant who is trying to please the researcher could have answered everything positively and favourably. Furthermore, the needs and requirements of the student cohort would differ substantially from a business traveller.

Therefore, ***future studies*** should explore the use of social robots with other demographics. In addition, cultural aspects are worthy to be considered as some countries are less receptive to having robots in customer service roles as compared to others. For example, certain Eastern Asian countries have been known to be more accepting of social robots whereas European countries seem to be less receptive to robot-provided services (Lu et al. 2020). Future studies should compare the use of other types of social robots in other service industries (e.g., restaurants, hotels, airports, etc.).

Thus, future studies should conduct a longitudinal study to control for the novelty effect and track consumer perceptions of SERVBOT over time. Young consumers are more accepting of technology and are more accepting of robots (Liu et al. 2021; May et al. 2017). Thus, future studies should compare the perceptions of the social robot's service quality between different age groups. It would also be interesting to see if the study can be generalised beyond large urban centres. Furthermore, to make the findings more generalisable, more studies should be conducted with business travellers in a realistic setting. The study also did not consider task complexity, future studies should compare SERVBOT in high complex tasks such as tertiary teaching vs low complex tasks such as information desk (or 5-star hotel concierge vs 2-star hotel concierge). Future researchers should conduct experiments comparing Human-Robot-Interaction (HRI), Human-Human-Interaction (HHI), and Human-Human & Robot-Interaction (HHRI) to validate the model. This will provide further validity to the SERVBOT model. To measure the long-term impact of the human and social robot service encounter, future studies should conduct a longitudinal study. This will help identify whether the social robot can build a long-term relationship with the customer. Future studies should also attempt to understand the perception of the more vulnerable population such as seniors or children in similar or different service settings.

This study is the first to propose a SERVBOT model for social robots and researchers should not underestimate the first insights into service robots. The first impression is vital in the service industry, and this is the first time that the customer is meeting the robot. Frontline employees are the first human contact and sometimes even the last, and their interaction with the customer creates a critical impression of the company (Payne & Webber, 2006). Thus, the study provides insights into the robot's ability to provide a basic service and build a relationship with the customer at first sight. It is critical to use a widely accepted service model to measure

service quality (e.g., SERVQUAL) so that researchers and business managers can track the performance of the service robots. Further testing of the SERVBOT is needed to ascertain the validity of the model. Nevertheless, this study has provided a strong theoretical foundation on how a social robot's service quality could be measured.

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Appendices

Appendix A

Consent From

The consent form was as follows:

Pepper the Robot Concierge: It's impact on visitor's satisfaction

Dear Respondent,

This study aims to understand the drivers of consumers' satisfaction based on their interaction with a robot concierge. The research is for academic purposes only. Your participation in this survey is entirely voluntary and you choose to end your participation at any point without prejudice. In this instance, your data will be removed. It will take approximately 10 minutes to complete the survey and there are no right or wrong answers. Please answer all the questions in this survey form and give the response which most accurately reflects your views. Please note that your answers will be aggregated and treated with the strictest confidence.

Completion of the survey will be taken as evidence of consent to participate in this study. Western Sydney University Ethics Approval Number: H13082

I would like to thank you for taking the time to complete the survey. If you have any questions regarding the survey, please contact the researcher:

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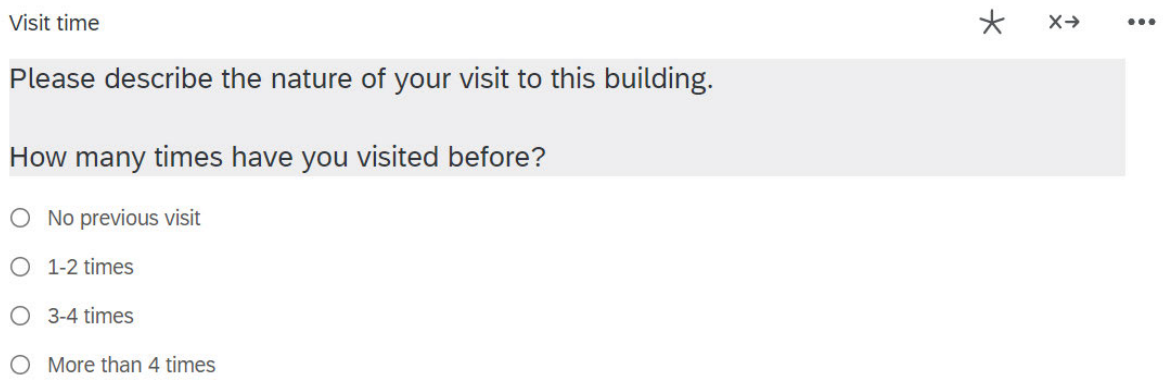
Phone: 02 4736 2493

I am 18 years old and above, and I have read and understood the information above. I would like to participate in this study.

APPENDIX B

Survey Questionnaire – CONTROL



Performance

Please rate the performance of the Concierge:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The Concierge has access to the latest technology	○	○	○	○	○	○	○
The Concierge is visually appealing	○	○	○	○	○	○	○
The Concierge seems to be very capable	○	○	○	○	○	○	○
The Concierge is professional	○	○	○	○	○	○	○

Reliability

Please rate the reliability of the Concierge:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The Concierge is capable of doing tasks in time	○	○	○	○	○	○	○
The Concierge appears to be smart and reassuring	○	○	○	○	○	○	○
The Concierge is dependable	○	○	○	○	○	○	○
The Concierge provides timely services	○	○	○	○	○	○	○

Responsiveness

Please rate the responsiveness of the Concierge:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I do not think the Concierge can perform well at the front desk	○	○	○	○	○	○	○
The Concierge does not provide good service	○	○	○	○	○	○	○
I do not think the Concierge can help customers	○	○	○	○	○	○	○
The Concierge is inarticulate when responding to people	○	○	○	○	○	○	○

Assurance

Please rate the Concierge on the following:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I can trust the Concierge	○	○	○	○	○	○	○
I feel safe with the Concierge	○	○	○	○	○	○	○
I think the Concierge is polite	○	○	○	○	○	○	○
The Concierge can do a good job	○	○	○	○	○	○	○

Empathy

Please rate the Concierge on the following:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The Concierge provides caring and individualised attention to customers	○	○	○	○	○	○	○
The Concierge does not give me personal attention	○	○	○	○	○	○	○
The Concierge does not know what my needs are	○	○	○	○	○	○	○
The Concierge does not have my best interest at heart	○	○	○	○	○	○	○
The Concierge is not available when customers need it	○	○	○	○	○	○	○

EntertainmentValue

the Concierge is:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Entertaining	○	○	○	○	○	○	○
Enjoyable	○	○	○	○	○	○	○
Pleasing	○	○	○	○	○	○	○
Funny	○	○	○	○	○	○	○

Engagement-Social

Please rate your level of engagement with technology:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I would love to show new tech to my friends	○	○	○	○	○	○	○
I would enjoy sharing new technology even more when I am with others	○	○	○	○	○	○	○
Interacting with new technology will be more fun when other people around me do it too	○	○	○	○	○	○	○

EmotionalEngagement

Please rate your level of engagement with the Concierge:

EE1

I felt happy with the Concierge

Never ○ ○ ○ ○ ○ ○ ○ Always

EE2

I felt bored with the Concierge

Never ○ ○ ○ ○ ○ ○ ○ Always

+ Add page break

EE3

I felt excited by the Concierge

Never ○ ○ ○ ○ ○ ○ ○ Always

EE4

I liked hanging out with the Concierge

Never ○ ○ ○ ○ ○ ○ ○ Always

+ Add page break

EE5

I am interested in the work being done by the Concierge

Never ○ ○ ○ ○ ○ ○ ○ Always

Intention

If the same person was available as a concierge how likely are you:

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
To use the concierge's services	○	○	○	○	○	○	○
To plan on using the concierge's services	○	○	○	○	○	○	○
To desire the concierge's services	○	○	○	○	○	○	○

Gen

What is your gender?

- ○ Male
- ○ Female

+ Add page break

Marital

What is your marital status?

- ○ Single
- ○ Married
- ○ Divorced/Widowed
- ○ De facto

Age

What is your age? (years)

- ○ 17 and under
- ○ 18 - 24
- ○ 25 - 29
- ○ 30 - 34
- ○ 35 - 39
- ○ 40 - 44
- ○ 45 - 49
- ○ 50 - 54
- ○ 55 - 59
- ○ 60 - 64
- ○ 65 - 69
- ○ 70 - 74
- ○ 75 and above

Occupation

What is your occupation?

- ○ Student
- ○ Homemaker/Housewife
- ○ Production/Clerical
- ○ Technical/Sales
- ○ Executive/Managerial/Professional
- ○ Self-employed
- ○ Unemployed/Retired
- ○ Others

Income

What is your annual income in AUD?

- ○ $0 - $7,999
- ○ $7,800 - $15,599
- ○ $15,600 - $20,799
- ○ $20,800 - $25,999
- ○ $26,000 - $33,799
- ○ $33,800 - $41,599
- ○ $41,600 - $51,999
- ○ $52,000 - $64,999
- ○ $65,000 - $77,999
- ○ $78,000 - $90,999
- ○ $91,000 - $103,999
- ○ $104,000 - $155,999
- ○ $156,000 - $ 249,999
- ○ Over $250,000

Q20

End of survey.

I would like to thank you for your time for completing the survey.

Press "next" to submit your responses.

APPENDIX C

Survey Questionnaire – SERVBOT

Please describe the nature of your visit to this building.

How many times have you visited before?

- ○ No previous visit
- ○ 1-2 times
- ○ 3-4 times
- ○ More than 4 times

Performance

Please rate the performance of Pepper the Robot:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Pepper demonstrates the latest technology	○	○	○	○	○	○	○
Pepper is visually appealing	○	○	○	○	○	○	○
Pepper seems to be very capable	○	○	○	○	○	○	○
Pepper is professional	○	○	○	○	○	○	○

Reliability

Please rate the reliability of Pepper the Robot:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Pepper is capable of doing tasks in time	○	○	○	○	○	○	○
Pepper appears to be smart and reassuring	○	○	○	○	○	○	○
Pepper is dependable	○	○	○	○	○	○	○
Pepper provides timely services	○	○	○	○	○	○	○

Responsiveness

Please rate the responsiveness of Pepper the Robot:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I do not think Pepper can perform well at the concierge	○	○	○	○	○	○	○
Pepper does not provide good service	○	○	○	○	○	○	○
I do not think Pepper can help customers	○	○	○	○	○	○	○
Pepper is inarticulate when responding to people	○	○	○	○	○	○	○

Assurance

Please rate Pepper the Robot on the following:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I can trust Pepper	○	○	○	○	○	○	○
I feel safe with Pepper	○	○	○	○	○	○	○
I think Pepper is polite	○	○	○	○	○	○	○
Pepper can do a good job at the concierge	○	○	○	○	○	○	○

Empathy

Please rate Pepper the Robot's empathy:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Pepper provides caring and individualised attention to customers	○	○	○	○	○	○	○
Pepper does not give me personal attention	○	○	○	○	○	○	○
Pepper does not know what my needs are	○	○	○	○	○	○	○
Pepper does not have my best interest at heart	○	○	○	○	○	○	○
Pepper is not available when customers need it	○	○	○	○	○	○	○

EntertainmentValue

Pepper the Robot is:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Entertaining	○	○	○	○	○	○	○
Enjoyable	○	○	○	○	○	○	○
Pleasing	○	○	○	○	○	○	○
Fun to use/watch	○	○	○	○	○	○	○

Engagement-Social

Please rate your level of engagement with technology:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I would love to show this robot to my friends	○	○	○	○	○	○	○
I would enjoy this robot even more when I am with other	○	○	○	○	○	○	○
Interacting with this robot will be more fun when other people around me do it too	○	○	○	○	○	○	○

EmotionalEngagement

Please rate your level of engagement with Pepper the Robot:

EE1

I felt happy watching Pepper the Robot

Never ○ ○ ○ ○ ○ ○ ○ Always

EE2

I felt bored with Pepper the Robot

Never ○ ○ ○ ○ ○ ○ ○ Always

EE3

I felt excited by Pepper the Robot

Never ○ ○ ○ ○ ○ ○ ○ Always

EE4

I liked hanging out with Pepper the Robot

Never ○ ○ ○ ○ ○ ○ ○ Always

EE5

I am interested in the work being done by Pepper the Robot

Never ○ ○ ○ ○ ○ ○ ○ Always

Intention

If Pepper the Robot was available as a concierge how likely are you:

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
To use Pepper the Robot's services	○	○	○	○	○	○	○
To plan on using Pepper the Robot's services	○	○	○	○	○	○	○
To desire Pepper the Robot's services	○	○	○	○	○	○	○

Gen

What is your gender?

- ○ Male
- ○ Female

Marital

What is your marital status?

- ○ Single
- ○ Married
- ○ Divorced/Widowed
- ○ De facto

Age

What is your age? (years)

- ○ 17 and under
- ○ 18 - 24
- ○ 25 - 29
- ○ 30 - 34
- ○ 35 - 39
- ○ 40 - 44
- ○ 45 - 49
- ○ 50 - 54
- ○ 55 - 59
- ○ 60 - 64
- ○ 65 - 69
- ○ 70 - 74
- ○ 75 and above

Occupation

What is your occupation?

- ○ Student
- ○ Homemaker/Housewife
- ○ Production/Clerical
- ○ Technical/Sales
- ○ Executive/Managerial/Professional
- ○ Self-employed
- ○ Unemployed/Retired
- ○ Others

Income

What is your annual income in AUD?

- $0 - $7,999
- $7,800 - $15,599
- $15,600 - $20,799
- $20,800 - $25,999
- $26,000 - $33,799
- $33,800 - $41,599
- $41,600 - $51,999
- $52,000 - $64,999
- $65,000 - $77,999
- $78,000 - $90,999
- $91,000 - $103,999
- $104,000 - $155,999
- $156,000 - $ 249,999
- Over $250,000

Q20

End of survey.

I would like to thank you for your time for completing the survey.

Press "next" to submit your responses.

APPENDIX D

Multiple Regression – CONTROL

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance[b]	.	Enter

a. Dependent Variable: TEngageSocial

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.430[a]	.185	.147	1.09500	.185	4.950	6	131	.000

a. Predictors: (Constant), TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.611	6	5.935	4.950	.000[b]
	Residual	157.072	131	1.199		
	Total	192.683	137			

a. Dependent Variable: TEngageSocial

b. Predictors: (Constant), TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.662	.836		3.183	.002
	TPerf	.417	.188	.275	2.210	.029
	TRelia	-.017	.170	-.013	-.101	.920
	TResponsiveness	-.041	.109	-.036	-.373	.709
	TAssurance	.392	.181	.279	2.163	.032
	TEmpathy	-.218	.135	-.164	-1.616	.109
	TEntValue	-.056	.131	-.048	-.430	.668

a. Dependent Variable: TEngageSocial

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance[b]	.	Enter

a. Dependent Variable: Emotional engagement

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.732[a]	.536	.515	.81016	.536	25.217	6	131	.000

a. Predictors: (Constant), TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	99.308	6	16.551	25.217	.000[b]
	Residual	85.982	131	.656		
	Total	185.290	137			

a. Dependent Variable: Emotional engagement

b. Predictors: (Constant), TEntValue, TResponsiveness, TEmpathy, TPerf, TRelia, TAssurance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.627	.619		-1.013	.313
	TPerf	.016	.139	.011	.116	.908
	TRelia	.095	.126	.072	.754	.452
	TResponsiveness	.036	.080	.033	.453	.652
	TAssurance	.249	.134	.181	1.859	.065
	TEmpathy	.072	.100	.055	.719	.473
	TEntValue	.586	.097	.504	6.036	.000

a. Dependent Variable: Emotional engagement

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Emotional engagement[b]	.	Enter

a. Dependent Variable: TIntention

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.605[a]	.366	.361	.91415	.366	78.418	1	136	.000

a. Predictors: (Constant), Emotional engagement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	65.532	1	65.532	78.418	.000[b]
	Residual	113.651	136	.836		
	Total	179.183	137			

a. Dependent Variable: TIntention

b. Predictors: (Constant), Emotional engagement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.585	.355		7.286	.000
	Emotional engagement	.595	.067	.605	8.855	.000

a. Dependent Variable: TIntention

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEngageSocial[b]	.	Enter

a. Dependent Variable: TIntention

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.295[a]	.087	.080	1.09678	.087	12.956	1	136	.000

a. Predictors: (Constant), TEngageSocial

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.585	1	15.585	12.956	.000[b]
	Residual	163.598	136	1.203		
	Total	179.183	137			

a. Dependent Variable: TIntention

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.049	.454		8.911	.000
	TEngageSocial	.284	.079	.295	3.599	.000

a. Dependent Variable: TIntention

APPENDIX E

Multiple Regression – SERVBOT

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance[b]	.	Enter

a. Dependent Variable: TEmotionalEngagement

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.719[a]	.517	.483	.88658	.517	15.492	6	87	.000

a. Predictors: (Constant), TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	73.062	6	12.177	15.492	.000[b]
	Residual	68.383	87	.786		
	Total	141.446	93			

a. Dependent Variable: TEmotionalEngagement

b. Predictors: (Constant), TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.833	.699		-1.191	.237
	TPerformance	.240	.160	.174	1.497	.138
	TReliability	.044	.145	.031	.304	.762
	TResponsiveness	.032	.095	.033	.340	.735
	TAssurance	.119	.118	.100	1.011	.315
	TEmpathy	.289	.122	.226	2.366	.020
	TEntertainment	.418	.106	.375	3.948	.000

a. Dependent Variable: TEmotionalEngagement

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEmotionalEngagement[b]	.	Enter

a. Dependent Variable: TIntention

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.520[a]	.270	.262	1.28845	.270	34.028	1	92	.000

a. Predictors: (Constant), TEmotionalEngagement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	56.491	1	56.491	34.028	.000[b]
	Residual	152.729	92	1.660		
	Total	209.220	93			

a. Dependent Variable: TIntention

b. Predictors: (Constant), TEmotionalEngagement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.433	.602		2.381	.019
	TEmotionalEngagement	.632	.108	.520	5.833	.000

a. Dependent Variable: TIntention

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance[b]	.	Enter

a. Dependent Variable: TEngagement_social

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.544[a]	.295	.247	1.10437	.295	6.080	6	87	.000

a. Predictors: (Constant), TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.492	6	7.415	6.080	.000[b]
	Residual	106.108	87	1.220		
	Total	150.600	93			

a. Dependent Variable: TEngagement_social

b. Predictors: (Constant), TEntertainment, TEmpathy, TReliability, TResponsiveness, TAssurance, TPerformance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.838	.871		.962	.339
	TPerformance	-.021	.200	-.015	-.105	.917
	TReliability	-.005	.181	-.003	-.026	.979
	TResponsiveness	.096	.118	.094	.810	.420
	TAssurance	.386	.147	.313	2.621	.010
	TEmpathy	.086	.152	.066	.568	.572
	TEntertainment	.267	.132	.232	2.023	.046

a. Dependent Variable: TEngagement_social

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEngagement_social[b]	.	Enter

a. Dependent Variable: TIntention

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.388[a]	.150	.141	1.39011	.150	16.269	1	92	.000

a. Predictors: (Constant), TEngagement_social

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.438	1	31.438	16.269	.000[b]
	Residual	177.782	92	1.932		
	Total	209.220	93			

a. Dependent Variable: TIntention

b. Predictors: (Constant), TEngagement_social

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.493	.604		4.129	.000
	TEngagement_social	.457	.113	.388	4.033	.000

a. Dependent Variable: TIntention