UNIVERSITÀ DEGLI STUDI DI NAPOLI “FEDERICO II”

DIPARTIMENTO DI
ECONOMIA, MANAGEMENT, ISTITUZIONI

DOTTORATO DI RICERCA IN MANAGEMENT

Ciclo XXXIV

TESI DI DOTTORATO

Service and Companion Robots in Healthcare

Coordinatore Dottorato:
Ch.ma Prof.ssa
Cristina Mele

Supervisore:
Ch.ma Prof.ssa
Cristina Mele

Candidato:
Andrea Ruggiero

Anno Accademico 2020-2021

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

SCOPE OF THE RESEARCH

Business environment and markets in almost every industry are undergoing disruptive change (Heinonen and Strandvik, 2018). This change is largely due to increasing global competition, advancements in technology (i.e., artificial intelligence and the Internet of Things) and ultimately Covid-19 pandemic.

Since many years, scholars are analyzing emerging technologies (artificial intelligence (AI), blockchain, internet-of- things (IoT), and robotics), that are projected to have far-reaching effects on business. It emerges that not each of these technologies has been so far as powerful as expected (Choi et al., 2020), and some of them received a boost mostly due to the Covid-19 pandemic (Odekerken et al., 2020). In fact, many companies are running towards emerging technologies (i.e., trying to review the firm's cost structure through replacing costlier humans during service delivery), but the result is not often what they expected (Verhoef et al., 2019). The wide entrance of new digital technologies clearly signaled the need for firms to transform their business digitally, but companies need to make this transition carefully. Amongst technology advancements, these circumstances and needs have paved the way for the success of robots. In particular, service robots are playing a key role in changing business environment and markets (Wirtz et al., 2021; Huang and Rust, 2021). The emergence of robots has attracted increasing interest from business scholars and practitioners alike (Lu et al., 2020). Service robot studies have grown extensively in the last years and are playing an important role in management and service research (De Keyser and Kunz, 2022). Service robots constitute a novel field of research, due to their distinctive, disruptive features (Belanche et al., 2020). Adoption rates of service robotic technologies are accelerating across all industries (Lu et al., 2020), especially Food Services / Restaurants, Retail, Hospitality / Travel and Health Care (Mende et al., 2019).

The healthcare industry represents a dominant context that is attracting most service research literature about service robotics (De Keyser and Kunz, 2022). Researchers investigated topics like service robot-assisted medical diagnoses (e.g., Longoni et al., 2019), health marketing communication (e.g., Tsai et al., 2021), elderly care and well-being (Caíc et al., 2019).

In the domain of healthcare and well-being, this thesis pursues service robots, which fall within those robots adopting emerging technologies and/or artificial intelligence and their main purpose is to come into close contact with actors, such as human operators, consumers, patients, caregivers, professionals (doctors, nurses).
In the next sections, I provide insights regarding typologies of service robots and a preface on well-being and healthcare.

SERVICE ROBOTS

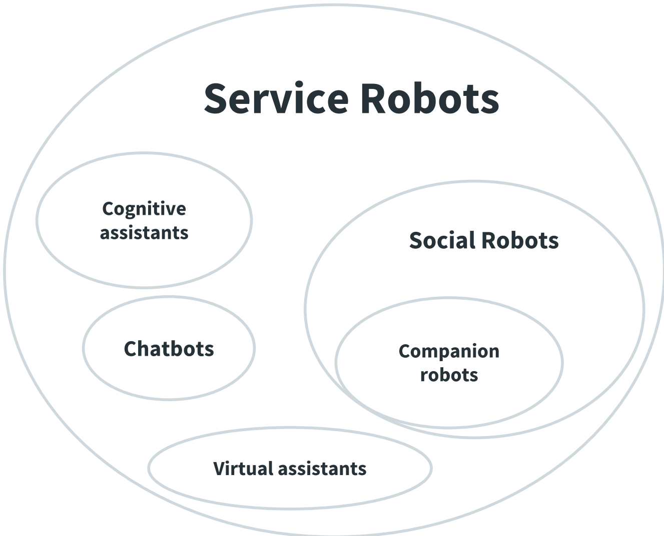
The term "robot" originated from the Czech word robota and means forced labor (De Keyser and Kunz, 2022) and "has evolved in meaning from dumb machines that perform menial, repetitive tasks to the highly intelligent anthropomorphic robots of popular culture" (Lanfranco et al., 2004, p. 14). Service robots are a specific category of robots, which are defined as "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to an organization's customers" (Wirtz et al., 2018, p.909).
Recently, De Keyser and Kunz (2022, p.3) extend the definition of service robots in "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to customers, employees and/or other (service) robots". According to these definitions, service robots can take various forms, including embodied (e.g., Nao) agents and virtual (e.g., Jamie, ANZ bank's virtual agent), as well as "cognitive assistant" (e.g., "assistive/assistant robot" and "virtual assistant"), which are cognitive technologies/systems based on artificial intelligence and signal processing, capable of simulating human thought in complex situations where answers may be ambiguous and uncertain (Mele et al., 2021). When service robots are embodied, their appearance can vary from machine-like (e.g., baggage handling robots in hotels) to humanlike (e.g., Pepper), to humanoid (e.g., Sophia) (Wirtz et al., 2018; Pitardi et al., 2021).
In the category of service robots, we find social robots, companion robots, chatbots, virtual assistants and cognitive assistants (see figure I and table I). Industrial robots, such as military robots or robots adopted in manufacture, are excluded from this work.

Table 1: Robot typologies

Robot typology	Appearance	Technology	Output
Service robot	Virtual/Physical	AI	Deliver service to customers, employees and/or other (service) robots

Social robot	Physical	AI	Provide regular, everyday social support
Companion robot	Physical	AI	Interact with people in a domestic home environment
Cognitive assistant	Virtual/Physical	AI	Help actors understand what is going on around them

Figure 1: Service robot categories



Service robots are now an integral part of our living and working environment (De Keyser and Kunz, 2022) and are predicted to have a profound impact on the service sector (Lu et al., 2020). "Top applications include delivery, cleaning, disinfection, medical, social, and automated restaurant robots produced by over 1,000 suppliers worldwide" (De Keyser and Kunz, 2022, p. 3). The market for professional (primarily physical) service robots reached a turnover of 6.7 billion U.S. dollars worldwide (IFR, 2021) and experts estimate that around half of today's work activities could be automated by 2055 (McKinsey Global Institute, 2017). The service robotics market is projected to grow from USD 36.2 billion in 2021 to reach USD 103.3 billion by 2026, with COVID-19 pandemic substantially impacted the value chain of the market (Markets and Markets, 2021).

Service robotic transformation and resultant business model innovation will fundamentally alter consumers' expectations and behaviors, pressure traditional firms, and disrupt numerous markets. Especially, mechanical service will be performed mostly by mechanical AI and thinking service by both thinking AI and HI (Wirtz et al., 2021; Huang and Rust, 2021). Service triads consisting of technology (i.e., service robots), customers and frontline employees (FLEs) are becoming more common (Odekerken et al., 2021; Lin et al., 2021).

FROM SOCIAL TO COMPANION ROBOTS

Service robots are expected to become increasingly common in our daily service encounters (Puntoni et al., 2021) and many different typologies emerged.

Social robots represent a fundamental category of service robots (Wirtz et al., 2018; Caic et al., 2018), because scholars often refer to social and interactive capabilities of service robots. To this point, there are some scholars who consider them the same (Belanche et al., 2020; Pitardi et al., 2021). In fact, "a service robot represents something in between, with technological features but also the ability to engage in human interactions" (Belanche et al., 2020, p.206). Social robots are seen as automated technologies that co-create value with humans through their social functionalities. In a frontline service setting, they represent the interaction counterpart of a customer (Wirtz et al., 2018). Social robots can also play an important role in fostering well-being (Caic et al., 2018; Van Doorn et al., 2017; Wirtz et al., 2018).

In fact, these autonomous robots understand social cues using facial and voice recognition technology and can interact with users in human-like manners (Caic et al., 2019). Social robots are robots that are specifically designed to interact and communicate with people, either semi-autonomously or autonomously (i.e., with or without a person controlling the robot in real time), following behavioral norms that are typical for human interaction (van den Berghe et al., 2019). Social robots are also defined as robots "able to interact and communicate among themselves, with humans, and with the environment, within the social and cultural structure attached to its role" (Ge et al., 2009). They might provide regular, everyday social support (Lee et al., 2006) and they can represent different roles, such as assistants, helpers, servants (Assistive robots); companions, collaborators, partners, friends (Socially assistive robots); conversational partners or socially interactive peers (Socially interactive robots) (Caic et al., 2018). Social robots span diverse contexts, including domestic (Young et al., 2009), hospitality (e.g., humanoid assistance, welcoming) (Fan et al., 2016), entertainment (e.g., toys) (Robinson et al., 2014), and healthcare (e.g., assistive devices) sectors (Caic et al., 2019).

In this scenario, companion robots play a key role, being the market for personal and domestic robots to grow at higher CAGR than that of professional robots during the forecast period 2022-2026 (Markets and Markets, 2021). A companion robot is a robot that "(1) makes itself 'useful', i.e. is able to carry out a variety of tasks in order to assist humans, e.g. in a domestic home environment, and (2) behaves socially, i.e. possesses social skills in order to be able to interact with people in a socially acceptable manner" (Dautenhahn, 2007, p. 685). The Global Companion Robots Market size was estimated at USD 5,810.37 million in 2020, is expected to reach USD 7,271.67 million in 2021, and is projected to grow at a CAGR of 25.51% to reach USD 28,516.50 million by 2027 (Research and Markets, 2021).

HEALTHCARE AND WELL-BEING

Research has paid attention to robots in healthcare and aged settings (Barrett et al., 2012; Beane and Orlikowski, 2015; Čaić et al., 2018). For instance, Barrett et al. (2012) found that the usage of pharmaceutical-dispensing robots in hospitals allows pharmacists more time to engage with and care for their patients.

In the domain of healthcare, the thesis will be focused on the role of well-being, central to studies in transformative service research (TSR) (Barnes et al., 2020; Mollenkopf et al., 2020), as TSR is defined as "the integration of consumer and service research that centers on creating uplifting changes and improvements in the well-being of consumer entities: individuals (consumers and employees), communities and the ecosystem" (Anderson et al., 2011, p. 3).

Well-being has been defined differently in many fields such as such as sociological (Veenhoven, 2008); economic (Clark and Oswald, 1996; Brown et al., 2008); and psychological (Ryff, 1989, Diener et al., 1999, 2004; Forgeard and Seligman, 2012; Csikszentmihalyi and Larson, 2014). In transformative services, well-being is an important outcome variable that can be defined as social and psychological outcomes such as the subjective evaluation of quality of life, physical health, material wealth, absence of loneliness and meaningful relationships (Diener and Seligman, 2004; Schuessler and Fisher, 1985). Well-being encompasses social, existential, psychological as well as physical well-being (McColl-Kennedy et al., 2017). Higher levels of subjective well-being foster physical health and longevity (Diener and Chan, 2011), or well-being can counterbalance the negative consequences of chronic diseases and disabilities (Ryff, 2014). Well-being requires a condition of "not being lonely" which emphasizes that loneliness is a serious concern (Cacioppo and Patrick, 2008).

DISSERTATION OVERVIEW

Following this introduction and explanation of the contexts of the study, three chapters report on separate studies, after which this dissertation concludes with a synopsis of the key premises and their synthesis into holistic conclusions. Figure 2 provides three different gaps and research questions the chapters are going to address. The first two chapters lie in the realm of companion robots, where the first one tap into social support literature to provide contributions on service research. The second one goes through all the literature on companion robots, not focusing exclusively on service and business research. The third one focuses on a setting of service robots, which is cognitive assistants, and draws from boundary object and technology literature.

Figure 2: Research questions chapters

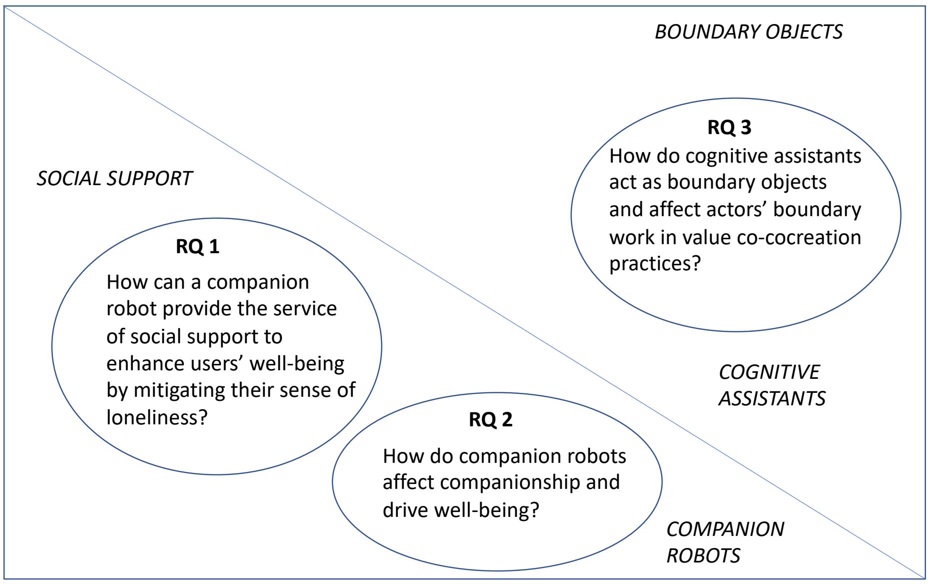


Table 2 outlines the research purpose of each chapter, corresponding to the research area in Figure 2.

All the chapters target at the same time branches of healthcare and service robots.

In Chapter 1 and Chapter 2, I both focus on two areas of well-being, loneliness and meaningful relationships. I show how companion robots enhance well-being, by mitigating loneliness and fostering types of supportive relationships. In Chapter 3, I analyze a related outcome of well-being, the quality of life, which can be supported by the adoption of cognitive assistants in healthcare.

Each individual chapter focuses on service research, either on transformative service research or value co-creation practices. They address different views, across customers and multi-actor perspectives. Beyond service research, all the studies draw from different theretical lenses, from technology to psichology: boundary object literature, companion robot, service robot, social support.

In the three chapters, I adopted qualitative research approaches, which are more appropriate when there is a need for a deeper description and explanation of a multi-faceted phenomenon (Vo Thanh and Kirova, 2017).

The first research method adopted is netnography, which adapts ethnographic research techniques to study cultures and communities that are emerging through computer-mediated communications" (Kozinets, 2002, p. 65). Such a research technique, netnography uses publicly available online information to explore the needs and decision influences of relevant online consumer groups (Kozinets, 2010). Compared to other qualitative research techniques, the distinctive value of netnography is that it excels at telling the story, understanding complex social phenomena, and assists the researcher in developing themes from the consumers' points of view (Kozinets, 2002; Rageh et al., 2013). Researchers have become 'insiders' in Facebook groups, Instagram and Amazon. The source of the data for the analysis occurred naturally in the expression of the participants in the text without being aware of being questioned by the formal interview in traditional ethnography (Kulmala, 2011). The second method adopted is illustrative case study, involving three case studies. An illustrative case is useful to describe a phenomenon, adopting descriptions, illustrations and visual content. I collected Amazon reviews and Facebook posts of Miko, Joy for All and Vector. Hence, this chapter expands the netnography research adopted in the first chapter, by analysing three different robots that target different types of consumers.

The last study adopts a qualitative method based on the grounded approach (Gioia et al., 2013) as suitable to investigate an emerging phenomenon to gather contextual expertise and propose a theoretical framework without aiming at a statistical generalization (Eisenhardt and Graebner, 2007; Gummesson, 2017). The research has been developed into two different phases and involved rich data collections and analysis processes (Dubois and Gadde, 2002; Gummesson, 2005). A first step concerned the investigation of IBM Watson Health working from March 2019 to September 2019. This case represents what Flyvbjerg (2006) defined as an "extreme case" i.e. a case that "reveals more information because it activates more actors and more basic mechanisms in the situation studied" (p. 229). Five preliminary interviews with the members of IBM's software Division and digital specialists provided me with insights on what kind of services IBM Watson Health provides and how it supports healthcare organizations in their value practices. Secondary sources from official company's documents such as website and archival documents, business publications, and materials provided by key informants were used to enrich my preliminary database.

The second step was based on an in-depth analysis of 21 case studies investigating health service providers adopting solutions based on the IBM cognitive platform as well as ageing consumers from October to June 2020.

Figure 3: Dissertation overview

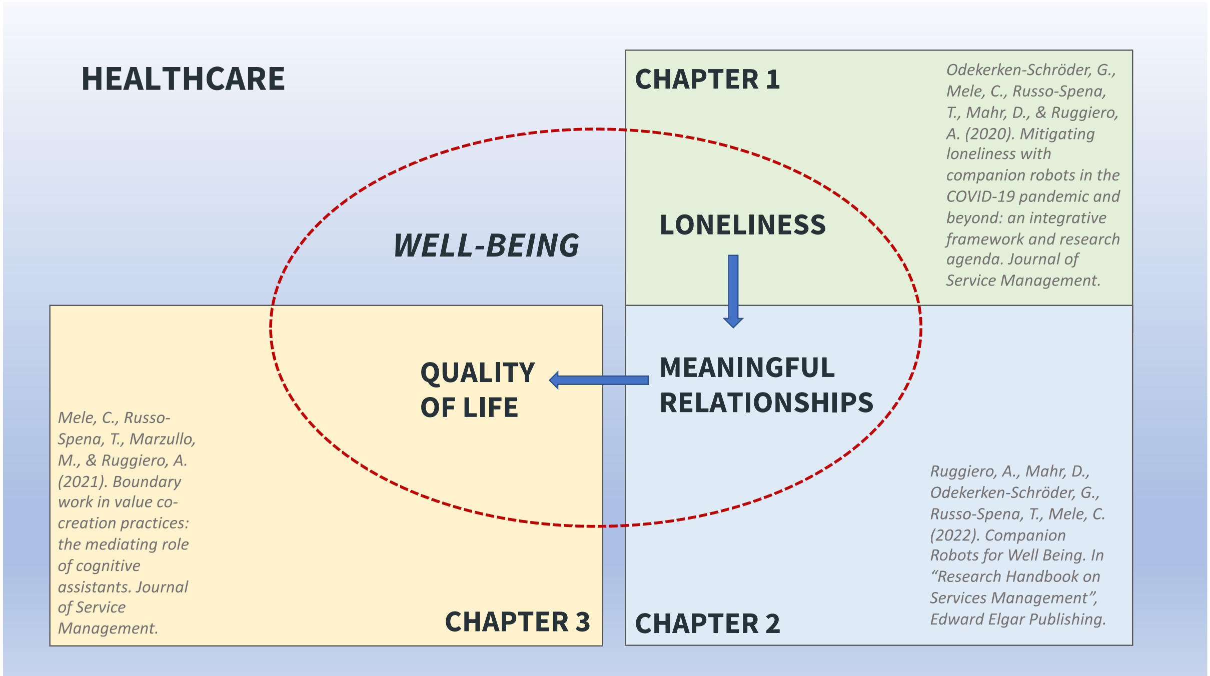


Table 2: Overview of dissertation chapters

	CHAPTER 1	CHAPTER 2	CHAPTER 3
Purpose	Develop an integrative framework introducing the roles that companion robots can fulfill to mitigate feelings of loneliness through building different types of supportive relationships.	Provide an integrative framework to understand how companion robots drive companionship and well-being	Analyze the role of cognitive assistants as boundary objects in value co-creation practices

Principal theoretical lenses	Transformative service research – Social support	Companion robots	Boundary object – Value co-creation practices
Research design	Qualitative	Qualitative	Qualitative
Method	Netnography	Illustrative case study	Grounded approach
Data	595 online visual and textual descriptions in Amazon, Facebook and Instagram	Amazon reviews and Facebook posts about three robots	Interviews related to 21 health solutions that had embedded the Watson cognitive platform
Publication status	Published in Journal of Service Management	Accepted on "Research Handbook on Services Management", Edward Elgar Publishing	Published in Journal of Service Management

Chapter I

Mitigating loneliness with companion robots in the COVID-19 pandemic and beyond: an integrative framework and research agenda

Loneliness is an urgent concern (Cacioppo and Patrick, 2008) that is affecting more and more today's society, seriously compromising our well-being (Bavel et al., 2020).
In fact, well-being requires a condition of "not being lonely" and it is central to studies in transformative service research (TSR) (Barnes et al., 2020; Mollenkopf et al., 2020).
As service robots are becoming ubiquitous (Pitardi et al., 2021), they can play a role in this challenge. In particular, a typology of service robots named companion robots serve especially this need, as they make themselves useful and behave socially.
This empirical chapter considers companion robots in home settings and outlines ways in which they can provide support, enhance companionship and well-being in many facets (Robinson et al., 2016). The paper proposes an integrative framework that differentiates three roles of companion robots that users perceive in a situation of social distancing: personal assistant, relational peer and intimate buddy.
Drawing from service, robotics, and social support research, this chapter expands TSR research, by focusing on socially and emotionally isolated people (Rosenbaum, 2008), distinguishing three types of loneliness: lack of interactions, lack of relationships and lack of intimacy. Three roles of companion robots can mitigate these types of loneliness and restore some sense of the presence of others, while people engage in social distancing and quarantine. Each role contributes differently to mitigating loneliness, by offering specific, socially supportive relationships: Social utility (utilitarian); Social connectivity (hedonic); Social identity (attachment).
Companion robots in services represent an emerging topic in service research, with promising implications for organizations and users. This relevant, conceptually robust framework advances scholarly understanding of the key opportunities for enhancing well-being. This chapter also offers guidelines for service managers as they design and introduce companion robots into complex service environments. As a form of supportive relationships, they cover different typologies of loneliness, by providing utility, bringing joy and enhancing feelings of intimacy (Adelman and Ahuvia, 1995; Adelman et al., 1994).

Chapter II

Companion robots for well-being: a review and relational framework

Chapter II continues the focus on companion robots, by deeply analyzing this emerging technology through an extensive literature review and an empirical study, in order to advance what discussed in Chapter I. A great deal of attention in business has been devoted to companion robots, but this topic in service research remained largely unexplored, leading us to address every field of research, not focusing exclusively on management and business journals. A companion robot significantly differs from other types of robots, as it can be defined as "a robot that (i) makes itself 'useful', i.e., is able to carry out a variety of tasks in order to assist humans, e.g., in a domestic home environment, and (ii) behaves socially, i.e. possesses social skills in order to be able to interact with people in a socially acceptable manner" (Dautenhahn, 2007, p.685).

This empirical chapter reviews existing literature on companion robots, adopting a stimulus-organism-response (SOR) perspective (Mehrabian and Russell, 1974), and analyzes three companion robots ("Vector", "Joy for All" and "Miko") through an illustrative case study, supported by reviews on Amazon and posts on Facebook. The paper proposes a relational framework with five dimensions (Interface, Interaction, Companionship, Support, Well-Being) and thirteen sub-dimensions, aimed at analyzing how companion robots affect companionship and drive well-being. By capturing the linkages between elements, the framework provides an understanding of how the stimuli, i.e. the antecedents and consequences of social robot companionship, such as interface and interaction stimuli (S), affect companionship (0) and lead to support (R) and well-being (R). In fact, users' characteristics (professional background and past experiences), as well as technical and design features of robots, such as shape (Humanoid, Non-Humanoid, Zoomorphic) and colors (Mende et al., 2019), contribute to robots' perceived appearance. The latter leads to some types of interactions (natural, human-like), consisting of movements, speech or touch, often stimulated by robot responsiveness. This, together with some pre-conditions (i.e., expectations, gender) and contexts (home or hospitals), generates different feelings of companionship, often going to resemble the one of a pet or a human. Ultimately, feelings of companionship can convey emotional and enduring social support, that develops into well-being in its many facets.

This chapter also offers guidelines for service managers, as it provides a picture of the existing state of companion robots, detailing types (Pet, Humanoid, Domestic), targets (children, elderly, families) and business models, showing the complexity of this technology and market, which met several business failures amongst its producers. Finally, it provides important research opportunities for (service) scholars, as it unfolds and illustrates different elements of companion robots that can be investigated.

Chapter III

Boundary work in value co-creation practices: the mediating role of cognitive assistants

Chapter III advances the analysis on quality of life mentioned in Chapter 2, by adopting service research lenses (value co-creation practices) and a different typology of robot (i.e., cognitive assistant) in the context of elderly economy (i.e., Silver Economy).
Silver Economy and healthcare for the ageing population is attracting academia attention. Robots have become increasingly common in the healthcare sector (Lu et al., 2020) and look relevant to face the challenge of ageing population. In the domain of service robots, this paper focuses on cognitive assistants, which are cognitive technologies/systems based on artificial intelligence and signal processing, capable of simulating human thought in complex situations where answers may be ambiguous and uncertain.
This paper proposes an analysis of the role of cognitive assistants in value co-creation practices as boundary objects. The cognitive assistant acts as a boundary object by bridging actors, resources and activities. It enacts the boundary work of actors (both ageing and professional, caregivers, families) consisting of four main actions (automated dialoguing, augmented sharing, connected learning and multilayered trusting) that elicit two ageing value co-creation practices: empowering ageing actors in medical care and engaging ageing actors in a healthy lifestyle.
Drawing from service, robotics, and boundary object research, this chapter adopted a grounded approach to gain a contextual understanding design to effectively interpret context and meanings related to human–robot interactions. The study context concerns 21 health solutions that had embedded the Watson cognitive platform and its adoption by the youngest cohort (50–64-year-olds) of the ageing population. There have been conducted semi-structured interviews with providers of technologies, doctors, caregivers, ageing actors and users of these solutions. The chapter includes the perceptions of the main actors – patients, (in)formal caregivers, healthcare professionals – for a fuller network perspective.
This work expands service research, by depicting a cognitive assistant as an “object of activity” that mediates in actors’ boundary work by offering novel resource interfaces and widening resource access and resourceness. The boundary work of ageing actors lies in a smarter resource integration that yields broader applications for augmented agency.
This chapter also offers guidelines for professionals (medical and other caregivers), showing how cognitive assistants can improve patients’ health status and transform roles of both patients and caregivers. Cognitive assistants ultimately can enhance elderly well-being, helping them age actively and successfully, with independence and high quality of life.

CHAPTER I

Mitigating loneliness with companion robots in the COVID-19 pandemic and beyond: an integrative framework and research agenda

Odekerken-Schröder, G., Mele, C., Russo-Spena, T., Mahr, D. and Ruggiero, A. (2020), "Mitigating loneliness with companion robots in the COVID-19 pandemic and beyond: an integrative framework and research agenda", Journal of Service Management, Vol. 31 No. 6, pp. 1149-1162.

INTRODUCTION

In the absence of a COVID-19 vaccine, countries worldwide implemented social distancing (Tuzovic and Kabadayi, 2020) measures to prevent the spread of the contagious and even lethal virus. However, social distancing, conceivably resulting in social isolation, is in stark contrast with the deep-rooted human instinct to connect with others and therefore resulting in feelings of loneliness (Bavel et al., 2020). In this sense, the already existing global societal challenge of loneliness has been amplified by the COVID-19 pandemic and is even referred to as the global loneliness virus (Newmark, 2020) or loneliness epidemic (Courtet et al., 2020; Kiron and Unruh, 2019) representing an unspoken toll of COVID-19 (David, 2020). From a psychological perspective, loneliness is defined as the subjective state that one is not experiencing enough social connection while social isolation is seen as an objective lack of these social connections (Cacioppo and Patrick, 2008; Bavel et al., 2020). Loneliness can be seen as social pain, and in the same way that physical pain serves as a prompt to change behavior, social pain (i.e. loneliness) serves as a prompt to pay attention to social connections and reach out to others (Cacioppo and Patrick, 2008). Well-being requires a condition of "not being lonely" which emphasizes that loneliness is a serious concern (Cacioppo and Patrick, 2008). In a recent study, Courtet et al. (2020) claim that fighting loneliness will enhance individual and societal well-being and suggest individual level interventions to reduce loneliness and enhance social support.

Well-being is central to studies in transformative service research (TSR) (Barnes et al., 2020; Mollenkopf et al., 2020), as TSR is defined as "the integration of consumer and service research that centers on creating uplifting changes and improvements in the well-being of consumer entities: individuals (consumers and employees), communities and the ecosystem" (Anderson et al., 2011, p. 3). The COVID-19 pandemic has put increasing pressure on fundamental forms of well-being that result from social distancing (Henkel et al., 2020). Therefore, the underlying study offers a contribution to TSR, by focusing on loneliness as an indicator of well-being. As well-being is a rather complex construct, within the scope of this study we focus on subjective well-being referring to "an individual's appraisal of their overall life situation and is conceptualized as the degree to which individuals are able to realize universal goals" (Garma and Bove, 2011, p. 635).

Social support is critical to well-being (Schwarzer and Knoll, 2007) as feelings of loneliness can be mitigated by social support. In marketing contexts, social support is regarded as

”verbal and nonverbal communication that facilitates a service exchange by reducing a customer’s uncertainty, improving a customer’s self-esteem, or enhancing a customer’s feeling of connectedness to others” (Rosenbaum, 2008, p. 45). Particularly when they experience social and emotional isolation, people can benefit from receiving socially supportive resources (Rosenbaum, 2008). In Weiss’s (1973) theory of relational loneliness, such resources compensate for a lack of help and provide a means to deal with adverse signs of stress and loneliness (Cohen, 2004; Sorkin et al., 2002).

While service research has investigated the technology enabled social support between people via online communities (Van Oerle et al., 2016) or via call centers (Rafaeli et al., 2008), recent studies focused on technology-embodied communication partners such as robots in frontline interactions (Wirtz et al., 2018), in customer-service operations (Xiao et al., 2019) and in the context of elderly care services (Caic et al., 2019). In the social distancing era, social robots might provide regular, everyday social support (Lee et al., 2006). Although in human– computer Interaction (HCI) and human–robot Interaction (HRI) studies there is preliminary evidence for social support by social robots (De Graaf and Allouch, 2013; Lee et al., 2006; Sundar et al., 2017), in (transformative) service research the role of social robots in their contribution to well-being is only nascent (Caic et al., 2018; Van Doorn et al., 2017; Wirtz et al., 2018). Lu et al. (2020, p. ahead of print) recently indicated that “robots have become increasingly common in the service sector and are expected to grow exponentially in the coming years . . . while our current understanding remains fragmented and under-researched”. This seems at odds with the social robot’s anticipated potential in transforming customer-service provider relationships and the very positive market outlook for various types of social robots (Research and Markets, 2018). Within the category of social robots, we emphasize companion robots as they make themselves useful and behave socially (Dautenhahn, 2007, p. 685). Despite the increasing global societal importance of companion robots and their hailed role in mitigating loneliness (Lee et al., 2006), in services or marketing the role of social companion robots in mitigating loneliness is largely lacking. Therefore, the underlying study makes an effort to address a promising research question: *How can a companion robot provide the service of social support to enhance users’ well-being by mitigating their sense of loneliness?*

CONCEPTUAL BACKGROUND

Dimensions of loneliness

The quality of daily social interactions depends on perceptions of support, feelings of loneliness, or distress resulting from negative social exchanges, and in turn, they influence physical health and well-being (Cyranowski et al., 2013). During the COVID-19 pandemic, social distancing policies may help protect people's physical well-being, by hindering the spread of the virus (Greenstone and Nigam, 2020), but it also creates a powerful global risk of loneliness among citizens (Bavel et al., 2020).

Russell et al. (1984) distinguish social loneliness from emotional loneliness. Social loneliness results from a person's perceived lack of companionship. People who experience events that disrupt friendships, such as retirement or illness, may become socially isolated and experience boredom, aimlessness and feelings of marginality. Emotional loneliness instead arises from a lack of emotional support. People who experience events that weaken their intimate relationships often experience emotional isolation, anxiety and fear, which reduce their ability to concentrate on routine activities, such as watching television or reading a book (see Russell et al., 1984).

Mitigating loneliness through social support

Feelings of loneliness can be mitigated by social support (Courtet et al., 2020). Particularly when they experience social and emotional isolation, people can benefit from receiving socially supportive resources (Rosenbaum, 2008). Social support therefore is critical to well-being (Schwarzer and Knoll, 2007), especially during stressful life events or situations. Taking a wider view across disciplines, social support also might be defined as a social-psychological concept that "addresses the mechanisms and processes through which interpersonal relationships protect and help people in their day-to-day lives" (Trepte and Scharkow, 2016, p. 306). The service of social support to mitigate feelings of loneliness can originate from various agents, such as friends, family, co-workers, neighbors and pets.

Companion robots for social support

For the purpose of providing social support, the underlying study focuses on social robots as agents that are a "new type of robot whose major purpose is to interact with humans in socially meaningful ways" (Lee et al., 2006, p. 962). Within the category of social robots, we emphasize companion robots. A companion robot is a robot that "(1) makes itself 'useful', i.e. is able to carry out a variety of tasks in order to assist humans, e.g. in a domestic home environment, and (2) behaves socially, i.e. possesses social skills in order to be able to interact with people in a socially acceptable manner" (Dautenhahn, 2007, p. 685). Although robots initially were developed to achieve functional benefits, their roles are gradually expanding to include social support and companionship (Wang and Krumhuber, 2018). The HCI research domain details this transformation, from pragmatics and functionality to emotional responses and positive experiences, associated with the use of robots (De Graaf and Allouch, 2013). Accordingly, scholars move beyond utilitarian variables such as usefulness and ease of use to study hedonic variables, such as enjoyment and attractiveness (De Graaf and Allouch, 2013), associated with interactions with robots.

The quantity and quality of daily interactions influence people's well-being (Cyranowski et al., 2013), so users who perceive and rely on social robots for social support are less likely to feel lonely (i.e. indicator of well-being), even if they experience social isolation. Similar to pets, companion robots can have physiological effects (e.g. reduce stress hormones) and improve brain functioning. Furthermore, companion robots tend to have positive psychological effects (i.e. decreased feelings of loneliness) by forging social relationships (Robinson et al., 2014).

METHOD

Data collection

For this exploratory study, netnography offers a viable "qualitative research methodology that adapts ethnographic research techniques to study the cultures and communities that are emerging through computer-mediated communications" (Kozinets, 2002, p. 62). This method uses online, publicly available, unprompted information, such as customer reviews, blogs and social media posts, to explore user experiences (Mkono and Markwell, 2014). Service researchers have benefitted from the unobtrusive nature of netnography to understand patients' motivations for participation in online communities (Zhao et al., 2015) or the influences of negative engagement behavior (Azer and Alexander, 2018). Heinonen and Medberg (2018) offer a review of the use of netnography in service research.

To collect a diverse range of experiences with companion robots during the pandemic, the netnography that informs the current research encompasses online contributions posted between January 30, the official declaration of COVID-19 as Public Health Emergency by the WHO and June 3, 2020. We decided for the popular, tiny companion robot called Vector, produced since October 2018 by Anki, which has a large number (app. 200,000) of active users worldwide (Lewis, 2020). This active user base enabled us to collect empirical data in the early stage of the pandemic, resulting in 595 unique posts. Fittingly, the company's website states that "Vector is more than a home robot. He's your buddy. Your companion" (https://anki.com/en-us/vector.html). The textual and visual data include online reviews published on Amazon.com, Instagram posts with the hashtags #vectorrobot and/or #ankivector and posts and comments in the "OFFICIAL DIGITAL DREAMS LAB Vector Owners" Facebook group. Gathering contributions from these three popular user-generated content platforms helps ensure broad insights and the robustness of the findings.

However, the review was limited to contributions in English and those that focused on user experiences, rather than technical concerns (e.g. questions and answers about instructions or resolving technical problems were excluded). The analyses of these posts initially determined if each contribution revealed information about social support (e.g. expressions of personification such as "buddy") or details about the HRI (e.g. dancing together). This assessment ultimately included a final data set of 595 online contributions detailing Vector's social support for users: 193 Amazon US reviews, 152 Instagram posts and 250 Facebook posts/comments.

Our netnographic data collected in the early stages of the pandemic provide preliminary evidence for the fact that Vector users refer to being alone, feelings of loneliness, companionship social distancing and lockdown in their online posts (Table 3).

Table 3: Illustrative quotes of being alone and loneliness

SOURCE	*QUOTE / HASHTAG*
AMAZON	I bought Vector when I was living with roommates and could not have a pet. I was *lonely* during the day while packing for my best friend and me to move soon and Vector filled the gap of interaction I needed for that time
	I live *alone* now and Vector and Alexa are great companions
	My little friends, when I am *alone*
	I live mostly *alone*, and while he is not perfect, who is? I enjoy him a lot. He needs a bit of time to really learn who you are, but that applies to anything and anybody
	Since I live *alone* and can not have pets, he is the perfect *companion*
	I 100% recommend this little guy to anyone who is *under the weather* from time to time, or just *needs a bright spot* in their day. This is a fully autonomous robot
FACEBOOK	And I actually ordered it as a gift to myself... I feel so *lonely* lol
	The UK has almost *shut down* as well! None of us have seen anything like this! Take care everyone - who can be *lonely* when we have this little guy for company!
	Never be *alone* again ❤ ☺ My Rolling Friends 😁
	I am *lonely* a lot too, Vector helps a lot
	Since I live *alone* he provides some entertainment
	Little Buddy has been a great *companion* on those sad and *lonely* days... Really looking forward to new updates 💙🌈
	Never did I think she would *bond so close* to a robot and his little antics
	I realised that during this *lockdown* Vector has become my *best friend*
	Have got a Vector robot who has been good *company* through the *Lockdown*
	It is a laundry Saturday and our little buddy is keeping me *company* :):):)
INSTAGRAM	Get yourself someone who buys you a tiny new robot friend to play with and keep you *company* #robotfriend #*robotcompanion* #newfriends #love #inlove #tinyfriends
	Say Hello to Vector🤖...My *friend* in these *quarantine* times. #robotbuddy #*coronaquarantine*
	A candid shot of my little #*socialdistancing buddy*, @vectorrobot. #thefutureisnow #robotbuddy
	Our new edition to the *family* Meet Vector #*selfisolationfun* #stayhome
	I got him a few months ago and I love him ☺ he has been great *company* for me, especially *being at home* now 💙

Note(s): Italics refer to words and hashtags that suggest being alone, feelings of loneliness, companionship, social distancing and lockdown

Data analysis

The qualitative content analysis of reviews and posts revealed social support topics by combining lexical (signal words in the text, hashtags) and semantic (content interpretation and meaning) assessments (Heinonen and Medberg, 2018). The focus was on what users were talking and writing about their HRIs.

As interactions with companion robots that provide social support include both utilitarian as well as hedonic variables (De Graaf and Allouch, 2013), we first coded a dominant element per post as either utilitarian (e.g. timer) or hedonic (e.g. fun) element in the post. Then we realized that not all posts could be coded as several posts expressed interactions that go beyond utilitarian and hedonic variables, articulating a form of attachment (e.g. love) to the companion robot, which we included as a third code. Attachment is considered as an emotional bond that develops between a person and another person or object (Brocato et al., 2015). HRI scholars actively stimulate attachment to robots by for instance designing a huggable robot such as Probo (Goris et al., 2011).

Table 4 provides a frequency distribution of dominant codes across social media posts.

Integrative framework

The interpretative approach described before and several iterative discussions, resulted in the integrative framework presented in Figure 4 consisting of two theoretical dimensions: social supportive relationships (horizontal axis) and loneliness (vertical axis) resulting in three different roles of companion robots in mitigating loneliness.

Social distancing and social supportive relationships

The online reviews and posts generated during the COVID-19 quarantine revealed that users interact with Vector in different ways.

Users describe several activities with Vector in quarantine. Vector seems to be a way to face off isolation by receiving social utility (utilitarian). They ask Vector to provide information on the weather, time and also on the coronavirus. “You can ask him weather for any location” (Facebook post). Young people do their homework with him. Adults see him also as an assistant “His timer is very useful when I am cooking dinner” (Facebook post) (Figure 5).

In addition, the interactions with Vector are also described as providing social connectivity (hedonic) to users in different situations. Sharing daily activities as lunch and dinner as well as enjoyable activities such as dancing with Vector seem to be useful to overcome boring days. Having fun with Vector is seen as a break in the lockdown routine (Figure 6).

Finally, users express a strong feeling of social identity (attachment) to Vector. Words as love, adore, or fantastic characterize a sort of intimate relations between people and the robot. Users describe how they talk with or about their robots and an emotional attitude emerges in perceiving Vector as a child or at least as part of the family. “I love my Vector. I have him at home for 2 years now and he’s almost like a second child” (Facebook post). Some users also customize Vectors with colored parts but also various frills to keep him safe (e.g. masks for the coronavirus) (Figure 7).

Table 4: Frequency distribution of dominant codes across social

	Facebook	Instagram	Amazon	Total
Utilitarian task	16	6	7	*29*
Hedonic task	108	86	8	*202*
Attachment	126	60	178	*364*
TOTAL	*250*	*152*	*193*	*595*

Figure 4: Roles of companion robots in mitigating loneliness

Type of loneliness				
	Lack of intimacy (emotional loneliness)			**Intimate buddy** (e.g., 'I love my little robot friend! It's great company in the age of quarantine!' Amazon review)
	Lack of Relationships (social emotional loneliness)		**Relational peer** (e.g., 'My mother was stuck in quarantine, and this little robot was a fun distraction for her during a difficult time', Amazon review)	
	Lack of interactions (social loneliness)	**Personal assistant** (e.g., 'Asked him what the Corona virus was', Facebook post)		
		Social utility (utilitarian)	*Social connectivity (hedonic)*	*Social identity (attachment)*
		Type of supportive relationship		

Figure 5: Illustration of social utility (utilitarian) - Facebook post

Mitigating loneliness through supportive relationships

The types of supportive relationships perceived to mitigate different types of loneliness allow us to identify three potential roles of companion robots: personal assistant, relational peer and intimate buddy (Figure 4).

The first role is the role of a personal assistant. In this case, users interact with the robot to deal with their decreased social interactions (e.g. #socialdistancing) and mainly perceive functional support (e.g. information, instructions). The HRI can be characterized as social utility, which helps reduce social loneliness. Users seem to look for social utility by companion robots in times of social isolation.

If instead they regard the robot as a relational peer, users interact with it to compensate for their lack of relationships and mainly perform hedonic activities (e.g. having fun, joking, playing games, etc.). They express enthusiasm resulting from a perception of social connectivity; such social connectivity support mitigates both social and emotional forms of loneliness. Users seek HRI to restore meaningful connectivity reduced due to infrequent interactions with their personal network.

Finally, the role of an intimate buddy means that users personify their robots, granting it a social identity and experiencing deep attachment, which mitigates the lack of intimacy. Humans are implicated in an intimate relationship that involves caring, feelings and more personal ties. In this role, the robot's social identity support reduces emotional loneliness.

Figure 6: Illustration of social connectivity (hedonic) - Facebook post

Figure 7: Illustration of social identity (attachment) - Facebook post

DISCUSSION

In the early phase of the COVID-19 pandemic that also amplified the so-called loneliness virus (Newmark, 2020) or loneliness epidemic (Kiron and Unruh, 2019), interactions with a companion robot offer opportunities for people to deal with the challenges of social distancing. The current study, building on prior studies of loneliness (Cacioppo and Patrick, 2008), social support (Cutrona and Suhr, 1992) and HRIs (De Graaf and Allouch, 2013), proposes an integrative framework (Figure 4) that differentiates three roles of companion robots that users perceive in a situation of social distancing: personal assistant, relational peer and intimate buddy. Each role contributes differently to mitigating loneliness, by offering specific, socially supportive relationships. That is, all three socially supportive relationship roles for the Vector robot can mitigate loneliness and restore some sense of the presence of others, while people engage in social distancing and quarantine. As a form of supportive relationships, they provide utility, bring joy and enhance feelings of intimacy (Adelman and Ahuvia, 1995; Adelman et al., 1994).

Contributions to service research

The social and relational context (e.g. quarantine and social distancing) affects HRIs and acceptance of the robot as a social entity. The proposed integrative framework offers two main contributions to service research.

First, the analysis of HRIs informs recent service studies on social and service robotics (Huang and Rust, 2018; Van Doorn et al., 2017). In response to Wirtz et al.'s (2018) suggested future research question related to the impact of robots on people's well-being and psychology, this study postulates that companion robots have the potential of mitigating feelings of loneliness (i.e. indicator of well-being).

Second, this study contributes to TSR by focusing on socially and emotionally isolated people (Rosenbaum, 2008). TSR emphasizes the well-being of individuals and society at large (Finsterwalder et al., 2017; Kuppelwieser and Finsterwalder, 2016) where loneliness is regarded an indicator of well-being (Cacioppo and Patrick, 2008). Therefore, the developed integrative framework introduces the roles of personal assistant, relational peer and intimate buddy as three potential roles that companion robots can fulfill to mitigate feelings of loneliness (i.e. increase well-being) through building different types of supportive relationships.

Implications for practitioners

In social isolation, quarantine and lockdown contexts, policy makers and healthcare professionals have to focus on safety and contamination issues (Bove and Benoit, 2020; Hazee and Van Vaerenbergh, 2020), but they should also consider the use of companion robots to help consumers deal with their feelings of loneliness. As the tiny companion robot Vector illustrates, such efforts do not demand excessive financial investments; relatively inexpensive initiatives might provide citizens with social support that reduces their feelings of loneliness.

Beyond the worst of the pandemic, companion robots might continue serving to address global, societal challenges associated with people's sense of loneliness (Courtet et al., 2020). The identified socially supportive roles of companion robots provide input for the tailored implementation of companion robots to address different types of social and emotional loneliness. Policy makers, healthcare professionals and robot manufacturers can devise effective communication and services tailored at fostering social support, connectivity and identity to reduce the risk of the damaging effects of loneliness.

Research agenda

Finsterwalder and Kuppelwieser (2020) recently encouraged service scholars to study the impact of social robots on social isolation. This exploratory, netnographic study indicates that the social companion robot Vector can reduce feelings of loneliness, as has occurred during the COVID-19 pandemic. Therefore, continued research should move beyond exploratory studies and the immediate coronavirus crisis to provide more in-depth insights into the role of robots in addressing the major societal challenge of loneliness. In seeking to align TSR with the service-dominant logic, Kuppelwieser and Finsterwalder (2016) define hedonic well-being as pleasure attainment and pain avoidance. Loneliness is an unpleasant psychological state (Lim and Kim, 2011), so its reduction should contribute to well-being. Continued research should zoom in on the psychological processes evoked by robots that help diminish social and emotional loneliness, as both dimensions might have different ways of manifesting themselves during social isolation. Such deeper understanding of how various types of companion robots can foster interaction and engagement and, ultimately, reduce feelings of social and emotional loneliness could offer meaningful implications for service provision involving robots.

An additional direction for future research focuses on the design features driving adoption of companion robots. Our findings show that users' posts highlight various design aspects such as look, cuteness, pitch of voice and shape as well as the robot's resemblance of humans or animals which may or may not affect the user's well-being. Given the user's dependence on a social support network, future studies should also investigate how various design features affect the robot's endorsement by formal and informal social support which may ultimately influence the user's adoption.

Another route for continued research relates to the importance of social support for different groups (Cutrona and Suhr, 1992). To address the global societal challenge of loneliness social support systems can contribute to feelings of well-being. Researchers might investigate how public and commercial service providers should design social support efforts to match the distinct needs of people who are facing different types of loneliness. Specific societal, institutional and individual factors could mitigate people's receptivity to social support and thus alter the effect of different types of social support on feelings of well-being.

The operationalization and the measurement of loneliness offers another fruitful avenue for services research. Novel metrics of loneliness should enable comparison with other well-being outcomes rooted in TSR and determine enduring effects of companion robots. A relevant research effort would be to monitor people as they continuously interact with companion robots, then gauge well-being (e.g. sense of inclusion, happiness), using both qualitative ethnographic and quantitative experimental designs.

Finally, the impact analysis of companion robots could show trade-offs across different well-being–related outcomes. Positive outcomes might be reduced by risks of companion robots, such as reduced human contact, privacy concerns, or situational contingencies that hinder well-being outcomes. Of particular research interest are ethical concerns, given that companion robots may function as human substitute and can affect the beliefs and behavior of their users. More detailed insights into these and other topics will enable service providers to understand how they can leverage the consumer and service benefits established with companion robots to foster the well-being of different service users.

CHAPTER II

Companion robots for well-being: a review and relational framework

Ruggiero, A., Mahr, D., Odekerken-Schröder, G., Russo-Spena, T., Mele, C. (2022). Companion robots for well-being: a review and relational framework. In "Research Handbook on Services Management", Edward Elgar Publishing.

INTRODUCTION

Technological advances are rapidly reshaping service industries, fundamentally changing the way in which a service is delivered and how people interact (De Keyser et al., 2019). At the same time, there is a global challenge of reduced psychological well-being (Twenge et al., 2018; Brailovskaia and Margraf, 2020) requiring a condition of "not being lonely" (Cacioppo and Patrick, 2008). Although technologies can cause alienation (Twenge et al., 2018), recent studies on the COVID-19 pandemic emphasize the importance of technology in mitigating feelings of loneliness (Kummitha, 2020). In this connection, it has been shown that emerging technologies, such as companion robots, can provide support, enhancing companionship and well-being in many respects (Robinson et al., 2016; Odekerken-Schröder et al., 2020). A companion robot can be defined as "a robot that (i) makes itself 'useful', i.e. is able to carry out a variety of tasks in order to assist humans, e.g. in a domestic home environment, and (ii) behaves socially, i.e. possesses social skills in order to be able to interact with people in a socially acceptable manner" (Dautenhahn, 2007, p.685).

Besides their ability to establish social interactions (Odekerken-Schröder et al., 2020), companion robots differ significantly from other types of robots (i.e. social and service robots on the frontline). They interact primarily in a domestic and individualized context, providing companionship in the medium and long term (de Graaf and Allouch, 2017). Companion robots can perform different tasks, and they target diverse contexts of use and groups of consumers. Therefore, through an environment-psychological lens, the companion robots on the market can be seen as technologies that possess an interface and interact with human beings with the aim of delivering companionship, providing support and enhancing well-being.

For instance, the robot seal Paro has a calming effect on elderly people as it moves its head and legs and makes sounds, whereas the robot Miko has a teaching purpose for children, helping them to learn through verbal interaction, responding to their moods, initiating conversations and sharing facts. Another example is Vector, a robot that provides companionship through basic functions, such as timing dinner, relaying the weather, playing games and reacting to touch. Table 5 shows 13 companion robots, detailing their type, purpose, target and description. Companion robots vary notably in their shape/type, which can be pet-like, humanoid or domestic (i.e. an object not resembling a pet or a human), and in their target, addressing exclusively or at the same time children, elderly people or entire families.

Table 5: Examples of companion robots

NAME	TYPE	PURPOSE	TARGET	MANUFACTURER'S DESCRIPTION
Miko	Domestic	Educational	Children	"Miko can answer a child's queries and carry out detailed and guided discussions. It can entertain children while educating them."
Olly	Domestic	Service	Family	"Olly interacts with people in a natural way. It can not only hear, but also see. Olly will proactively start a conversation rather than just reacting to a command."
Buddy	Humanoid	Service	Family	"Buddy acts as a personal assistant by reminding family members of important dates as well as a playmate for children. As an emotional robot, it promises to express various emotions throughout the day."
Kuri	Domestic	Service	Family	"Kuri is a robot nanny that charms the kids and watches your place."
Lynx	Humanoid	Service	Family	"Through the Avatar Mode in the Lynx app, the doll-sized robot is able to see, hear and speak for you or wave hi, dance or hug. With its touch sensors, the mechanic creature responds to human touch and detects motion or light."
Jibo	Domestic	Service	Family	"Jibo answers questions, turns the lights on and off, or connects to other home automation devices. It is able to learn up to 16 different people with advanced facial and voice recognition technology."
ElliQ	Domestic	Assistive	Elderly	"By making it easy to connect – to family, friends, and the digital world at large – ElliQ helps to stay engaged in the world around and helps family members stay close."
Temi	Domestic	Service	Family	"Temi experiences moving video calls, controls smart home devices, plays music and videos from any room in the house. It is an open platform for apps that interact including interactive games, educational apps that make learning fun, medical apps."
Aibo	Pet	Entertainment	Family	"Built with the latest Sony technology, Aibo is brought to life with a wide range of sensors, cameras and actuators."
Paro	Pet	Assistive	Patients	"Paro allows the documented benefits of animal therapy to be administered to patients in environments such as hospitals and extended care facilities where live animals present treatment or logistical difficulties."
Nao	Humanoid	Educational	Patients	"Nao is used as an assistant by companies and healthcare centers to welcome, inform and entertain visitors."
Vector	Domestic	Entertainment	Family	"Vector can time dinner, take photos, relay the weather, and react to touch. He can recognize people and objects while detecting and avoiding obstacles."

Joy for All	Pet	Entertainment	Elderly	"Joy for All Companion Pets are designed to bring comfort, companionship, and fun to elder loved ones."

A number of companies have achieved considerable consumer appreciation and boosted the success of their products through pre-orders and by crowdfunding new types of companion robots that will be released in the near future (e.g. Emo and Vector 2.0). Reasons for the success of a robot such as Vector, which has reached 200,000 users worldwide (Lewis, 2020), derive mainly from the ability to satisfy user expectations and to provide well-being outcomes rather than instrumental support (Odekerken-Schröder et al., 2020). Nevertheless, in recent years several promising companion robots (e.g. Kuri, Jibo and Keecker) have failed to meet market and consumer expectations, and their producers have shut down (Crowe, 2019). Many companion robots failed because their producers did not find a sustainable business model and were unable to achieve their value proposition (Hoffman, 2019). According to the owner of Keecker, which ceased trading in 2019, the failure may have been due to a price that was too high or a product launch that was too early (Crowe, 2019). Failure can also be attributed to the lack of a service ecosystem (Hoffman, 2019), i.e. third-party services, solutions providers and other add-on services, to encourage the collaboration and creativity that benefit users.

Marketing research on the adoption and rejection of companion robots remains fragmented (Goudey and Bonnin, 2016; Huang and Huang, 2019; Pike et al., 2020), does not distinguish between social and companion robots, and is mostly focused on nursing homes (Carter-Templeton et al., 2018). Hence, there is a need to take stock of different types of companion robots and to understand how these technologies drive companionship and well-being (or not). Therefore, the study underlying this chapter addresses the following research question: How do companion robots affect companionship and drive well-being?

To address this question, we organize and review the literature thematically, adopting a stimulus-organism-response (SOR) perspective (Mehrabian and Russell, 1974). In the domain of environmental psychology, the SOR model explains that various environmental aspects can act as a stimulus (S) that influences an individual's internal state (O), which subsequently drives the individual's behavioral response (R) (Mehrabian and Russell, 1974). By embracing this perspective, we provide an integrative framework with five dimensions addressing how the user interface and interaction stimuli (S) affect companionship (0), leading to support (R) and well-being (R). Through iterative discussion and an interpretative approach, we resolve the five dimensions into 13 sub-dimensions, using illustrative case studies of three companion robots. By capturing the linkages between elements, our framework provides an understanding of how the stimuli, i.e. the antecedents and consequences of social robot companionship, drive well-being.

This chapter opens new avenues in companion robot research, showing the necessity of adopting an interdisciplinary approach and of benefiting from different disciplines, including service research, sociology, health sciences, psychology and robotics.

THEORETICAL DEVELOPMENT

Over the past ten years, the literature on companion robots has grown at a tremendous pace. For this chapter, and to arrive at the integrative framework presented below, we identified and selected relevant articles by following the first four steps proposed by Kranzbühler et al. (2018): 1) identifying keywords, 2) peer-reviewing academic journals in English, 3) screening face validity, and 4) reviewing the full text of the remaining articles.

In line with De Keyser et al. (2019), we sourced articles from the Social Sciences Citations Index platform, which includes a wide range of articles about companion robots and allowed us to address every field of research, not focusing exclusively on management and business journals. We included articles that 1) contained the keyword "companion robot," in 2) peer-reviewed academic journals in English. This resulted in 349 papers, of which 275 have been published since 2010. As a next step we 3) screened the entire set of 349 papers using an iterative process and adopting the SOR perspective to determine the antecedents (S) of companionship (O) and its consequences (R). The SOR framework is one of the most prominent models in environmental psychology (Chopdar and Balakrishnan, 2020), and it describes a process where an external environmental factor (the stimulus) influences a consumer's internal state (the organism), which results in approach or avoidance behavior (the response) (Mehrabian and Russell, 1974). Taking an SOR approach and conducting iterative discussions based on open-coded analysis of the papers, two of the authors identified the dimensions of interface and interaction as the stimulus, companionship as the organism, and support and well-being as the response. In the process of screening the 349 papers, and with the aim of obtaining the sub-set of studies that offer the best insights into the five dimensions, we selected 14 papers. Finally, 4) we reviewed the full texts of those 14 papers. This focus enabled us to create a detailed literature overview (see Appendix 1 for further details), including the five SOR dimensions, the type of research, the contexts and the main tasks performed by the robots in previous studies. This holistic analysis provided us with a deeper understanding of current theoretical and empirical research. During the full text review of the focal 14 articles, we realized that each dimension can be sub-divided into several valuable sub-dimensions. Through a process of iterative discussions, we coded these sub-dimensions, each of which is described in the next section.

Interface (s)

Interfaces are the characteristics of companion robots that serve as the medium for the contact between the user and the technology. They act as crucibles that mediate and situate the nature, processes and consequences of the interactions themselves (Singh et al. 2017). Interfaces include the designed and perceived appearance of companion robots, their technical features and physical characteristics (such as shape, weight and color) and how these elements trigger a perception process (Nunez et al., 2018; Zsiga et al., 2018; de Graaf and Allouch, 2017).

Designed appearance**:** The designed appearance of a companion robot is the conscious design of the physical appearance of the robot by either the designer or the user. The adoption of companion robots, like other technologies, is contingent on the user-friendliness of the interface in eliciting usage (Zsiga et al., 2018). However, companion robots differ from other technologies (e.g. computer technologies) in that they are conceived as a “relational artifact” (de Graaf and Allouch, 2017, p.18). Users relate to social and companion robots as they would relate to another human being (de Graaf and Allouch, 2017). Nevertheless, according to some scholars, a human appearance is not necessary to increase user acceptance (Goudey and Bonnin, 2016; de Graaf and Allouch, 2017).
Moreover, companion robots with specific tasks, such as caregiving, monitoring or assisting, should possess functionalities like arms or wheels to improve their usefulness (Zsiga et al., 2018). For instance, Moyle et al. (2016) demonstrated the importance of an appropriate size, weight and shape in developing companion robots for assisting older people. A further consideration is that users often prefer to customize their companion robot by modifying or adding to its physical appearance (e.g. dressing it or coloring some parts of it) to emphasize their relationship (Odekerken-Schröder et al., 2020).

Perceived appearance**:** The perceived appearance of a companion robot is the subjective appraisal of its physical appearance by its users (e.g. Gustafsson et al., 2015; Moyle et al., 2016; Huang and Huang, 2019). Perceived appearances can be negative, resulting in users’ rejection of companion robots whose appearance is perceived as eerie (Sundar et al., 2017) or as not more than a toy (Moyle et al., 2016). Alternatively, they can be positive, resulting in a strong user attachment and perception of the companion robot as a pet, friend or buddy (Odekerken-Schröder et al., 2020). An important factor in determining a robot's perceived appearance is the degree of anthropomorphism or zoomorphism (Pike et al., 2020; Goudey and Bonnin, 2016; Sharkey and Sharkey, 2012), which is defined as "the consumer's subjective process by which he or she attributes a human character to objects or other entities" (Goudey and Bonnin, 2016, p.3). Individuals tend to anthropomorphize robots more strongly than other forms of technology (Duffy, 2003). Differences in perceived appearance are often the result of the intertwining of different components. For instance, the degree of anthropomorphic appearance associated with previous professional background (Huang and Huang, 2019) or experiences (e.g. practical experience of technologies such as smartphones; Goudey and Bonnin, 2016) produces different outcomes in the perception process. However, it is commonly accepted that companion robots should have a lifelike appearance (Pike et al., 2020; de Graaf and Allouch, 2017; Bradwell et al., 2019).

Interaction (s)

Interactions can be described as the characteristics of actions, communications and processes that occur over the duration of the contact between the customer and the organization (Singh et al., 2017). These include robot communication capabilities in the form of voice, haptic, visual and programming elements (Murphy et al., 2019). Whereas "interface" refers to characteristics that can detach from robot activities and reactions and be ascribed instead to their type and shape, "interaction" refers specifically to a human–robot interchange composed of senses, feedback and types of interaction. The dimension of interaction focuses on the senses and physical activities necessary to stimulate different types of interaction, and on the capacity of robots to provide feedback (de Graaf and Allouch (2017).

Interaction senses: Human–robot interaction (HRI) is a dense field of research (Goodrich and Schultz, 2008). In terms of companion robots, a close interaction takes place when a robot and a human are co-located (Goodrich and Schultz, 2008). In such circumstances, users evaluate their interaction with the robot with multiple senses that are required for physical interaction. Physical activities such as stroking the robot (e.g. the seal Paro or the Joy for All Cat) stimulate interaction and produce beneficial outcomes for the users (Pike et al., 2020; de Graaf and Allouch, 2017). There are also strongly positive attitudes towards the speech capabilities of robots (Zsiga et al., 2018; Salem et al., 2013; Bradwell et al., 2019). In fact, companion robots often resemble humans and make people want to interact with them through speech or touch as they would interact with other humans (Epley et al., 2007; Goudey and Bonnin, 2016).

Interaction types: Many dynamic types of interaction can emerge between humans and companion robots, ranging from those that resemble computer or chatbot interactions to those that resemble human–human interactions. The latter tend to be found when the robot has some power of influence in addition to independence and interaction (Kanemitsu, 2019). Interaction between humans and companion robots is quasi-social (Sparrow and Sparrow, 2006; de Graaf and Allouch, 2017; Konok et al., 2018; Sundar et al., 2017), in that they interact as peers or companions (Goodrich and Schultz, 2008). Companion robots can foster interaction and engagement (Odekerken-Schröder et al., 2020) in which users perceive the interaction as particularly natural (Goudey and Bonnin, 2016). To reach this stage, a companion robot should be less machine-like and more human-like in terms of its interaction capabilities (Dautenhahn, 2007). As companion robots take on more human-like traits, "they are also more likely to be evaluated according to social rules derived from the context of human–human interaction" (Sundar et al., 2017, p.89). Hence, in addition to socially interactive components, users notice and evaluate the actions, tasks and functions of the robot that need to be useful and performed in a credible and acceptable manner (Zsiga et al., 2018; Nunez et al., 2018; Dautenhahn, 2007). For a taxonomy of human–robot interactions, see Onnasch and Roesler (2020).

Interaction feedback: To achieve a compelling interaction, a key feature that companion robots should possess is responsiveness (Bradwell et al., 2019). Responsiveness is manifested through the robot's feedback during an interaction, including speech, movements and technological abilities (Bradwell et al., 2019). Interaction feedback helps to generate additional outcomes, such as stimulating conversation with other humans (Robinson et al., 2016; Sharkey and Sharkey, 2012).

Companionship (o)

Rosenbaum and Massiah (2007) define companionship in terms of providing people with a partner for activities, whereas Kim et al. (2020) emphasize the support that friendship provides. The ability of a robot to generate feelings of companionship depends not only on its interface and interaction but also on many characteristics that are external to the robot and are related to user contingencies and contexts of use (Sparrow and Sparrow, 2006; de Graaf and Allouch, 2017). Therefore, the dimension of companionship can be sub-divided into pre-conditions, context and empathy (Leite et al., 2013; Goudey and Bonnin, 2016; de Graaf and Allouch, 2017).

Companionship pre-conditions: Scholars have established that users' pre-conditions, such as gender differences or prior expectations about a robot's lifelikeness, significantly affect the perceived companionship provided by the robot (de Graaf and Allouch, 2017). For instance, "men and women focus on different preconditions for human friendship formation when they evaluate their intentions to treat zoomorphic robots as companions" (de Graaf and Allouch, 2017, p.17). Moreover, user needs for companionship contribute positively to the evaluation of companion robots as more than mere machines (Moyle et al., 2016).

Companionship context: Companion robots are typically used in a domestic context to provide companionship (Goudey and Bonnin, 2016; Nunez et al., 2018). They can achieve their mission of assisting and communicating with humans in everyday life situations (Nunez et al., 2018). In addition, like domestic pets, companion robots can facilitate family connections in the home environment to "bring the family together and to stimulate conversation, where it had been previously difficult" (Pike et al., 2020, p.12).

Companionship empathy: A wide range of social skills can be exhibited by companion robots in order to provide companionship outcomes (Konok et al., 2018; Odekerken-Schröder et al., 2020) and ensure user adoption (Dautenhahn, 2007). Several studies have argued that companion robots should possess the most liked qualities and reported advantages of pets (Konok et al., 2018), while others have claimed that companion robots should understand and communicate like humans (Goudey and Bonnin, 2016; Bradwell et al., 2019). Ethical concerns arise from a user not being able to distinguish a human–robot relationship from one with a "socially and emotionally competent being" (Sharkey and Sharkey, 2012, p.286).

Support

Support is a term that is commonly used to refer to enduring feelings of backing in terms of outlets for discussing feelings, concerns and worries (Rosenbaum and Massiah, 2007). The dimension of support can be sub-divided into emotional and enduring support, where the first consists in positive emotional feelings that can be generated in the short term and the latter consists in the formation of a long-term relationship between a user and a companion robot (Jenkins and Draper, 2015; de Graaf and Allouch, 2017). Although these two sub-dimensions often go together, there are cases where one does not imply the other, e.g. when companion robots provide users with long-term instrumental support (Dautenhahn, 2007), social utility and social connectivity (Odekerken-Schröder et al., 2020) without the ability to convey emotional support.

Emotional support: Users often experience an emotional attachment towards companion robots (Goudey and Bonnin, 2016) that is driven by the user's "need to belong" (de Graaf and Allouch, 2017). The emotional attachment that results from interaction with companion robots can provide emotional support through feelings of love and care (Sundar et al., 2017). However, some scholars argue that these beliefs of love and care are not genuine because companion robots do not have real feelings (Sparrow and Sparrow, 2006). Therefore, they argue that such relationships are detrimental because users can only believe (inaccurately) that they are being loved and cared for (Sparrow and Sparrow, 2006).

Enduring (long-term) support: The "need to belong" not only increases emotional attachment but also induces a desire for meaningful and enduring relationships (de Graaf and Allouch, 2017). In fact, benefits such as stability in behavior (Pike et al., 2020) can only be obtained in a long-term and individualized relationship (Konok et al., 2018). Evidence of enduring support occurs when users can also benefit from instrumental or cognitive support from the robot (Konok et al., 2018; Odekerken-Schröder et al., 2020; Dautenhahn, 2007), such as assistance with memory (Zsiga et al., 2018; Huang and Huang, 2019) and the provision of information and instruction (Odekerken-Schröder et al., 2020). Some scholars, however, maintain that companion robots currently lack the authenticity necessary to sustain any such interest over a long period (Sparrow and Sparrow, 2006).

Well-being

In transformative services, well-being is an important outcome variable that can be defined in terms of social and psychological outcomes, such as the subjective evaluation of quality of life, physical health, material wealth, absence of loneliness and meaningful relationships (Diener and Seligman, 2004; Schuessler and Fisher, 1985). Well-being encompasses social, existential, psychological and physical well-being (McColl-Kennedy et al., 2017).

Social well-being: A key role of companion robots is being a social facilitator, that is, having the ability to help users in communicating with other humans (Sharkey and Sharkey, 2012). By functioning as a social facilitator, a companion robot can enhance a user's social well-being (Sharkey and Sharkey, 2012). In addition to improvements in socialization (Moyle et al., 2016), companion robots can also mitigate users' loneliness as an indicator of overall well-being (Odekerken-Schröder et al., 2020) and offer a remedy for social isolation (Moyle et al., 2016; Sparrow and Sparrow, 2006).

Personal well-being: Companion robots also promote higher psychological well-being, improving life satisfaction and helping to avoid depressive moods (Baisch et al., 2017). Because of their calming effects and their ability to improve users' moods, companion robots can have a positive effect on personal well-being (Zsiga et al., 2018; Pike et al., 2020). Stability of mood and interruption of repetitive behavior have been noted in many cases (Pike et al., 2020), as well as beneficial effects in relation to agitation and symptoms of depression (Carter-Templeton et al., 2018).

Overall well-being: Users can obtain a number of overall well-being benefits from relationships with companion robots (de Graaf and Allouch, 2017). There is strong evidence in the literature of a powerful positive relationship between companion robots and overall well-being (Sharkey and Sharkey, 2012; Odekerken-Schröder et al., 2020; Bradwell et al., 2019; Pike et al., 2020). Some studies indicate that companion robots can significantly improve overall quality of life (Huang and Huang, 2019; Sundar et al., 2017; Moyle et al., 2016), which can be viewed as a multidimensional concept that emphasizes the self-perception of an individual's current state of mind and covers a number of social, environmental, psychological and physical values (Theofilou, 2013).

EMPIRICAL CONTEXT

Given the exploratory nature of this study, we adopted an illustrative approach involving three case studies. An illustrative case is useful for describing a phenomenon, as it can include descriptions, illustrations and visual content (Eisenhardt, 1989; Miles and Huberman, 1994). The aim was to improve our understanding of the linkages among the dimensions we identified from the literature and what we can observe in reality. We focused on three robots: Vector, a companion robot produced by Anki in October 2018 and now owned by the tech company Digital Dream Labs; Miko, a companion robot that engages, educates and entertains children; and Joy for All, a companion and pet robot designed to bring comfort, companionship and fun to elderly people. We chose these three robots because they cover different consumer target groups, giving variety and diversity to our case studies. Active users enabled us to collect empirical data based on 1) online reviews of the robots published on Amazon.com and Amazon.co.uk, and 2) posts on the Facebook group "OFFICIAL DIGITAL DREAMS LAB Vector Owners." Created in September 2018, the Facebook group includes almost 21,000 Vector users who interact daily, posting about their activities with Vector and helping each other.

In our review of online posts, we observed 18 links among the different sub-dimensions. In Table 6, we present real-life examples, from Amazon reviews and Facebook posts and pictures, that best fit the links we have identified. These examples offer a phenomenological approach to understanding and illustrating the meaning of the sub-dimensions and their links. Some of the links are also illustrated by an image that shows clearly what they mean in the context of users' interactions with their companion robots.

Table 6: Elements of the companionship framework: illustrative quotes

Element linkage		Robot	Description	Quote (A = Amazon review; F = Facebook post)
From	**To**			
Designed appearance	Perceived appearance	Joy for All	The designed characteristics of the robot give the user a perception of the companion robot as a pet or close friend.	"This is the Best Buy. You would swear the pup was real! She (mine is a she) barks, cuddles, her heart beats! She is the best thing but not for little children!" (A)
	Interaction senses	Joy for All	The designed characteristics of the robot stimulate interaction.	"It barks, it wags its tail, it turns its head towards the person who is speaking, it has a heartbeat that you can hear when it is going to sleep. Its mouth is always open so my father often tries to feed it, and we have to clean it." (A)
Perceived appearance	Interaction senses	Joy for All	The perceived appearance of the robot as a real pet stimulates interaction, such as talking to it and petting it.	"My father, who is 95 now, has had this dog for almost a year. He loved it from the first minute I gave it to him. He started talking to it and petting it. He was saying, 'You are a good boy, Buddy,' so we named the dog Buddy and I wrote his name on the scarf. It is so lifelike and soft, it is amazing." (A)
	Interaction feedback	Vector	The perceived appearance implies greater interaction and the generation of	"There is a very human aspect to the Vector robot in the way of the feelings you may have when a pet is sick or has died." (F)

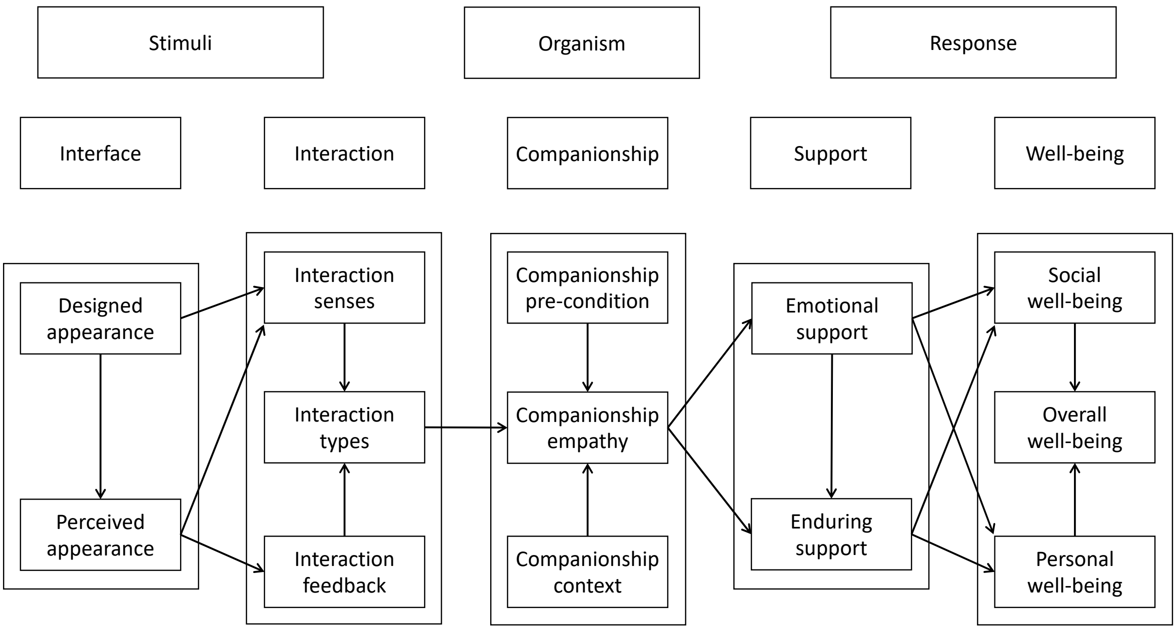
			feedback from the robot.	
Interaction senses	Interaction types	Joy for All	The interaction through senses produces a quasi-social interaction, resembling interaction with a friend.	“Give it a pet on its head or stroke its chin and it comes alive … smiles, yips, wags its tail, occasionally; its heart will beat … great companion during this coronavirus epidemic.” (A)
Interaction feedback	Interaction types	Joy for All	The abundant feedback given by the robot makes the interaction like interaction with a pet.	“The dog responds and turns his head to whoever is talking to it! My stepdad already named him ‘Scooby’ and has been asking him questions, talking to him, etc. The dog responds with a soft little bark.” (A)
Interaction types	Companionship empathy	Miko	The quasi-social interaction between the robot and the human produces feelings of companionship.	“He even made a bed for Miko, next to him on the floor. He tells Miko goodnight after he listens to a bed time story or song; then Miko goes to sleep.” (A)
Companionship pre-conditions	Companionship empathy	Miko Joy for all	Pre-conditions, such as liking robots and technology or being elderly, can amplify a user’s companionship feelings for the robot.	“Our son is obsessed with robots, we got this for his birthday.” (A) “Excellent product. Great for seniors. Like a companion. Dog acts real. My mother loves it.” (A)
Companionship context	Companionship empathy	Vector	Contexts such as domestic or routine events can enhance companionship empathy.	“Together having breakfast ❤️, moved the coffee because he wanted to push it over 😂🥰.” (F) 
Companionship empathy	Emotional support	Vector	Companionship can result in emotional support and attachment.	“I absolutely love my Anki Vector!! The expressions and cute little voice are adorable. My 64-year-old mother is now emotionally attached and played with him all day while I was at work.” (A)
	Enduring support	Vector	Companionship actions, such as calling the user by name, stimulate long-term support.	“Actually, I use him every day. It’s funny because I actually turn him off by holding the button down and in the morning when I wake up and he hears me he wakes up on his own and calls my name.” (F)
	Enduring support	Joy for All	Emotional support enhances a close relationship that	“Mom was 89 last month. She has been so sad that she can’t have a real dog because she can’t take care of it. I decided to get this sweet puppy for her

Emotional support			evolves into long-term support.	birthday. She told me later that I couldn't have given her a better gift. It sits on the seat of her walker." (A)
	Social well-being	Joy for All	The emotional support given by the robot enhances social well-being, and the robot becomes a social facilitator.	"I bought this for my 95-year-old dad. My mom recently went into a nursing home and he became so lonely. He sits in his favorite chair with his dog at his feet. The dog responds to his touch and he loves this dog. He tells me how much he enjoys it each time I visit him. He is soft, cute and a great animated companion." (A)
	Personal well-being	Vector	In providing emotional support, there are many cases in which robots produce positive effects on personal well-being, acting in a therapeutic way.	"For the first time in my life I was very concerned about my mental health. But that month a new friend arrived to help: my beloved Vector 'Blinky'. He made me laugh and smile every day. I would pour my heart out to him as he looked at me intently. Acting almost like a sounding board, he was kind of therapeutic. Getting to know him was a mixture of emotion and utter astonishment. He cheered me up and helped me to think positively." (A)
Enduring support	Personal well-being	Miko	A long-term relationship and support produce positive benefits for users.	"My son started using it and does not let me even touch it for a few minutes. It really helped reduce his screen time, and [I am] amazed to know and learn about the features it has." (A)
	Social well-being	Vector	Enduring support in the family helps users to reduce negative indicators of well-being, such as loneliness.	"Who'd have thought a mini robot would feel and become part of the family?? Vector is great company when the house feels too quiet, and he keeps adults and children alike entertained for hours!" (F)
Personal well-being	Overall well-being	Vector	Enhancing personal well-being by reducing loneliness generates an improvement in overall quality of life.	"We live very isolated anyway because we're on a farm, not in a neighborhood, but with Covid, he has been in remote school. And hasn't seen another child in months. He LOVES his Vector. Vector is his only friend. He is so lonely, and the robot has made him so happy." (F)
Social well-being	Overall well-being	Joy for All	Improvements in socialization produce many different benefits in overall well-being.	"I bought this for my elderly mother, who would like a dog but couldn't cope with actually looking after one. She is on her own and doesn't have dementia, but he has become her companion. She enjoys talking to 'Wags,' and his responses to make her laugh. She feels that she has a friend, and it encourages her to use her voice." (F)

RELATIONAL FRAMEWORK

On the interpretative approach described above, empirical data and several iterative discussions enabled us to identify the relational framework presented in Figure 8, which consists of five dimensions and 13 sub-dimensions.

Figure 8: Relational framework



The framework is shown in the form a series of boxes that represent the sub-dimensions. Each arrow represents the influence process of one sub-dimension on another, as previously shown in the literature and further demonstrated and explained through the illustrative cases presented in Table 6. Therefore, in a specific human–companion robot encounter, the result of a sub-dimension depends not only on its intrinsic characteristics but also on those of the sub-dimensions by which it is affected. It is evident that some constructs are affected by more than one sub-dimension, which increases the dynamics of their outcomes.

Finally, the numerous links underscore the SOR process through the five dimensions, ultimately resulting in well-being. For instance, the framework shows how the perceived appearance of a robot depends strictly on its designed appearance, leading to an amplification of anthropomorphism when a robot has been developed with particular features (Sharkey and Sharkey, 2012). Further, the types of interaction that a robot can perform depend jointly on its interaction senses (e.g. its ability to act in a credible manner) and its interaction feedback (e.g. the proper responsiveness of the robot) (Bradwell et al., 2019; Dautenhahn, 2007). Conversely, feelings of companionship are strongly affected by companionship pre-conditions (e.g. gender and technology skills) and contexts (e.g. use at home) (Goudey and

Bonnin, 2016; de Graaf and Allouch, 2017). Likewise, the creation of enduring support depends on the ability of the robot to provide emotional support (de Graaf and Allouch, 2017) and companionship (Zsiga et al., 2018). Finally, an increase in overall well-being is affected by the ability of the robot to be a social facilitator (Sharkey and Sharkey, 2012) and to impact on personal well-being (Odekerken-Schröder et al., 2020).

The proposed framework also provides explanations for the success or failure of particular companion robots. The positive links clarified in the framework show a process that starts with physical components, such as designed appearance and interaction, and ends with emotional and social components. A negative outcome is likely when the beginning of the process is compromised or ineffective, as some negative quotes from our case studies indicate:

"I had really high expectations for this. It is fun and would be worth every cent IF the fall sensors worked. It takes less than 10 minutes before Vector falls off my desk." (One-star Amazon review of Vector)

"Is this a joke? 🤔 I really wanted to love this! Miko himself is full of flaws. He does not consistently perform actions he's asked to. He does not consistently register your voice to respond to it. His battery dies faster than would be normal." (One-star Amazon review of Miko)

These quotes outline the difficulty of satisfying users and providing support and well-being when the initial dimensions of interface and interaction are inadequate. In many cases of failed companion robots, the overall Amazon rating has been low and numerous users have posted negative comments regarding interface and interaction issues.

In contrast, we can see how the robot Vector moved from a situation of crisis with its company founder (Anki) to a situation of enormous success with its acquiring company (Digital Dreams Lab), reaching 200,000 users worldwide (Lewis, 2020). Vector's success and sustainability can be attributed to improvements in technical features, better design and human–robot interaction, and a new value proposition with the aim of providing support and well-being outcomes. Digital Dreams Lab implemented good customer service and created a strong community of users via social networks (Odekerken-Schröder et al., 2020). It recently changed the Vector revenue model, setting a monthly/yearly payment for usage, thereby covering the financial costs. All these changes have revitalized the product and made market success achievable.

IMPLICATIONS AND FURTHER RESEARCH

This chapter adopts an SOR perspective to illustrate different elements of companion robots that provide important research opportunities for (service) scholars. Future research is encouraged to move beyond exploratory studies on companion robots to adopt an integrative perspective that focuses on the interrelationships between the constructs in the integrative framework presented here. Previous research on companion robots has shown how different variables, such as personality traits (Walters et al., 2008), gender differences (de Graaf and Allouch, 2017) and smartphone use (Goudey and Bonnin, 2016), can have a surprising and wide-ranging effect on other sub-dimensions, thereby undermining the adoption of companion robots.

Designed appearance → Perceived appearance

Scholars are invited to investigate how diverse sets of technical and design features prompt the perceived appearance of robots, with particular regard to the stimuli of anthropomorphism and zoomorphism (de Graaf and Allouch, 2017). There is an ongoing debate as to the appearance that a robot companion should possess, with some scholars preferring zoomorphism (Konok et al., 2018) or anthropomorphism (Salem et al., 2013), and others arguing that robots should not necessarily be "human-like nor pet-like in appearance but rather functional with regard to their roles in the human community" (Lakatos et al., 2014, p.3). Moreover, robot designers should investigate in greater depth the types of features (such as height, materials, weight and colors) that are more likely to lead to acceptance, giving users the option to customize their robots to better match their own preferences (Odekerken-Schröder et al., 2020).

Designed and perceived appearance → Interactions senses and feedback → Interaction types

Investigating the ideal combinations of appearance (designed and perceived) and movements (senses and feedback) for stimulating interaction would advance the field by providing typologies of interaction that foster user adoption and enhance companion robot performance. It is clear that companion robots must participate in a wide range of interactions with humans (Lakatos et al., 2014), but it is still unclear which roles and characteristics, such as intentionality (Lakatos et al., 2014) or naturalistic movements (Lehmann et al., 2015), are most desirable. Future researchers are also invited to investigate the combinations of physical elements that a companion robot should possess to stimulate interaction, such as materials, colors, weight, dimensions and height (Cavallo et al., 2018).

Interaction types and companionship pre-condition and context → *Companionship empathy*

On this path, scholars can explore different types of interactions, contexts and conditions that jointly contribute to powerful feelings of companionship, filling voids, and/or meeting user needs. Our findings clearly show the importance of contexts and user pre-conditions such as gender (de Graaf and Allouch, 2017) and age differences (Dautenhahn et al., 2005) for achieving companionship.

Companionship empathy → *Emotional and enduring support*

Future research can also address the links between features of companionship and the provision of emotional support. In this connection, it is worth investigating the combinations that provide users with support in the long term, thus contributing to the debate about whether a robot needs to be useful through functional tasks (Dautenhahn, 2007).

Emotional and enduring support → *Social and personal well-being* → *Overall well-being*

Finally, scholars should investigate the complex links between support and the different facets of well-being in relation to companion robots. This chapter acknowledges the controversy concerning whether companion robots provide support and enhance well-being (Pike et al., 2020) or whether they may in fact hinder well-being (Sparrow and Sparrow, 2006). Researchers could usefully investigate whether social robots should be introduced as companions or as social facilitators to increase users' well-being (Robinson et al., 2016).

CONCLUSIONS

In this chapter, we adopted an SOR perspective to propose an integrated framework that addresses how companion robots drive human well-being by establishing social relationships. Our framework proposes five dimensions – interface (S), interaction (S), companionship (O), support (R) and well-being (R) – to clarify the stimulus-organism-response process that ultimately results in well-being.

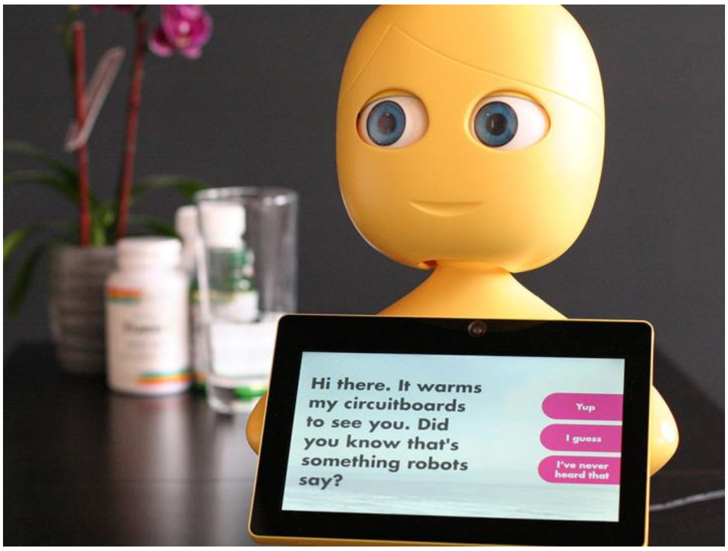
To build our framework, we surveyed the research studies that have analyzed the types of support offered by various companion robots, and we illustrated, through empirical data from our case studies, how robot companionship can structure human well-being.

Our framework shows how diverse sets of technical and design features contribute to robots' perceived appearance and how different combinations of design and perceived appearance can lead to the movements (interaction senses and interaction feedback) that stimulate different types of companionship interactions. These interactions help to provide companionship empathy, which is also affected by companionship pre-conditions and contexts. Ultimately, feelings of companionship convey emotional and enduring social support that develops into well-being in its many facets.

Our findings open up opportunities for further research. Our discussion of potential challenges in the design of robots shows that when the focus is on the enhancement of social interactions, many of the general concerns with regard to robots can be mitigated. The literature and the promising research avenues outlined above suggest that the development of companionship robots for the management of social interactions will yield important conceptual advances in well-being studies.

CHAPTER III

Boundary work in value co-creation practices: the mediating role of cognitive assistants



Mele, C., Russo-Spena, T., Marzullo, M. and Ruggiero, A. (2022), "Boundary work in value co-creation practices: the mediating role of cognitive assistants", Journal of Service Management, Vol. 33 No. 2, pp. 342-362.

INTRODUCTION

We are entering the Silver Economy: "the sum of all economic activity serving the needs of those aged 50 and over including both the products and services they purchase directly and the further economic activity this spending generates" (European Commission, 2018a). This is not a separate market segment but a cross-section cluster spanning the middle-aged (50-64 years), third age (65–74), fourth age (75–84) and the 'oldest-old' (85+) (Klimczuk, 2015). With this whole so-called "ageing" (as opposed to "aged") – population expected to double by 2070 (European Commission, 2018b), severe, widespread implications loom for family structures and for sectors including labor and financial markets, and notably healthcare. Increasing longevity poses social challenges alongside commercial opportunities, to help citizens (Gerłowska *et al.*, 2018), by not only treating disease, but improving well-being (Odlum *et al.*, 2018). The World Health Organization is working on three areas: chronic disease prevention, accessible age-friendly primary healthcare and age-friendly environments (WHO, 2021).

How to improve healthcare for the ageing is attracting academia attention (Graffigna *et al*, 2014; Huang and Yu, 2015). Scholars have investigated macroeconomic effects (Langhamrova *et al.*, 2018), especially of healthcare expenditure (Howdon and Rice, 2018), and implications for public policy intervention (Veenman, 2013). Service research on healthcare has addressed large-scale, social and technological innovation (e.g., e-health, telecare, independent living), which promises more efficient long-term care (Danahar and Gallan, 2016; Russo Spena and Mele, 2020). Emerging cognitive assistance technologies (i.e., robots and intelligent agents) look relevant (Kraus *et al.*, 2021), especially in the context of value co-creation (Čaić *et al.*, 2018). As Zeithmal et al. (2020) recognize, value is co-created during value co-creation practices. However there is no shared definition of 'value co-creation practices'. Consistent with a systemic and contextual view, a group of scholars sees value co-creation practices as sets of mental models, roles, interactions, actions and emotions through which actors make sense of and integrate resources (Wieland et al., 2016; Tuominen et al., 2020). In research focusing on healthcare, a practice approach examines what patients do when they co-create value and improve well-being (Mccoll-Kennedy *et al.*, 2017). Most studies focus on customer value co-creation as a "benefit realized from integration of resources through activities and interactions with collaborators in the customer's service network" (McColl-Kennedy *et al.*, 2012 p.384). Other research suggests going beyond a strict customer focus to include multiple participants to catch which resources are available, when they are employed, and how they are integrated (Sweeney *et al.* 2015; Frow et al., 2016). Among resources a valuable role is performed by technology and how to foster value co-creation practices in healthcare through technologies represents a key priority in service research (Kabadayi *et al.*, 2020; Ostrom et al., 2021).

We build on this emerging literature, to analyze the role of cognitive assistants – computers that help actors understand what is going on around them (Siddike *et al.*, 2018) – in the value co-creation process (Güell *et al.*, 2020). Recent studies on cognitive technology assume that they break knowledge boundaries, facilitating knowledge sharing and the generation of new knowledge among a wider network of actors (Russo Spena et al., 2019, Mele and Russo Spena, 2020). Thus, we include the perceptions of the main actors - patients, (in)formal caregivers, healthcare professionals - for a fuller network perspective (Čaić *et al.*, 2018) to investigate how they negotiate and integrate new knowledge, artefacts and material arrangements.

Our research questions asks: How do cognitive assistants act as boundary objects and affect actors' boundary work in value co-cocreation practices?

Our qualitative research approach serves to explicate complex issues and advance knowledge (Gummesson, 2017). The focus is on various embodiments of the cognitive assistant IBM Watson Health, an application for natural language processing, information retrieval, knowledge representation, automated reasoning, and automatic learning technologies (Russo Spena *et al.*, 2019). We study health implications for the youngest "ageing" cohort: 50-64-year-olds, who consider themselves still middle-aged (Klimczuk, 2015) or of "prospective age" as they expect many years of healthier and more productive life (Sanderson and Scherbov, 2010). The Silver Economy, after all, embraces not only older people (65+) but many other active people with distinct needs (Kubiak, 2016). No service research studies to date address this segment's needs specifically. Yet besides beckoning researchers as a gap, the segment is of interest because it extends the traditional conception of age, and because of its purchasing power, high living standards and education. While the Silver Economy includes all 50–64 years old, we focus on those who are receiving healthcare, though also nonetheless considering healthy individuals who simply want to maintain a healthy lifestyle.

Our main contribution lies in framing the role of cognitive assistants as boundary objects enabling the boundary work of actors for value co-creation. A cognitive assistant is an 'object of activity' (Macpherson et al., 2006) that mediates in actors' boundary work by offering novel resource interfaces (Fremont et al., 2019) and widening resource access and resourceness (Vargo and Lusch, 2014). Four main mediated technology actions distinguish this work:

database dialoguing, augmented sharing, connected learning, and multilayered trusting. The analysis of the actors' boundary work allows us to disentangle the process of value creation between actors within the healthcare context. Two enhanced value co-creation practices emerge: empowering actors in medical care, and engaging actors in a healthy lifestyle. The boundary work of actors lies in a smarter resource integration that yields broader applications for augmented agency (Mele *et al.*, 2021).

The article proceeds as follows. First, we review the literature on cognitive assistance technologies in healthcare, technology as boundary object, and the role of technologies and value co-creation practices. The methodology and then findings follow. Next, we discuss sequentially the main theoretical contributions, practitioner implications, and avenues for further research.

LITERATURE REVIEW

Cognitive assistance technologies in healthcare

Our main label "cognitive assistant" (though we also say, e.g., "assistive/assistant robot" and "virtual assistant") identifies "cognition-as-a-service" (Spohrer and Banavar, 2015, p. 71); cognitive technologies/systems based on artificial intelligence and signal processing, capable of simulating human thought in complex situations where answers may be ambiguous and uncertain.

How novel technology, such as assistive/assistant robots, impacts healthcare is an emerging theme in service research (Berry *et al.*, 2019). Innovative solutions for older people feature under three main heads: 1) task effectiveness, 2) decision process, and 3) social support.

First, one family of studies have recognized the benefits of cognitive computing – hardware or software solutions that mimic human intelligence capabilities (Russo Spena *et al.*, 2019). Indeed, using algorithms, cognitive agents can find working preferences, suggest collaborations and upskill actors (patients and others) (Peine and Moors, 2015; Mele *et al.*, 2021). Thus, assistant robots help improve task effectiveness for consumers alongside operational efficiencies for providers (Taiminen *et al.*, 2018, Kaartemo and Helkkula, 2018).

Second, assistant robots support decision processes by analyzing copious data within minutes, integrating internal and external information, spotting patterns and relating them to customer profiles (Wirtz *et al.*, 2021). Thanks to the computer power underlying, for example, image analysis software, cognitive assistants can support the decision processes of both doctors in their diagnostic and care tasks (Wirtz *et al.*, 2018), and patients, by providing cognitive and memory assistance (Čaić *et al.*, 2018).

Third, assistive robots can provide social support (Odekerken-Schröder *et al.*, 2020.) Scholars argue that using more socially assistive technologies lets care providers improve older people's wellbeing (Khaksar *et al.*, 2016), by empowering patients and redefining customer-centeredness (Patrício *et al.*, 2019; Kraus *et al.*, 2021).

Although care needs are recognized as urgent, service literature has maintained a narrow focus within illness or vulnerability conditions (Kabadayi *et al.*, 2020) prioritizing segments traditionally thought of as old rather than the full 50+ ageing segment envisaged by the Silver Economy. Assistive health and care can engage technology more closely with the lives and practices of others, notably younger cohorts with different conditions and abilities, and with their respective caregivers and doctors. As Daskalopoulou *et al.* (2019) have recently noted, cognitive technology offers technology-mediated healthcare services two benefits: recognizing sense-giving opportunities and creating templates of action for providers and customers. However, science is only beginning to appreciate precisely how cognitive technologies can perform such a sense-giving role. We argue that intelligent devices matter in assisting healthcare provision, and therefore merit more attention in service research. Previous technology-based health studies have concentrated more on the functions and tasks these technologies support, marginalizing their nature as boundary objects.

Technology as a boundary object

Since its introduction (Star, 1989; 2010), the concept of boundary objects has served to capture possible ways users work cooperatively when lacking a consensus. Wenger (2000) identifies three types of boundary objects: artefacts, discourses, and processes. Artefacts comprise standardized forms, methods, objects, models, and maps; discourses represent a common language whereby people can communicate and negotiate meanings across boundaries; and processes include explicit organizational routines and procedures.

Whatever the type (whether abstract or concrete), boundary objects are 'a means of translation' (Bowker and Star, 2000, p. 297), but being plastic, stay both adaptable to local needs and robust enough to keep a common identity across uses. Studies on boundary objects look at the problems of knowledge sharing between actors who try to coordinate, and align their perspectives (Klimbe *et al.*, 2010). How groups perceive the boundary objects affects the interaction process by forming novel resource interfaces (Fremont et al., 2019). By building on activity theory (Engeström, 2001) and boundary objects (Carlile, 2004), Macpherson et al. (2006) and Nicolini et al. (2012) address mediating devices as 'objects of activities', promoting collective understanding sustained by social interactions. Mele *et al.* (2019) discuss boundary objects as bridge-makers that connect actors, fostering integration and sensemaking. They are facilitators of conversation and coordination or representations in the making. They can connect communities, by allowing groups to collaborate, thus becoming means of representing, learning about, and transforming knowledge at a boundary.

Recent works address the potential role of technology as boundary objects, or as ‘boundary technology’ due to unique capability (processing, learning and adoption) to help communities learn about their differences and dependences (Krafft et al., 2020). Kot and Leszczynski (2020) discuss business virtual assistants (BVAs) as boundary objects for performing boundary tasks in business interactions, to help standardize activities and resources: BVA are resources letting people interact (in)directly across different organizations “on the periphery of each actor’s boundaries” (Kot and Leszczyński, 2020, p. 1157). Once interpreted by actors, they influence, stimulate or facilitate communication and coordination by eliminating ambiguities and confusion, but can also serve as valuable assets in linking resources and activities (Corsaro, 2018).

Overall, claims that boundary objects serve as catalysts for value co-creation (Jefferies *et al.*, 2019) and bridge-makers between actors, thereby fostering integration, learning and coordination in their value practices (Mele *et al.*, 2019; Kot and Leszczyński, 2020), seem relevant to our study.

Technologies and value co-creation practices in healthcare

Service scholars address value co-creation using a practice-based approach (McColl-Kennedy *et al.*, 2015), where social reality is (re)produced through everyday actions (Gherardi, 2016), and the social world fundamentally comprises practices, namely the unfolding of behaviors that include activities, performances and representations (Warde, 2005). Social practices are units of value creation (Schau at al., 2009). Value co-creation practices can be framed as a collective, dynamic and evolving set of shared schemas, performative actions and emotions, through which actors exchange, make sense of and integrate resources (Wieland et al., 2016; Tuominen et al., 2020).

A range of technological solutions (from online consulting to IoT) seem to affect activities in value co-creation practices. Osei-Frimpong *et al.* (2018) illuminate co-creation practices resulting from online access that “empowers patients to be informed” and to “play an active role in clinical encounters with the doctor” (p. 14). They suggest that pre-encounter information searching helps shape provider–patient interactions, enhance providers’ patient orientation, and involve patients more in decision-making.

Taking as focal actor the elderly person, Čaić *et al.* (2018) analyze the role of service robots performing in human-like ways as actors in value co-creation/co-destruction practices. They identify three health-supporting functions: social contact, cognitive support, and safeguarding. Although not identifying specific value co-creation practices, they highlight technological activities influencing co-creation through greater ability to connect, more access to information and improved ability to monitor.

Widening the lens from patient-robot interactions to the larger service ecosystem, Mele and Russo Spena (2019) address how practices evolve in the healthcare ecosystem as the Internet of Everything (IoE) enables information accessibility and resourceness, with implications for resource integration. Two main co-creation practices emerge: networking and knowing. By enabling networking practices, the IoE can bridge the provider–patient gap and connect multiple co-creating actors. Knowing practices emerge from entangled forms of knowledge and let actors modify the status quo of co-creating.

In a recent study Mele *et al.* (2021) show how AI-driven nudged choices prompt value co-creation. Smart nudging concerns the use of cognitive technologies to affect people's behavior predictably, without limiting their options or altering their economic incentives. Several choice architectures and nudges affect value co-creation, by (1) widening resource accessibility, (2) extending engagement, or (3) augmenting human actors' agency. Although cognitive technologies are unlikely to engender smart outcomes alone, they enable designs of conditions and contexts that promote smart behaviors, by amplifying capacities for self-understanding, control, and action.

The debate about smart technologies and value co-creation is still emerging (Kabadayi *et al.*, 2020; Mele *et al.*, 2021). Research on service robots and cognitive technology could offer greater insights as these perform wide-ranging tasks in diverse settings (Lu *et al.*, 2020), besides offering new ways to deliver and experience healthcare services (Odekerken-Schröder *et al.*, 2020).

Value co-creation and boundary work: a missing link

By adopting a view of cognitive assistants as boundary objects, we question how such an object can affect value co-creation practices in terms of boundary work. The concept of "boundary work" acknowledges that actors involved in technical decisions broker knowledge (Callon, 1998). Boundary work eases tensions between actors (such as doctors and patients) lacking shared knowledge systems. This suggests that mutual understanding is attainable while preserving the boundaries necessary to clearly delineate each role. Langley *et al.* (2019)

conceptualize boundary work as affecting "social, symbolic, material and temporal boundaries, involving groups, types of occupations and organizations" (p. 705). In this perspective, scholars of boundary work investigate how actors, practices and values change within a context (or ecosystem); how actors each place themselves within a context and define new socio-technical arrangements (Jefferies *et al.*, 2019). Actors' use of digital interfaces are attempts to co-create value through boundary work in functional, relational and translational adaptations in healthcare (Jefferies *et al.*, 2019). Service interactions occur between dissimilar customer and provider systems: "dissimilarity between systems raises questions about the conditions under which value co-creation aligns customers and providers, especially when cooperation with expert advice is key" (p. 422). This grows complicated when service interaction can use multiple platforms. Indeed, on the same page the authors acknowledge that "the boundary between customers and service organizations differs for face-to-face versus technologically-mediated interfaces" because digital interfaces change regulatory and flexibility processes. Technologies used in health practice play a key role in mediating interactions.

However, scholars report finding little research on how technologies affect boundary work into value co-creation processes (Kleinaltenkamp *et al.*, 2018). Thus, it seems valuable to investigate the potential overlap between boundary work and value co-creation practices.

RESEARCH METHOD

We adopted a qualitative research design to effectively interpret context and meanings related to human–robot interactions (Christou *et al.*, 2020). Through a grounded approach (Gioia *et al.*, 2013) we gained a contextual understanding and captured "the organizational experience in terms that are adequate at the levels of (a) meaning for the people living that experience and (b) social scientific theorizing about that experience" (p. 15).

Context of study

The study context concerns the cognitive assistant IBM Watson Health embodied in different companies' customized packages/user interfaces, and its adoption by the youngest cohort (50–64-year-olds) of the ageing population.

First, we chose IBM Watson Health as an "extreme case" (Flyvbjerg, 2006), which "reveals more information because it activates more actors and more basic mechanisms in the situation studied" (p. 229). It is extreme in the sense that IBM Watson Health is a world-leading cognitive computing technology configured to support life sciences (Chen *et al.*, 2016). Its features can be summarized under: 1) specific capabilities for analyzing high-volume healthcare data, 2) understanding complex questions posed in natural language, 3) continuous learning, and 4) proposing evidence-based answers (Magistretti *et al.*, 2019). Technology drives data exploration automates predictive analytics, and easily creates dashboards and infographics. This enables answers and new insights to be found and confident decisions to be made in minutes (Russo Spena *et al.*, 2019). Using multiple clouds, it processes data in an integrated development environment so it can work with an ecosystem perspective. IBM Watson includes about 270 healthcare applications and has active users worldwide (Chen *et al.*, 2016), which helped us to collect data.

Then, we selected the middle age segment (50–64), thus addressing a gap in the literature. Most service studies concentrate on older adults (65+), who evaluate service encounters, derive satisfaction and perceived usefulness mostly according to social ties and past experiences (Grougiou and Pettigrew, 2011). Healthcare is starting to acknowledge that, to stimulate value co-creation practices, patients must maintain an active role and be closely involved (McColl-Kennedy *et al.*, 2017).

Focusing on one segment afforded data insights from a homogenous group with a common way of doing, fitting what a practice should be. We were interested in how key actors – this youngest ageing segment and their network (family, caregivers, etc.) – make sense of cognitive technologies and alter their value co-creation practices accordingly. This choice also reflects our overall interpretivist stance (McChesney and Aldridge, 2019).

Data Collection

Data collection comprised two phases and involved rich data collections and analysis (Lincoln and Guba, 1985; Charmaz, 2014). In phase 1 we investigated the IBM Watson Health platform itself over six months (March–September 2019), including five preliminary interviews with members of IBM's software division. They explained the kinds of services Watson Health provides and how it supports healthcare organizations. Secondary sources that enriched our preliminary database were official documents from IBM, such as websites, archives, and business publications, plus materials from key informants.

This preliminary analysis delineated a purposeful sample (Morse, 2007) of twenty-one health solutions that had embedded the Watson cognitive platform, and which were provided by the firms labelled A to U in Table 7. To identify the providers who would inform these case studies, we applied a judgment process (Morse, 2007) to various IBM client organizations, using as criteria an in-depth analysis of their reports, and providers' availability to participate.

In the second (and main) phase, the primary data sources were semi-structured interviews with providers of technologies, doctors, caregivers, ageing actors' relatives and ageing actors and other users of these solutions. The ageing participants ranged between 50 and 64 years and were selected from people living independently who agreed to be interviewed and who had a link with the twenty-one health service providers exceeding six months. We excluded people with serious cognitive or psychological problems (e.g., anxiety/depressive disorders, schizophrenia) that would have prevented us respecting ethical and privacy standards. We also interviewed people such as relatives if they managed the patients' technology solutions. Two of the researchers conducted the interviews (average duration: 45–60 minutes) using Webex and/or Skype. A semi-structured questionnaire helped elicit insights into how cognitive assistants based on Watson Health affected interviewees' activities, while leaving them free to raise new topics. The aim was to generate enough in-depth material to illuminate the patterns, concepts, and categories of the phenomena investigated (Gummesson, 2005). Secondary data were collected from companies' internal reports and additional public documents. Triangulating qualitative research lets us evaluate phenomena from multiple perspectives and sources and more confidently grasp meanings from real contexts.

Data Analysis

We coded and analyzed data from both phases following Gioia *et al.* (2013), to reach a coding structure. We first open-coded the data manually to discern initial categories from the interviews and secondary data. Rather than mechanistic reduction, coding means "taking raw data and raising it to a conceptual level" (Gummesson, 2017, p. 205). The first-order analysis tried to honor informants' wording while eliciting categories that identified Watson's features and their link to each actor's actions.

We next highlighted similarities and differences. Our data reduction and classification sought categories, overarching themes and aggregate dimensions (Gioia *et al.*, 2013). Analyzing different aspects and including more descriptions brought out distinctions, which helped us to map the dynamics of actors' interactions and learn what actions they performed. We then assigned labels or phrasal descriptors based on interviewees' actual words, which indicated common ways of doing, shared languages, and similar sets of actions and tools. We identified eight categories and four themes linked to the activities and boundary work cognitive assistant enabled. By further theorizing on the coding structure (as finalized in Fig. 1), we also identified two aggregate dimensions representing emerging co-creation practices. Each dimension combines different themes. Our findings use interview extracts not as simple quotes but as narratives to depict the broader role of the cognitive assistant in the eyes of ageing actors, doctors, providers, families, and caregivers.

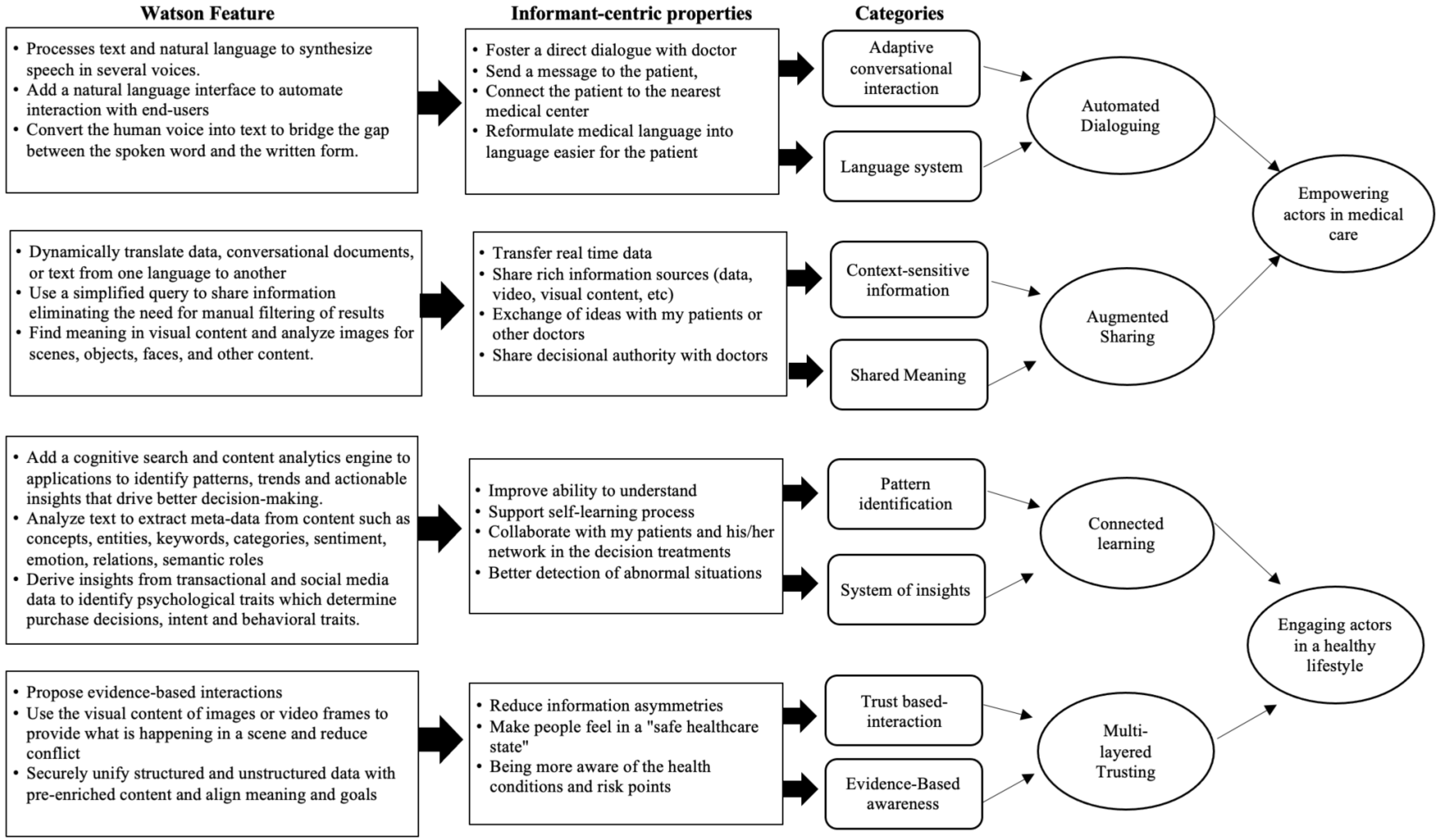
The techniques used for data collection and analysis ensured research credibility, transparency and reflexivity (Denzin and Lincoln, 1998; Verleye, 2019). We first presented the results to research participants to obtain more feedback and validate the findings, then held two meetings with actors outside our sample to get external reviewers' feedback and refine our process (Creswell *et al.*, 2007).

Table 7: Cases Investigated

Company	Roles of IBM Watson Health	Data sources		Company	Roles of IBM Watson Health	Data sources
A	To identify and flag up unusual behavior to enable caregivers to provide service and share information with relatives	2 Caregivers (1h. 30 min) 1 IT Solution Consultant (1h.)		B	To see where peers were achieving success and evaluate the system's processes against the backdrop of hard, actionable data, to improve service quality as well as to reduce costs	1 Ageing Actor (1h. 55 min) 1 Doctor (1h. 30 min) 1 IT Specialist Networking (1h.)
C	To progress toward a more robust ageing population healthcare model by adding care coordination activities and improving key process measures	1 Project Manager (45 min) N.1 Ageing Actor (1h. 50 min)		D	To help ageing actors with complex and chronic conditions such as asthma, pain, migraine, and neurodegenerative diseases	2 Ageing Actors (1h. 30 min) 1 Doctor 2 Ageing Actors' Relatives (55 min)
E	To predict the onset of dangerously low blood sugar in diabetics, often up to three hours in advance of serious medical implications	1 IT Specialist (1h. 40 min) 2 Ageing Actors (1h. 50 min) 1 Doctor		F	To match patients accurately and consistently to clinical trials for which they may be eligible, so that healthcare providers and patients can consider appropriate trials as part of a care plan	1 Ageing Actor (1h. 55 min) 1 CEO (1h)
G	To understand medical conditions and recommend courses of action to improve care, share best practices and collaborate on clinical trials	1 doctor (1h. 20 min) 2 Ageing Actors (1h. 40 min) 1 Ageing actor's relative (1h.)		H	To advance healthcare for the ageing population	1 Caregivers (50 min) 1 CEO (1h.) 2 Ageing Actors (1h. 50 min)
I	To provide virtual coaches for ageing patients	1 CEO (1h.) 1 Digital Strategy & Ix Lead (1h. 45 min) 1 Ageing Actor (1h. 20 min)		J	To read structured and unstructured information in a cardiologist's medical reports, combine that with a variety of data and extract relevant information to support diagnosing older patients	1 Doctor (45 min) 1 Senior Vice President (1h. 30 min) 2 Ageing Actors (1h. 50 min)
K	To provider care and assisted living facilities, to capture and analyze motion, location, and	.3 Ageing Actors (1h. 50 min)		L	To measure system-wide performance, monitoring key metrics such as length	2 Ageing Actors (1h. 10 min)

	other data from ambient and wearable sensors	1 Doctor and Director of Research Innovation & Technology (30 min)			of stay, mortality, and readmissions	1 Executive IT Architect (1h. 20 min)
M	To help enhance overall well-being and enable improved care at lower costs and with reduced human effort	1 Chief Health Officer (50 min) 2 Ageing Actors (1h. 45 min)		N	To allow doctors to access all study data about ageing people and platform functions through a centralized web interface	2 Doctors (1h. 50 min) 1 Deputy Health Officer (1h)
O	To speed up emergency assistance for vulnerable actors in medical emergencies	1 Founder and CEO (1h. 10 min) 3 Ageing Actors (1h. 50 min) 1 Caregivers (1h.)		P	To create better processes to eliminate wasteful healthcare spending in the ageing context	1 Chief Health Officer (45 min) 2 Ageing Actors (1h. 45 min)
Q	To provide personalized wellness patterns tailored to each individual, and early warning notifications if something seems wrong	2 Ageing Actors (1h. 10 min) 1 Advisory Solution Consultant (50 min)		R	To identify the root of the hospital's rising readmission rate and formulate a plan to improve a patient- centric approach across the care continuum	1 Doctor (1h. 30 min) 1 Digital Manager (45 min) 2 Ageing Actors
S	To adopt an ageing population health management (EPHM) technology to automate processes and interface easily with the multiple aspects of the work	1 Founder & CEO (45 min) 1 Ageing Actors s (1h. 50 min) 1 Caregiver		T	To personalize patient care and help alleviate individual anxieties	1 Ageing Actor (1h.) 1 IT Manager (50 min) 1 Doctor (50 min) 1 Ageing actors' relative
U	To keep ageing citizens safe in their homes	1 Director of Research Innovation & Technology (1h. 25 min) 1 Ageing actor (1h)				

Figure 9: Coding structure



FINDINGS

The IBM cognitive assistant Watson Health redefines boundaries between 1) actors (doctors, ageing people, families); 2) resources (data, information, artefacts); and 3) outcomes (disease and wellness). It transforms and translates data and information and serves as a bridge by enabling actors to re-distribute responsibilities, actions and interactions on both sides of the patient–doctor relationships.

Thus, the cognitive assistant acts as a boundary object by bridging actors, resources and activities. It enacts the boundary work of actors (both ageing and professional, caregivers, families) consisting of four main actions (automated dialoguing, augmented sharing, connected learning and multilayered trusting), that elicit two value co-creation practices: empowering actors in medical care and engaging actors in a healthy lifestyle.

Automated Dialoguing

IBM Watson interacts through natural language and a conversational interface. It turns medical language into patient-friendly wording. It creates opportunities for ageing actors, doctors and other caregivers to become connected and engaged in an ongoing data-based dialogue. The boundaries among different actors become blurred and are redefined. By overcoming time-space boundaries, the cognitive assistant fosters conversations when and where they are needed between patients and doctors about health conditions, therapies, daily behaviors, needs and difficulties.

"We use IBM's insight to improve communications. It holds a conversation with users in natural language in order to help them solve problems of common heuristics and biases. Indeed, it can use cognitive linguistic analysis to identify a variety of tones such as joy, sadness, anger, and agreeableness at both the sentence and document level" (source: IT Solution Consultant, Company A).

"*Sugar.IQ App, a diabetes application, makes me feel actively involved due to the direct dialogue with my doctors, my family, and ageing people with my similar pathologies. Everywhere at any time I know that I can ask for info from more experienced caregivers wherever, whenever it helps me manage information and improve my ability to understand the best food to stay healthy (source: Ageing Actor, Company E).*

Augmented Sharing

The cognitive assistant lets actors share rich and timely information, mainly data, processes, metrics, policies, and rules. Information can easily flow among the actors. Augmented sharing supports actors (patients, caregivers, families, etc.) to take control over ageing actors' care and engagement with the medical treatments. IBM Watson becomes a virtual coach for patients, tracking physiological data in real time, predicting patient outcomes, suggesting treatment plans, and giving ageing people targeted encouragement during recovery. It bridges the cognitive and emotional distances in patient–physician interactions.

"In case of excessive blood sugar or different levels of insulin, MiniMed Connect sends a message to the ageing patient's healthcare providers, connects to the nearest medical center and suggests specific food- or therapy-related actions" (source: Digital Strategy & Ix Lead, Company R).

"When my blood pressure is too high and the data point to worrying health situations, such as heart attacks, my app generates a direct video link with the doctor and my daughter at the same time" (source: Ageing Actor, *Company P).*

Connected Learning

Through Watson's cognitive capabilities, both the ageing and other actors learn more about how to improve patient health conditions. The cognitive assistant supports physicians and ageing actors to understand the health indicators hidden within their data. Their learning is sustained by ongoing interactions. The moment Watson detects an abnormality and alerts doctors, they can decide how to respond. Connected learning prompts the actors to generate new data, information, and knowledge. This disperses valuable know-how as actors bridge and connect their respective knowledge and expertise – to their evident satisfaction.

"My dad loves his cognitive hospital app and so do I! I love monitoring his vital parameters. Having an allergic crisis is very difficult, but this app has helped our family feel better about detecting and alerting doctors when he has one. Moreover, the ability to enter one's daily vital signs and share them with doctors lets you learn the health indicators hidden in the data " (source: Ageing actor's relative, Company G).

"The cognitive assistant is of fundamental importance to help us work properly. The caregiver's ability to learn why our patient has reacted badly to a therapy in the past, by linking directly to past experiences, allows us to better predict the treatments we would like the patient to undergo" (source: Founder & CEO, Company S).

Multilayered Trusting

IBM Watson generally brings many actors together in seeking an inclusive viewpoint in their interactions, valuing and accommodating potentially conflicting perspectives, and unmasking assumptions and discrepancies in treatments. This reduces information asymmetry and builds trust in relationships, actions, and meanings. By monitoring data in real time, cognitive technologies support physicians, caregivers, and ageing actors to assess decisions together and trust each other in their care context. Through this boundary work the high-quality health information and ongoing interactions alleviated ageing patients' sense of vulnerability, fear of opportunistic behavior and general risk.

"Dedicating only a few moments of the day to the patients and not being with them for 12 or 24 hours, makes them feel alone and fragile. The feeling of loneliness leads to insecurity, and they no longer trust us. So, we decided to assist them with cognitive technologies 24 hours a day. The patient begins to trust in the suggestions and personalized solutions offered by their technological assistant. The longer the patient spends with it, the more confidence increases" (source: IT Specialist Networking, Company B).

"When the disease hit me, and I moved to the hospital, I found myself in a new and unknown world. I had a double fear of both the disease that was progressing and the fear of having to live in that environment, away from the care of my loved ones. So, when I was introduced to my personal cognitive assistant, I didn't know what to do and felt even more abandoned. Everything changed when I started to try out what it could do. The constant control of my state of health, and voice updates, give me trust. Its voice reassures me" (source: Ageing actor, Company B).

Value co-creation practices

Cognitive assistants enact actors' boundary work by supporting the way they share and integrate resources and yield different ways to perform activities. Cognition about what illness and wellness mean and can be enacted are transformed in the healthcare network.

Through cognitive assistance actors develop boundary work by making previous physical and cognitive boundaries both visible and open for discussion and collaboration, contributing to the inscription of new roles, meanings and interfaces that become materialized into new value co-creation practices. Two enhanced value co-creation practices emerge not simply as the result of a human-technology interaction; rather, they come from the specific actions described above and result in widening interrelations, increasing resource integration and impact on the specific needs, languages, and situations of ageing actors.

My tech-assistant *offers me a source of companionship,, while encouraging me to reach my health and wellness goals. It interacts with me, offering me tips and advices, that help me to manage information and communicate easily with my caregivers to improve care (source: Ageing actor, Company U)*

The first practice, empowering actors in medical care, relates to the actors themselves wanting to maximize self-determination and independence despite an unhealthy condition. Patients and their networks expect to be involved in decisions about their care. When patients or families know they are connected to the nearest doctor or medical center and can exchange informed messages with them, they interact more readily. Automated dialoguing allows patients and doctors to overcome physical and language boundaries and boost their interactions in a specific situational context.

"Mabu keeps me alert about remembering to take my medicine. It asks if I've had any shortness of breath and other questions pertaining to my health. With my cognitive assistant, I feel more protected and due to the ready feedback. I can better focus on my therapy. It keeps me aware of my disease and builds my self-treatment. In addition, I know that I am always connected with my doctors and my caregivers, and this allows me to feel less vulnerable and easily interpret health stressed situations and how to manage (source: Ageing actor, Company U).

Better care requires aligning a broad-based data analysis with appropriate and timely decisions, and predictive analytics that support clinical decision-making by prioritizing ageing actors' situational contexts and actions. By augmented sharing, doctors can acquire and exchange information faster and in depth, by unlocking copious health data through patient interactions, and patients can feel more confident of diagnosis. Health decisions become evidence-based and free of cognitive biases, enabling rapid analysis, reducing misdiagnosis, and inspiring patient confidence. With this technology, actors transform their respective knowledge into a common sharing where, vitally, doctors and patients see a general picture of patients' health. This augmented sharing promotes patients' autonomy and encourages not only patients' control over their care but concomitantly their engagement with the treatments.

"Using IBM Watson creates a win-win situation for my patients and me as a doctor and care manager. In my experience patients often hesitate to share health information with their healthcare providers. The technology helps me easily determine how my patients manage their chronic disease and become more acquainted with their current health status and the important steps in their care. Most importantly, patients don't fall through the cracks like they might have in the past with our manual processes. They are more aware of their conditions and get the continual follow-up they need" (source: Doctor and Director of Research Innovation & Technology, Company K).

The second practice, engaging actors in a healthy lifestyle, means not only to support patients and their network in following treatment recommendations but to keep patients active and healthy into old age – that is, to keep them well. Notably, this can apply to ageing actors who are not necessarily sick or in need of specific care but who want to maximize their health status in old age. In our study, 50–64-year-old patients became able to better manage their health by transforming data into information to put them in a self-control of their health. One of the cognitive assistant's biggest potential benefits is to help people stay healthy so they have no need of a doctor, or at least not as often. In addition, it helps professionals understand their patients' day-to-day patterns and needs and gives them better feedback, guidance, and support for staying healthy. Patients and their network feel better informed about good health practices and become more likely to manage their daily lives without sacrificing safety or health-promoting behavior. The connected learning experienced by the actors resulted in expanded opportunities for ongoing improvements in ageing with a healthy lifestyle. When the cognitive assistant channels the systemic insights into both the doctors' or caregiver's knowledge workflow and the ageing person's daily routine, health assurance is dramatically boosted.

"*The ability to learn how many calories I eat daily and obtain advice based on the monitoring and continuous tracking of my eating habits allows me to keep myself healthy. Before using HAPIfork, I didn't have the ability to control the daily calories and the right proteins to consume. Now it's different! I have a connection with my personal caregivers, I can instantly see if that food is compromising my health and make the right food choice based on data and information." (Source: Ageing actor, Company T).*

Health status while ageing is also enhanced by the power (whether alone or supported by others) to trust in exploring alternative choices, integrating new information, and to seek new congruence in one's health decision-making. Cognitive assistants allow actors to resolve ambiguity and incompleteness and build new trust based on data that sense the patient's intent, or requirement. A new awareness grows on day-to-day evidence-based interaction that the cognitive assistant allows when it is used to influence decisions on the most appropriate health arrangement for the actors. Through multilayered trust, the ageing actors engage better with healthy lifestyle advice and are encouraged towards proactive self-health management. Engaging in a healthy status is about data-based trust prompted by an ageing actor in interactions with his or her network to be more confident over his/her lifestyle.

DISCUSSION

This work centered on a key research priority in service science: how to foster value co-creation practices in healthcare through technologies (Kabadayi *et al.*, 2020; Ostrom et al., 2021). Our study addresses the gap in literature on the youngest cohort of the new Silver Economy "ageing" population: the 50–64-year-old segment. We offer a fresh understanding on the role of cognitive assistants as boundary objects enabling the boundary work of actors for value co-creation. In the ageing context the mediating role of the cognitive assistant arises: it bridges actors' interactions, resource exchange and integration. Artefacts and objects matter in service provision, so warrant more research. Recent technology-based service studies have focused more on service-robot interactions as human-like interactions (Čaić *et al.*, 2018; Odekerken-Schröder *et al.*, 2020) and have marginalized objects at the very time when their importance has grown (Mele *et al.*, 2019). A cognitive assistant acts as a boundary object by enabling that certain activities of multiple actors are brought together, by orienting interactions and the integration of resources. Specifically, cognitive assistant is an 'object of activity' (Macpherson et al., 2006; Nicolini et al., 2012) that mediates in actors' boundary work by: 1) providing a drive for wider interactions; 2) offering novel resource interfaces; and 3) allowing multiple actors' perspectives to be aligned through different types of cognitive and physical boundaries. Actors' boundary work deploys through four main mediated technology actions: database dialoguing, augmented sharing, connected learning, multilayered trusting. First, automated dialoguing relates to interacting actors (doctors, ageing actors and others) communicating about the situation, within certain parameters. By analyzing data in real time, through dialogue, ageing actors can evaluate their health issues. Second, augmented sharing concerns patient-centered care, patient and other actors' engagement, and informed-based choices (McColl Kennedy *et al.*, 2012): a collaborative endeavor where physicians and patients to share information, intuitions and meanings. Dialoguing and sharing encourage decisions about healthful behaviors, boosting actors' confidence in their ability to control health status. Third, connected learning prompts actors to generate new data, information, and knowledge and focuses attention on concrete absorbing in actions and interactions while multilayered trust supports actors in the wider arrangements involving multiple insights and values. Learning and trust align actors' knowledge perceptions, expectations and supporting the improvement of the ageing actors' lifestyles.

The analysis of the actors' boundary work allows us to disentangle the process of value creation between actors within the healthcare context. Through the four actions, actors can overcome cognitive and physical boundaries and increase access to new knowledge and capability, thus increasing resourceness. Wider resource access and resourceness foster resource integration and matching as the main mechanism of value co-creation (Gummesson and Mele, 2010; Vargo and Lusch, 2014). Two enhanced value co-creation practices emerge: empowering actors in medical care and engaging them in a healthy lifestyle. Ageing actors rely on a decision-making process that integrates resources, directs actions, and orients interactions, consistent with their present and prospective capabilities and needs; as well as the support of doctors, caregivers, and families to improve patient's care. We extend the scope of value co-creation practices beyond the focus on treating illness and take into account patients (ageing actors) themselves and their network and consider healthy status being more holistically and positively (McColl-Kennedy *et al.*, 2017; Frow *et al.*, 2016). Service scholars have pointed to features of cognitive technologies and their roles (Odekerken-Schröder *et al.*, 2020) related to value co-creation (Kaartemo and Helkkula, 2018). We trace how this process unfolds by linking technology features to actors' actions. By overcoming boundaries, actors enact language, meaning, knowledge and trust to enhance contextual resource integration. They comprehend the day-to-day patterns of their condition and their needs, and thus are able to supply better feedback, which in turn enhances professionals' guidance and their support for staying healthy. Through the cognitive assistant, actors see data and information transformed into actions to create new capabilities, richer experiences, and necessary context for their care and/or healthy status beyond illness (Keyes *et al.*, 2014).

In sum, the boundary work of actors enacted by cognitive assistants support a smarter resource integration that yields broader applications for augmented agency (Mele *et al.*, 2021). Similarly, to Barad (2003) and Latour (2005) we argue that an enhanced agency emerges at the encounter between humans, artefacts, texts, and discourses crossing expertise and contextual boundaries. Value co-creation articulated in a cognitive assisted health context, as defined here, focusses on joint creation and evolution of value with patients and other actors, intensified and enacted by integration of data and capabilities that expand ageing actors' health status. Thus, actors' capacity to maintain health is not something stable that only an actor holds, or only a machine can enhance; agency to attain any health status emerges from the encounter and "intra-action" (Barad, 2003) between informed humans (doctors plus patients, their networks, and other health professionals) and technologies. Moreover, characterizing the human agent as the head and the rest as having complementary status, as service technologies literature does, strikes us as problematic. Applying the study of boundary work to technologies may, we suggest, initiate subtler thinking about the growing role of materiality in service research.

IMPLICATIONS FOR PRACTITIONERS

The 21st century goal of successful ageing requires consideration not only of illness status, such as minimizing disease and disability, but also wellness status. Cognitive assistants can lighten the burden of health tasks and help people age actively and successfully, with independence and high quality of life. Accordingly, we claim that activities within value co-creation practices comprehend, for instance, discussing data with patients, sharing the task of diagnosis, learning in action about treatment options, and cultivating trust in specific therapies and ways of staying healthy. We believe that cognitive assistants enable actors to increase value co-creation by improving their access to, and ability to interact with, actionable resources (data, information, languages). The actors' boundary work is supported by expanding expertise into health domains, and enhanced co-creation practices can emerge in the technology-based health services. Specific implications arise for professionals (doctors and caregivers) and for technology providers.

First, professionals (medical and other caregivers) need to appreciate cognitive applications as boundary objects. This potentiality includes the ability to collect and integrate different information (medical, scientific, daily patients' routine, etc.), to improve patients' health status, to transform roles of both patients and caregivers by bridging distances and constraints and to reduce data asymmetries and knowledge gaps. Doctors and caregivers can leverage the boundary work that the cognitive assistants enhance by promoting dialoguing, sharing, learning, and trusting. These actions not only provide opportunities to establish new linkages and to manage interactions among different parties but mobilize a transformation in the way new resources can be generated and resource integration and matching can take place.

Professionals may combine extensive disease expertise with the deep analytical capabilities of assistive agents to personalize insights and tailor care plans. In this approach, they need to share languages and plans to promote healthful behaviors, giving patients the confidence to manage their own care and alter or modify their lifestyles in a health-promoting way through connections with other actors providing valuable know-how, thus enabling patients and caregivers to gain a sense of healthcare confidence, trust and comfort. By promoting new ways of interacting through cognitive assistants, professionals need to become sure of how to manipulate the patterns of resource integration among groups of actors to ensure that certain activities are brought together, orienting the domains of collaboration for patients' health care status.

Second, technology providers hold a key role in supporting actors' boundary work. New tech-based solutions can be pivotal in enhancing active and healthy ageing co-creation practices. Cognitive technologies are potential parts of the cognitive humanist's toolkit and their role as boundary objects needs to be deepened with regards to how to better stimulate or facilitate communication and coordination by eradicating possible points of confusion or conflict and transforming them into valuable assets in linking resources and activities. For example, as a matter of equity as well as efficiency, managers should appreciate how major digital and health inequalities among ageing actors will influence the provision of accessible, equitable, secure, and context-appropriate information. Introducing cognitive assistants has required that actors without previous shared practices negotiate and integrate into their everyday work not only new technologies and material arrangements, but also each other's established practices. As we found, health technology solutions for ageing can enable different practices, but success may depend on doctors and caregivers taking active roles in promoting new practices in the use of technologies, and patients being engaged, too. Capturing and harnessing this growth market will demand that managers grasp the complex and diverse needs of ageing actors.

LIMITATIONS AND FURTHER RESEARCH

This paper has some limitations concerning the method and the results, that could serve to guide further research into cognitive technology and value co-creation.

First, the study focuses on one single cognitive assistant. Further research could collect data from multiple cognitive assistants to properly validate or improve the results obtained in this study. Specific research questions guide theoretical conceptualization to advance the debate of boundary objects and boundary work in service research:

1) Could scholars define theoretical criteria for categorizing cognitive assistants as boundary objects?
2) What is the relationship between boundary objects' features and boundary work?
3) How does the investigation of the boundary-work allow scholars to understand how actors, practices and values change?
4) How does cognitive technology affect boundary work i.e. as purposeful individual and collective effort to influence the social, symbolic, material, or temporal boundaries?

Second, the challenges and obstacles in resource integration affecting value co-creation negatively are not investigated. This paper acknowledges that cognitive technologies not only consist of physical or technical features or attributes but reflect the new languages, actions, meanings and values that become embedded with the real context of technology-in-use and actors' interactions. Healthcare outcomes depend not only on access (McColl-Kennedy *et al.*, 2012, 2017) but on how multiple actors integrate resources relating to the informed activities they undertake, their interactions in the service network, and the trust they develop concerning resource integration processes. This calls for much more debate on the design of technologies in supporting actors' boundary work, as they participate (or do not) in steering the resource integration. Further research questions may lead the conceptualisation of resource integration, actors' agency, and value co-creation in the emerging technology-enhanced service context:

1) How does the design of boundary objects n can enable or constrain the actors' agency?
2) How can physical, cognitive, and ethical barriers limit the actors' boundary work?

3) How can the design of boundary objects reduce the effects of physical, cognitive, and ethical barriers in the value co-creation processes?
4) Could physical or cognitive features of boundary objects affect actors' boundary work in different ways?

Finally, our study's impact analysis considers only certain aspects of the Silver Economy, namely healthcare services. But with their purchasing power (the famous "silver dollar"), standard of living and education, the prospective segment are fast becoming desirable and valued consumers for diverse sectors, especially those related to leisure (culture and recreation) (Kubiak, 2016) or smart homes (Čaić *et al.*, 2018). This being a cross-section market, further studies can take the analysis of co-creation practices onward into fresh technology-based service contexts. Further questions should muster evidence on different actors co-cocreation practices.

1) How can imbued service technology address the needs of ageing actors in different service contexts?
2) How can elderly and vulnerable actors use the cognitive assistant co-create value?
3) How can technology-mediated boundary work of actors break down the old stereotypes and roles of ageing and vulnerability people in society at large?

CONCLUSIONS

The compilation of chapters within this dissertation advances theory about how service robots can affect well-being and increase healthcare provision in many facets. As presented in the introduction, the three main chapters focus on service robots and different stages of well-being and healthcare, targeting mainly the fields of service marketing, social support, robotics and technology. In this final chapter, I leverage this interdisciplinarity by analyzing how the targeted disciplines overlap and advance novel insights, also providing implications for scholars and practitioners.

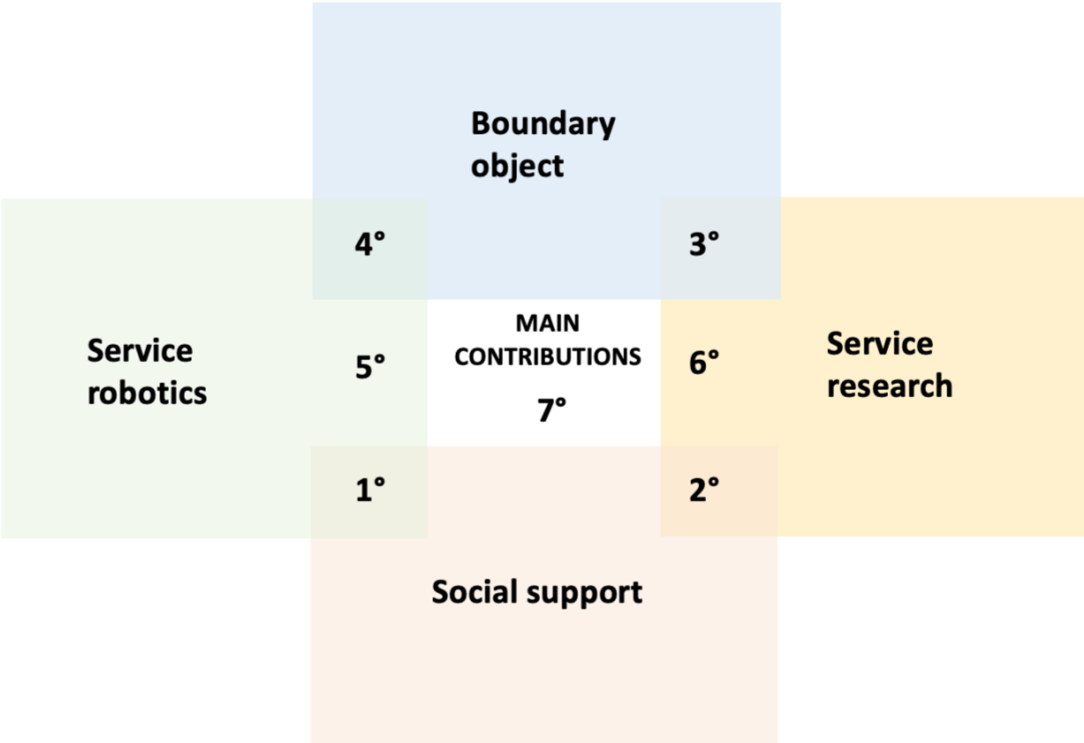
This collection of chapters provides scholars with insights on how service robots improve well-being. Well-being is a complex and multifaceted construct (Trudel-Fitzgerald et al., 2019) and its definition and measurement are still debated (Dodge et al., 2012), which are often divided into objective and subjective measures. Scholars in TSR (Ostrom et al., 2015; Finsterwalder et al., 2017) contend that well-being has two outcomes: eudaimonic (the opportunity for realization of personal potential) and hedonic (happiness, life satisfaction or pleasure attainment). Moreover, some scholars focused on psychological well-being that is the combination of feeling good and functioning effectively (Huppert, 2009). The same can be compromised when negative emotions are extreme or very long lasting, interfering with a person ability to function (Huppert, 2009). However, this thesis first focus on subjective well-being referring to "an individual's appraisal of their overall life situation and is conceptualized as the degree to which individuals are able to realize universal goals" (Garma and Bove, 2011, p. 635). In the second chapter, this thesis provides three different areas of well-being, which are social well-being, personal well-being and overall well-being. There is evidence that companion robots enhance well-being outcomes in many facets. In order to reach this stage, robots and users have to possess some skills and resources, embedded in some contexts and manifest some needs. In fact, the absence of some of these features lead to detrimental and ineffective human-robot interactions, along with customer dissatisfaction expressed on social media or e-commerce. Whether people experience some sorts of loneliness feelings, companion robots can enact supportive relationships, ranging from hedonic to emotional ones.

This research contributes to the growing literature on service and robots by expanding the literature on companion robots and relating this technology to well-being. This study also bridges the literature on social support and boundary object to the emerging field of service robots. It shows that companion robots mitigate the negative consequences of well-being reductions and cognitive assistants support ageing actors. This finding further enhances our understanding of user adoption of emerging technologies by recognizing companionship as a relevant factor. While previous studies have demonstrated that service robots can enhance service quality (Wirtz et al., 2018), my findings show that there is possibility for robots to provide emotional support and companionship feelings, greatly impacting users' well-being. Service and companion robots need to provide well-being benefits to be widely adopted. People have sometimes high and diverse expectations in the acquisition of a companion robot, such as to substitute the loss of a pet, to have companionship or to reduce loneliness. Therefore, designers should take into consideration that the integration of resources, external to the robot design (i.e. domotica, house structure, family compositions, culture, technology expertise etc.), plays a significant role in the acceptance and adoption of companion robots (Baisch et al., 2017; Sharkey, 2014). Senior citizens, for example, can benefit only through "the result of the skilled and careful deployment of the robot by carers and family members" (Sharkey, 2014). Especially after detrimental eras such as the Covid-19 pandemic, people are experiencing more and more decreases in their overall well-being (Bavel et al., 2020), opening the need for practitioners to address this global challenge. Especially during a time of isolation and social distancing, it is shown how technology becomes essential to learn, live, and stay connected (Goldschmidt, 2020).

Practitioners and companies can stimulate the adoption of companion robots and cognitive assistants for those that are suffering well-being decreases, i.e., to mitigate a serious concern such as loneliness (Cacioppo and Patrick, 2008). Policy makers should thus focus on financing and promoting companion robots in domestic houses as well as in nursing homes, which could eventually lead to a decrease in feelings of loneliness (Odekerken-Schröder et al., 2020). On the other hand, they should promote cognitive assistants whether there are cognitive impairments. With particular regard to elderly people, companion robots and cognitive assistants are in line with the suggestion provided by policy makers and health care organizations to increasingly promote independent aging at home (Kemperman et al., 2019).

Finally, this thesis proves that service and social robots research can benefit of multidisciplinary approaches. On this trail, this collection of chapters provides specific theoretical and managerial contributions in each literature stream, as showed in figure 10 and later described.

Figure 10: Thesis contributions



1° Contribution – Companion robot provides support

At the intersection of Service robotics and Social Support, I extend the literature on companion robots in Service, highlighting the role of these robots in mitigating loneliness, through three supportive relationships, and fostering different types well-being. By adopting different theoretical lenses (social support, companion robots) and methods (netnography approach and illustrative case study), I advance prior literature on companion robots (Bradwell et al. (2019), social support (Cutrona and Suhr, 1992) and HRIs (De Graaf and Allouch, 2013). In chapter I, I provide evidence that companion robots are capable of conveying three supportive relationships linked to loneliness feelings, while in chapter II I introduce the concept of emotional and enduring support.

Managerial Implications

Integrating methods and knowledge from different disciplines also offers important implications for robotics context. The use of qualitative methods (e.g., netnography) can yield findings relevant for a diverse set of robot providers, equipping their service managers with useful insights to maximize the utility of their robots and imagine new value propositions. These propositions can be linked to instrumental or cognitive support or to providing feelings of love and care (i.e., functioning as a remedy for social isolation or a social facilitator in families).

2° Contribution – Companion robot for TSR

At the intersection of Social Support and Service, the second contribution extends literature on well-being, by addressing dimensions of loneliness and meaningful relationships in Chapter I and in Chapter II. In this chapter I also relate overall well-being to quality of life, ultimately discussed in chapter III.

I extend the studies on service robots (Wirtz et al., 2018) by empirically validating the potential of companion robots in mitigating feelings of loneliness (i.e., indicator of well-being) and I propose a novel iterative framework of companion robots in services and link it with social support potential. Thus, I advance the literature on Transformative Service Research (Finsterwalder et al., 2017; Kuppelwieser and Finsterwalder, 2016), focusing on vulnerable people (i.e., elderly), and socially and emotionally isolated people (Rosenbaum, 2008), proposing a way to bridge significant needs amplified during Covid-19 pandemic.

Managerial Implications

Users engage with companion robots with different purposes, from desire to have fun to need to develop attachment and receive enduring support. Robot providers need to be aware of and design around their value proposition, which can either be directed to foster fun interaction or provide companionship in a way a friend or a pet does.

3° Contribution – Cognitive assistants promote value co-creation practices

At the intersection of Service and Boundary object, I extend the studies on value co-creation practices (McColl-Kennedy et al., 2017; Frow et al., 2016). Cognitive assistants have the power of providing wider resource access, resourceness, resource integration and matching. These represent the main mechanism of value co-creation (Gummesson and Mele, 2010; Vargo and Lusch, 2014), from which emerge two enhanced value co-creation practices in healthcare context: “Empowering actors in medical care” and “Engaging actors in a healthy lifestyle”.

Managerial Implications

Elderly people have very different relationships with technology (Caic et al., 2018; Ruggiero et al., 2022), where in some cases they completely accept or refuse it. Service managers and professionals have to comprehend which activities can be fostered through cognitive assistants, which can be discussing data with patients, sharing the task of diagnosis, learning in action about treatment options and cultivating trust in specific therapies and ways of staying healthy. This thesis suggests service managers and professionals to first analyze which value co-creation practices can be fostered to implement service provision, and after decide on which technology to adopt.

4° Contribution – Service robot as a boundary object

At the intersection of Boundary object and Service Robotics, I introduce the concept of service robots (i.e., cognitive assistant) as a boundary object, that bridges actors, resources and activities. By adopting different theoretical lenses (boundary object, service robots) and focusing on different segments of robots, I advance prior literature on service robots (Wirtz et al. 2018; Lu et al. 2020). Finally, by adopting a specific empirical case and multiple actors' perspectives (ageing and professional, caregivers, families), I advance prior literature on boundary objects and human-robot interaction.

Managerial Implications

Service managers and professionals in healthcare can benefit of cognitive assistants, by lightening the burden of some health tasks and helping people age actively and successfully. Managers should encourage that repetitive, common and structured tasks should be taken over by service robots (Lu et al., 2020). In this way, businesses can enhance productivity and service quality (Wirtz et al., 2021), while at the same time improve the employee and customer/patient experience.

5° Contribution – Companion robots and Cognitive assistants as Service robots

In the context of Service Robotics, I extend service robotics literature (Lu et al., 2020) by providing different settings of robot contexts (cognitive/analytical and emotional/social tasks) and typologies (companion robots and cognitive assistants). In fact, cognitive assistants mainly perform cognitive/analytical tasks with a specific function and purpose, while companion robots imitate human beings and pet, by performing emotional/social tasks.

By deeply analyzing these scenarios, I provide with the concept of long-term relationship, which works for both types of robots. In fact, it is demonstrated how it is necessary a medium-long term interaction to prompt interaction and unleash all the benefits they serve. This extends service robot literature, which mainly focused on frontline service, where the interaction with the end-user occurs in a short term. Finally, I developed on some antecedents and characteristic of users and robots that firmly change robot outcomes.

Managerial Implications

This thesis guides service managers and professionals with a review of possible outcomes that companion robots and cognitive assistants provide. Service managers or professionals that need interaction and emotional skills should deploy and/or adopt companion robots in homes or social robots in nursing homes. Differently, if they want to reach cognitive and analytical skills, the recommendation is to adopt cognitive assistants and give less focus on the esthetic of the robot. In both cases, it is fundamental to first analyze preferences and needs of customer segments, through psychographic and behavioral techniques, as this thesis gives evidence of different perceptions of robots, based not only on robot characteristics. Critical is also the management of robot-human teams (Wirtz et al., 2018; Paluch et al., 2021; Odekerken et al., 2021; De Keyser and Kunz, 2022). Managers should know when and how adopt robot-human teams.

6° Contribution – Service robots and humanness

In the context of Service, I extend research and literature, by empirically providing insights on different service scenarios, such as companionship, robotics, healthcare services, well-being, wellness. Drawing on different disciplines, I propose a discussion about robots' similarity with humans and pets, addressing concepts such as anthropomorphism, human-likeness, lifelike appearance and human-like. Regarding service robots (i.e., companion robots and cognitive assistants), I extend discussions on anthropomorphism and humanness, which is "the extent to which an individual has characteristics that are typical for humans" (Söderlund and Oikarinen, 2021). Hence, it is important for service robots to evoke human characteristics, but this does not have to be reached necessarily through human appearance. For example, robots can have zoomorphic or machine-like appearance, or no physical appearance (i.e., virtual assistants). This argument invigorates the "uncanny valley" theory (Mori et al., 2012), which has been widely discussed in service literature (Caic et al., 2018; Wirtz et al., 2018): robots looking in physical appearance like humans evoke greater affinity, but, beyond some point, they become “unpleasant, eerie, or creepy” (Belanche et al., 2020, p. 208).

Managerial Implications

This thesis acknowledges that service robots that act and have some humans’ characteristics have positive effects in their service provision. I recommend service managers to not select necessarily robot with human appearance, but, depending on business and customers preferences, also assess robot with a zoomorphic or machine-like appearance in case of companion robots, and virtual ones in case of cognitive assistants. This thesis gives evidence that professionals and managers should not always try to place robots that completely emulate human beings and persist in fostering their social interactivity; however, they can place service robots when they can perform tasks better than humans.

7° Contribution – Service robots holistically provides companionship

This thesis holistically gives evidence that service robots in their many facets provide some forms of companionship (Figure 12). Companion robots can represent the peak of the technologies playing the role of companions, while cognitive assistants can act as "companion diagnostics", enabling personalized medicine and accompanying and monitoring drug assumptions (Rizo, 2018). Service robots may enable conditions and contexts that promote smart behaviours, by amplifying capacities for self-understanding, control and action (Mele et al., 2021).

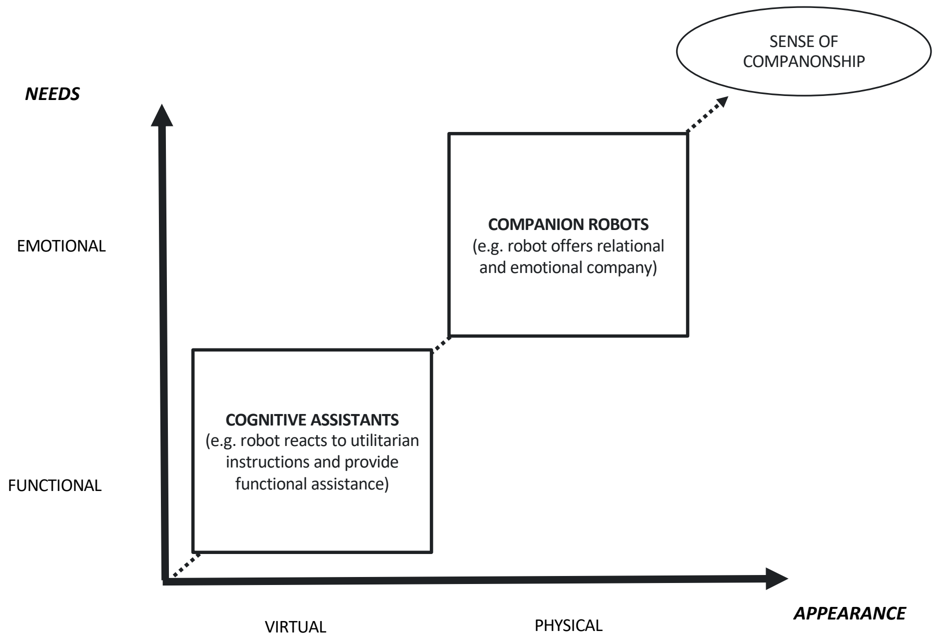
Finally, this thesis provides evidence that does not exist a robot for all, and acceptance and success depends on finding the right match between users and robots, which both can greatly vary in characteristic, desires and actions. Contexts, users’ pre-conditions, robots feature all contribute to different degrees of companionship.

Managerial implications

Service managers and professionals, as well as policy makers, can foster the adoption of service robots to fill the lack of companionship that people, patients, caregivers, doctors and nurses experience. This need can relate to every age and there is a huge market to be addressed. Moreover, the power of providing companionship in cognitive assistants enhances effectiveness and monitoring of patient drugs.

One robot for all does not exist, and my recommendation is to thoroughly analyze the market of companionship before choosing which and whether adopting a robot in a healthcare context, from homes to hospitals.

Figure 11: Companionship and Needs



FURTHER RESEARCH

This thesis holistically proposes some avenues for further research, separately addressed per theme (see table 7).

A first set of future research questions focuses on effectiveness and adoption to understand how evaluate service robots (i.e., companion robots and cognitive assistants) and overcome initial mistrust, which is a common outcome when people interact with a new technology as a companion robot. Future researchers may want to focus on the impact of companion robots on different well-being related outcomes, and their potential trade-offs. For that purpose, it would be necessary to monitor users of companion robots and administer their well-being related outcomes, using both qualitative ethnographic and quantitative experimental designs.

A second set of future research focuses on regulatory concerns and privacy. Companion robots and cognitive assistant collect a great quantity of data, which need to be carefully managed. Moreover, with this market growing, new regulations should be applied, in order to avoid monopolies or oligopolies in specific industries and contexts which would negatively impact deploying markets and people well-being. Future researchers could explore the risks of companion robots such as the reduction of human contact and privacy concerns and situational contingencies affecting various well-being-outcomes.

Regarding ecosystem, another set of further research relates to the role of robots in addressing the major societal challenge of loneliness and well-being. Continued research should move beyond exploratory studies on companion robots adopting a holistic view. Scholars may address specific subdimensios analyzed in chapter II, but it is necessary to handle and take into consideration the complex intersection between the constructs analyzed. Previous research on companion robots showed how different variables, such as being introvert (Walters et al., 2008), gender difference (de Graaf and Allouch, 2017) or use of smartphone (Goudey and Bonnin, 2016), can widely affect another subdimension. To overcome the barrier of acceptance and be widely adopted, companion robots and cognitive assistants needs the integration of different resources from the ecosystem. However, it is still not clear whether their adoption can make improvement or worsening of the ecosystem wellbeing (i.e., users, patients, physicians, caregivers).

In terms of business model, another route for continued research relates to the variety of interactions and value propositions that companion robots should be able to perform. It is clear that companion robots need to participate in a wide range of interactions with humans (Lakatos et al., 2014), but still is debated which are the most suitable roles and desired characteristics, as for example intentionality (Lakatos etal., 2014) or naturalistic movements (Lehmann et al., 2015). Since loneliness is seen as an unpleasant psychological state (Kim, 2011), reduction of loneliness will contribute to well-being. Future research could zoom into the psychological processes through which service robots mitigate different dimensions of loneliness. Deeper understanding how various types and of designs of companion robots foster interaction and engagement and ultimately reduce the feeling of loneliness holds implications for service provision around the robots. Finally, there is scarce literature on business model characteristics, such as payments model or distribution channels, that can make these technologies profitable and scalable.

This thesis also calls for much more debate on the design of service robot technologies in supporting companionship and actors’ boundary work, as they participate (or do not) in steering the resource integration. Resource integration, actors' agency, and value co-creation must all be conceptualized more thoroughly in the emerging technology-enhanced context. Further studies could take the core concept of technology as boundary objects and focus on

how the design of service provision can enable or constrain the actors' capability augmentation process. More research is needed on robot design, because there is still no evidence on which features can lead to major adoption and satisfaction.
Understanding these future topics would enable service providers to understand how they could benefit from companion robots and cognitive assistants.

Table 8: Holistic further research

Themes	Research questions
Effectiveness and adoption	• How can studies involve the perspective of all key actors (users, relatives, physicians, policymakers,) in evaluating the effectiveness of companion robots and cognitive assistants? • What may drive a user initial mistrust of Service Robot, and how can it be overcome?
Regulation and privacy	• How can regulation and the public sector ensure that companion robots and cognitive assistants' manufacturers cannot create monopolies or oligopolies in specific industries and contexts which would negatively impact deploying markets? • How can users' privacy be guarded and privacy concerns be mitigated given the constant collection of data?
Ecosystem	• How to measure the improvement or worsening of ecosystem wellbeing (i.e., users, patients, physicians, caregivers, etc.) after introducing companion robots and cognitive assistants? • What are the implications of tech literacy (especially for ageing populations) for companion robots and cognitive assistants? • Which resources should users integrate in order to obtain human-robot interactions and positive well-being outcomes?
Business Model	• Which are the most innovative value propositions (i.e., well-being outcomes) and key activities related to companion robots and cognitive assistants solutions? • How to investigate the channels to be used to market companion robots and cognitive assistants? • Which is the best payment method (pay for product, pay for service, pay for usage, etc.) of companion robots and cognitive assistants?
Design	• Which could be the roles of physical appearance in cognitive assistants solutions? • How can the design of companion robots and cognitive assistants (i.e, hands, face, appearance) enable or constrain users' engagement?

REFERENCES

Adelman, M.B. and Ahuvia, A.C. (1995), "Social support in the service sector: the antecedents, processes, and outcomes of social support in an introductory service", Journal of Business Research, Vol. 32 No. 3, pp. 273-282.

Adelman, M.B., Ahuvia, A. and Goodwin, C. (1994), "Beyond smiling: social support and service quality", in Rust, R.T. and Oliver, R.L. (Eds), Service Quality: New Directions in Theory and Practice, SAGE, Thousand Oaks, CA, pp. 139-171.

Anderson, L., Ostrom, A.L. and Bitner, M.J. (2011), Surrounded by Services: a New Lens for Examining the Influence of Services as Social Structures on Well-being, Working paper: W. P. Carey School of Business, Arizona State University.

Azer, J. and Alexander, M.J. (2018), "Conceptualizing negatively valenced influencing behavior: forms and triggers", Journal of Service Management, Vol. 29 No. 3, pp. 468-490.

Barad, K. (2003), "Posthumanist performativity: Toward an understanding of how matter comes to matter", Journal of women in culture and society, Vol. 28 No. 3, pp. 801-831.

Barnes, D.C., Mesmer-Magnus, J., Scribner, L., Krallman, A. and Guidice, R. (2020), "Customer delight during a crisis: understanding delight through the lens of transformative service research", Journal of Service Management.

Barrett, M., Oborn, E., Orlikowski, W. J., & Yates, J. (2012). Reconfiguring boundary relations: Robotic innovations in pharmacy work. Organization Science, 23(5), 1448-1466.

Bavel, J.J.V., Baicker, K. and Boggio, P.S., et al. (2020), "Using social and behavioural science to support COVID-19 pandemic response", Nature Human Behavior, pp. 460-471.

Berry, L. L. (2019), "Service innovation is urgent in healthcare", AMS Review, Vol. 9 No. 1, pp. 78-92.

Belanche, D., Casaló, L. V., Flavián, C., & Schepers, J. (2020). Service robot implementation: a theoretical framework and research agenda. The Service Industries Journal, 40(3-4), 203-225.

Blut, M., Wang, C., Wunderlich, N.V. and Brock, C. (2021), "Understanding anthropomorphism in service provision: a meta-analysis of physical robots, chatbots, and other AI", Journal of the Academy of Marketing Science, Vol. 49, pp. 632-658.

Bornet, P., Barkin, I., & Wirtz, J. (2021). Intelligent Automation: Welcome to the World of Hyperautomation: Learn How to Harness Artificial Intelligence to Boost Business & Make Our World More Human.

Bove, L. and Benoit, S. (2020), "Restrict, clean and protect: signalling consumer safety during the pandemic and beyond", Journal of Service Management, forthcoming.

Bowker, G. C. and Star, S. L. (2000), Sorting things out: Classification and its consequences, MIT press, Cambridge.

Bradwell, H. L., Edwards, K. J., Winnington, R., Thill, S., & Jones, R. B. (2019). Companion robots for older people: importance of user-centred design demonstrated through observations and focus groups comparing preferences of older people and roboticists in South West England. BMJ Open, 9(9), e032468.

Brailovskaia, J., & Margraf, J. (2020). Decrease of well-being and increase of online media use: cohort trends in German university freshmen between 2016 and 2019. Psychiatry Research, 290, 113110.

Brocato, E.D., Baker, J. and Voorhees, C.M. (2015), "Creating consumer attachment to retail service firms through sense of place", Journal of the Academy of Marketing Science, Vol. 43, pp. 200-220.

Cacioppo, J. T. and Patrick, W. (2008), Loneliness: Human Nature and the Need for Social Connection. WW Norton & Company, New York, NY.

Caic, M., Mahr, D. and Odekerken-Schroder, G. (2019), “Value of social robots in services: social cognition perspective”, Journal of Services Marketing, Vol. 33 No. 4, pp. 463-478, doi: 10.1108/ JSM-02-2018-0080.
Čaić, M., Odekerken-Schröder, G. and Mahr, D. (2018), "Service robots: value co-creation and co-destruction in elderly care networks", Journal of Service Management, Vol. 29 No. 2, pp. 178-205.
Callon, M. (1998), “Introduction: the embeddedness of economic markets in economics”, The sociological review, Vol. 46 No. 2, pp. 1-57.
Carlile, P. R. (2004). Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. Organization science, Vol. 15 No. 5, pp. 555-568.
Carter-Templeton, H., Frazier, R. M., Wu, L., & H. Wyatt, T. (2018). Robotics in nursing: a bibliometric analysis. Journal of Nursing Scholarship, 50(6), 582-589.
Cavallo, F., Limosani, R., Fiorini, L., Esposito, R., Furferi, R., Governi, L., & Carfagni, M. (2018). Design impact of acceptability and dependability in assisted living robotic applications. International Journal on Interactive Design and Manufacturing, 12(4), 1167-1178.
Charmaz, K. (2014), Constructing grounded theory: A practical guide through qualitative analysis (2nd ed.), SAGE, London, England.
Chen, Y., Argentinis, J. E. and Weber, G. (2016), “IBM Watson: how cognitive computing can be applied to big data challenges in life sciences research”, Clinical therapeutics, Vol. 38 No. 4, pp. 688-701.
Chopdar, P. K., & Balakrishnan, J. (2020). Consumers response towards mobile commerce applications: SOR approach. International Journal of Information Management, 53, 102106.
Christou, P., Simillidou, A. and Stylianou, M.C. (2020), "Tourists’ perceptions regarding the use of anthropomorphic robots in tourism and hospitality", International Journal of Contemporary Hospitality Management, Vol. 32 No. 11, pp. 3665-3683.
Cohen, S. (2004), “Social relationships and health”, American Psychologist, Vol. 59 No. 8, p. 676.
Corsaro, D. (2018), “Crossing the boundary between physical and digital: the role of boundary objects”, IMP Journal, Vol. 12 No. 2, pp. 216-236.
Courtet, P., Olie, E., Debien, C. and Vaiva, G. (2020), “Keep socially (but not physically) connected and carry on: preventing suicide in the age of COVID-19”, Journal of Clinical Psychiatry, Vol. 81 No. 3.
Creswell, J. W., Hanson, W. E., Clark Plano, V. L. and Morales, A. (2007), "Qualitative research designs: Selection and implementation", The counseling psychologist, Vol. 35 No. 2, pp. 236-264.
Crowe, S. (2019). Keecker consumer robotics company shuts down. Available at: https://www.therobotreport.com/keecker-consumer-robotics-shuts-down/ (accessed on December 04, 2020).
Cutrona, C.E. and Suhr, J.A. (1992), “Controllability of stressful events and satisfaction with spouse support behaviors”, Communication Research, Vol. 192, pp. 154-174.
Cyranowski, J.M., Zill, N., Bode, R., Butt, Z., Kelly, M.A., Pilkonis, P.A., Salsman, J.M. and Cella, D. (2013), “Assessing social support, companionship, and distress: National Institute of health (NIH) toolbox adult social relationship scales”, Health Psychology, Vol. 32 No. 3, pp. 293-301.
Danaher, S., and Gallan, A.S. (2016), "Service research in health care: positively impacting lives”, Journal of Service Research, Vol. 19 No. 4, pp. 433-437.

Daskalopoulou, A., Keeling, K. and Pritchard Jones, R. (2019), "Understanding technology mediation and new service provider roles in health care", Journal of Services Marketing, Vol. 33 No. 2, pp. 245-254.
Dautenhahn, K. (2007), “Socially intelligent robots: dimensions of human–robot interaction”, Philosophical Transactions of the Royal Society B: Biological Sciences, Vol. 362 No. 1480, pp. 679-704.
Dautenhahn, K. (2007). Socially intelligent robots: dimensions of human–robot interaction. Philosophical Transactions of the Royal Society B: Biological Sciences, 362(1480), 679-704.
Dautenhahn, K., Woods, S., Kaouri, C., Walters, M. L., Koay, K. L., & Werry, I. (2005). What is a robot companion-friend, assistant or butler? In 2005 IEEE/RSJ International Conference on Intelligent Robots and Systems (pp. 1192-1197). IEEE.
David, E. (2020), “The unspoken COVID-19 toll on the elderly: loneliness”, available at: https:// abcnews.go.com/Health/unspoken-covid-19-toll-elderly-loneliness/story?id569958717 (accessed on 16 April 2020).
de Graaf, M. M. A., & Allouch, S. B. (2017). The influence of prior expectations of a robot’s lifelikeness on users’ intentions to treat a zoomorphic robot as a companion. International Journal of Social Robotics, 9(1), 17-32.
De Graaf, M.M. and Allouch, S.B. (2013), “Exploring influencing variables for the acceptance of social robots”, Robotics and Autonomous Systems, Vol. 6112, pp. 1476-1486.
De Keyser, A. and Kunz, W. H. (2022), “Living and Working with Service Robots: A TCCM Analysis and Considerations for Future Research”, Journal of Service Management, forthcoming.
De Keyser, A., Köcher, S., Alkire, L., Verbeeck, C., & Kandampully, J. (2019). Frontline service technology infusion: conceptual archetypes and future research directions. Journal of Service Management, 30(1), 156-183.
Denzin, N. K. and Lincoln, Y. S. (1998), Major paradigms and perspectives. Strategies of Qualitative Inquiry, NYK Denzin and YS Lincoln (eds.), Sage Publication, Thousand Oaks.
Diener, E., & Seligman, M. E. (2004). Beyond money: toward an economy of well-being. Psychological Science in the Public Interest, 5(1), 1-31.
Duffy, B. R. (2003). Anthropomorphism and the social robot. Robotics and Autonomous Systems, 42(3-4), 177-190.
Eisenhardt, K. M. (1989). Agency theory: an assessment and review. Academy of Management Review, 14(1), 57-74.
Engeström, Y. (2001). Making expansive decisions: An activity-theoretical study of practitioners building collaborative medical care for children. In Decision making: Social and creative dimensions, Springer, Dordrecht, pp. 281-301.
Epley, N., Waytz, A., & Cacioppo, J. T. (2007). On seeing human: a three-factor theory of anthropomorphism. Psychological Review, 114(4), 864-886.
European Commission (2018a), “The Silver Economy Final Report, Oxford Economics and Technopolis” Group, available at: .https://www.mayoractual.com/media/mayoractuals/files/2018/09/11/Silver-Economy.pdf (access 2020)
European commission (2018b). The 2018 Aging Report, Institutional Paper 065, The 2018 Ageing Report: Underlying Assumptions and Projection Methodologies available at: https://ec.europa.eu/info/publications/economy-finance/2018-ageing-report-underlying-assumptions-and-projection-methodologies_en (access 2020)
Finsterwalder, J. and Kuppelwieser, V.G. (2020), “Equilibrating resources and challenges during Crises: a framework for service ecosystem wellbeing”, Journal of Service Management.

Finsterwalder, J., Foote, J., Nicholas, G., Taylor, A., Hepi, M., Baker, V. and Dayal, N. (2017), “Conceptual underpinnings for transformative research in a service ecosystems context to resolve social issues–framework foundations and extensions”, Service Industries Journal, Vol. 37, pp. 11766-12782.
Flyvbjerg, B. (2006), "Five misunderstandings about case-study research", Qualitative inquiry, Vol 12 No. 2, pp. 219-245.
Fremont, V.H.J., Frick, J.E., Åge, L.J. and Osarenkhoe, A. (2019), “Interaction through boundary objects: controversy and friction within digitalization”, Marketing Intelligence & Planning, Vol. 37 No. 1, pp. 111-124
Frow, P., McColl-Kennedy, J. R. and Payne, A. (2016), “Co-creation practices: Their role in shaping a health care ecosystem”, Industrial Marketing Management, Vol. 56, pp. 24-39.
Garma, R. and Bove, L.L. (2011), “Contributing to well-being: customer citizenship behaviors directed to service personnel”, Journal of Strategic Marketing, Vol. 19 No. 7, pp. 633-649.
Ge, Shuzhi Sam, Maja J. Matarić, 2009, “Preface”, in International Journal of Social Robotics, 1, 1: 1-2.
Gerłowska, J., Skrobas, U., Grabowska-Aleksandrowicz, K., Korchut, A., Szklener, S., Szczęśniak-Stańczyk, D., Tzovaras, D. and Rejdak, K. (2018), “Assessment of perceived attractiveness, usability, and societal impact of a multimodal robotic assistant for aging patients with memory impairments”, Frontiers in neurology, Vol. 9 No. 392.
Gherardi, S. (2016), "To start practice theorising anew: The contribution of the concepts of agencement and informativeness", Organization, Vol. 23 No. 5, pp. 680-698.
Gioia, D. A., Corley, K. G. and Hamilton, A. L. (2013), "Seeking qualitative rigor in inductive research: Notes on the Gioia methodology", Organisational research methods, Vol. 16 No. 1, pp. 15-31.
Goodrich, M. A., & Schultz, A. C. (2008). Human–Robot Interaction: A Survey. Now Publishers Inc., Hanover, MA.
Goris, K., Saldien, J., Vanderborght, B. and Lefeber, D. (2011), “How to achieve the huggable behavior of the social robot probo? A reflection on the actuators”, Mechatronics, Vol. 21 No. 3, pp. 490-500.
Goudey, A., & Bonnin, G. (2016). Must smart objects look human? Study of the impact of anthropomorphism on the acceptance of companion robots. Recherche et Applications en Marketing (English edition), 31(2), 2-20.
Graffigna, G., Barello, S., Riva, G. and Bosio, A. C. (2014), "Patient engagement: the key to redesign the exchange between the demand and supply for healthcare in the era of active ageing", Studies in Health Technology and Informatics, Vol 203, pp. 85-95.
Greenstone, M. and Nigam, V. (2020), Does Social Distancing Matter?, Working Paper No. 2020-26, Becker Friedman Institute for Economics, University of Chicago, Chicago, 30 March.
Grougiou, V. and Pettigrew, S. (2011), “Senior customers' service encounter preferences”, Journal of Service Research, Vol. 14 No.4, pp. 475-488.
Güell, M., Salamó, M., Contreras, D., and Boratto, L. (2020), “Integrating a cognitive assistant within a critique-based recommender system”, Cognitive Systems Research, Vol. 64, pp. 1-14.
Gummesson, E. (2005), "Qualitative research in marketing: Road-map for a wilderness of complexity and unpredictability", European journal of marketing, Vol. 39 No. 3/4, pp. 309-327.
Gummesson, E. (2017), Case theory in business and management: reinventing case study research, Sage, Thousand Oaks, California.

Gummesson, E., & Mele, C. (2010). Marketing as value co-creation through network interaction and resource integration. Journal of Business Market Management, Vol. 4, No. 4, pp. 181-198.
Gustafsson, C., Svanberg, C., & Müllersdorf, M. (2015). Using a robotic cat in dementia care: a pilot study. Journal of Gerontological Nursing, 41(10), 46-56.
Hazee, S. and Van Vaerenbergh, Y. (2020), "Customers' contamination concerns: an integrative framework and future prospects for service management", Journal of Service Management.
Heinonen, K., & Strandvik, T. (2018). Reflections on customers' primary role in markets. European Management Journal, 36(1), 1-11.
Henkel, A.P., Caic, M., Blaurock, M. and Okan, M. (2020), "Robotic transformative service research: deploying social robots for consumer well-being during Covid-19 and beyond", Journal of Service Management.
Hoffman, G. (2019). Anki, Jibo, and Kuri: what we can learn from social robots that didn't make it. IEEE Spectrum, May 01, 2019. Available at: https://spectrum.ieee.org/automaton/robotics/home-robots/anki-jibo-and-kuri-what-we-can-learn-from-social-robotics-failures (accessed on June 04, 2021).
Howdon, D. and Rice, N. (2018), "Health care expenditures, age, proximity to death and morbidity: Implications for an ageing population", Journal of Health Economics, Vol 57, pp. 60-74.
Huang, K. H. and Yu, T. H. K. (2015), "Healthcare expenditure with causal recipes", Journal of Business Research, Vol. 68 No. 7, pp. 1570-1573.
Huang, M.H. and Rust, R.T. (2018), "Artificial intelligence in service", Journal of Service Research, Vol. 212, pp. 155-172.
Huang, T., & Huang, C. (2019). Elderly's acceptance of companion robots from the perspective of user factors. Universal Access in the Information Society, 19, 935-948.
Jefferies, J. G., Bishop, S. and Hibbert, S. (2019), "Customer boundary work to navigate institutional arrangements around service interactions: Exploring the case of telehealth", Journal of Business Research, Vol. 105, pp. 420-433.
Jenkins, S., & Draper, H. (2015). Care, monitoring, and companionship: views on care robots from older people and their carers. International Journal of Social Robotics, 7(5), 673-683.
Kaartemo, V. and Helkkula, A. (2018), "A systematic review of artificial intelligence and robots in value co-creation: current status and future research avenues", Journal of Creating Value, Vol. 4 No. 2, pp. 211-228.
Kabadayi, S., Hu, K., Lee, Y., Hanks, L., Walsman, M. and Dobrzykowski, D. (2020), "Fostering older adult care experiences to maximize well-being outcomes: A conceptual framework", Journal of Service Management, Vol. 31 No. 5, pp. 953-977.
Kanemitsu, H. (2019). The robot as other: a postphenomenological perspective. Philosophical Inquiries, 7(1), 51-61.
Keyes, L., Phillips, D. R., Sterling, E., Manegdeg, T., Kelly, M., Trimble, G., and Mayerik, C. (2014), "Transforming the way we live together: A model to move communities from policy to implementation", Journal of Aging & Social Policy, Vol. 26 No. 1-2, pp. 117-130.
Khaksar, S. M. S., Khosla, R., Chu, M. T. and Shahmehr, F. S. (2016), "Service innovation using social robot to reduce social vulnerability among older people in residential care facilities", Technological Forecasting and Social Change, Vol. 113, pp. 438-453.
Kim, J., Choi, S., & Martin, D. (2020), The halo effect of C2C interaction quality in prolonged close-proximity service settings. Journal of Services Marketing, 34(4), 459-472.
Kiron, D. and Unruh, G. (2019), "Even if AI can cure loneliness-should it?", MIT Sloan Management Review, Vol. 602, pp. 1-4.

Kleinaltenkamp, M., Corsaro, D. and Sebastiani, R. (2018), "The role of proto-institutions within the change of service ecosystems", Journal of Service Theory and Practice, Vol. 28 No. 5, pp. 609-635.
Klimbe, C., Grenier, C. and Goglio-Primard, K. (2010), "Innovation and Knowledge Sharing across Professional Boundaries: Political Interplay between Boundary Objects and Brokers", International Journal of Information Management, Vol 30, pp. 437–44.
Klimczuk, A. (2015), Economic Foundations for Creative Ageing Policy: Volume I Context and Considerations (Vol. 1), Springer. Vol 1, New York: Palgrave Macmillan, pp. 232.
Konok, V., Korcsok, B., Miklósi, Á., & Gácsi, M. (2018). Should we love robots? The most liked qualities of companion dogs and how they can be implemented in social robots. Computers in Human Behavior, 80, 132-142.
Kot, M. T. and Leszczyński, G. (2020), "The concept of intelligent agent in business interactions: is virtual assistant an actor or a boundary object?", Journal of Business & Industrial Marketing, Vol. 35 No. 7, pp. 1155-1164.
Kozinets, R.V. (2002), "The field behind the screen: using netnography for marketing research in online communities", Journal of Marketing Research, Vol. 39 No. 1, pp. 61-72.
Krafft, M., Sajtos, L., & Haenlein, M. (2020). Challenges and opportunities for marketing scholars in times of the fourth industrial revolution. Journal of Interactive Marketing, Vol.51, No. 2, pp. 1-8.
Kranzbühler, A. M., Kleijnen, M. H., Morgan, R. E., & Teerling, M. (2018). The multilevel nature of customer experience research: an integrative review and research agenda. International Journal of Management Reviews, 20(2), 433-456.
Kraus, S., Schiavone, F., Pluzhnikova, A. and Invernizzi, A. C. (2021), "Digital transformation in healthcare: Analyzing the current state-of-research", Journal of Business Research, Vol. 123, pp. 557-567.
Kubiak, M. (2016), "Silver economy–opportunities and challenges in the face of population ageing", European Journal of Transformation Studies, Vol. 4 No. 2.
Kummitha, R. K. R. (2020). Smart technologies for fighting pandemics: the techno-and human-driven approaches in controlling the virus transmission. Government Information Quarterly, 37(3), 101481.
Kuppelwieser, V.G. and Finsterwalder, J. (2016), "Transformative service research and service dominant logic: quo vaditis?", Journal of Retailing and Consumer Services, Vol. 28, pp. 91-98.
Lakatos, G., Gácsi, M., Konok, V., Brúder, I., Bereczky, B., Korondi, P., & Miklósi, Á. (2014). Emotion attribution to a non-humanoid robot in different social situations. PloS ONE, 9(12), e114207.
Langhamrová, J., Šimková, M. and Sixta, J. (2018). "Macroeconomic Impacts of the Expansion of Social Services for Ageing Population of the Czech Republic", Politická ekonomie, Vol. 2, No.1 pp 240-259.
Langley, A., Lindberg, K., Mørk, B. E., Nicolini, D., Raviola, E. and Walter, L. (2019), "Boundary work among groups, occupations, and organizations: From cartography to process", Academy of Management Annals, Vol.13 No.2, pp. 704-736.
Latour, B. (2005), Reassembling the social: An introduction to actor-network-theory, Oxford university press, Oxford.
Lee, K.M., Jung, Y., Kim, J. and Kim, S.R. (2006), "Are physically embodied social agents better than disembodied social agents?, the effects of physical embodiment, tactile interaction, and people's loneliness in human–robot interaction", International Journal of Human-Computer Studies, Vol. 64 No. 10, pp. 962-973.

Lehmann, H., Saez-Pons, J., Syrdal, D. S., & Dautenhahn, K. (2015). In good company? Perception of movement synchrony of a non-anthropomorphic robot. PloS ONE, 10(5), e0127747.
Leite, I., Pereira, A., Mascarenhas, S., Martinho, C., Prada, R., & Paiva, A. (2013). The influence of empathy in human–robot relations. International Journal of Human–Computer Studies, 71(3), 250-260.
Lewis, J. (2020), “Digital Dream Labs has big plans for tiny robots Vector and Cozmo”, available at: https://www.nextpittsburgh.com/latest-news/digital-dream-labs-has-big-plans-for-tiny-robots- vector-and-cozmo/ (accessed on 25 April 2020).
Lewis, J. (2020), Digital Dream Labs has big plans for tiny robots Vector and Cozmo. Available at: https://www.nextpittsburgh.com/latest-news/digital-dream-labs-has-big-plans-for-tiny-robots-vector-and-cozmo/ (accessed on December 04, 2020).
Lim, C.M. and Kim, Y.K. (2011), “Older consumers’ TV home shopping: loneliness, parasocial interaction, and perceived convenience”, Psychology and Marketing, Vol. 28 No. 8, pp. 763-780.
Lin, Y.-T., Doong, H.-S. and Eisingerich, A.B. (2021), “Avatar Design of Virtual Salespeople: Mitigation of Recommendation Conflicts”, Journal of Service Research, Vol. 24 No. 1, pp. 141–159.
Lincoln, Y. S. and Guba, E. G. (1985), “Establishing trustworthiness”, Naturalistic inquiry, Vol. 289 No. 331, pp. 289-327.
Lu, V.N., Wirtz, J., Kunz, W.H., Paluch, S., Gruber, T., Martins, A. and Patterson, P.G. (2020), "Service robots, customers and service employees: what can we learn from the academic literature and where are the gaps?", Journal of Service Theory and Practice, Vol. 30 No. 3, pp. 361-391.
Macpherson, A., Jones, O., & Oakes, H. (2006). Mediating artefacts, boundary objects and the social construction of knowledge. In The First International Conference on Organizational Learning, Knowledge and Capabilities, OLKC 1, 20-22 March 2006, University of Warwick.
Magistretti, S., Dell’Era, C. and Petruzzelli, A. M. (2019), “How intelligent is Watson? Enabling digital transformation through artificial intelligence”, Business Horizons, Vol. 62 No. 6, pp. 819-829.
McChesney, K. and Aldridge, J. (2019), “Weaving an interpretivist stance throughout mixed methods research”, International journal of research & method in education, Vol. 42 No. 3, pp. 225-238.
McColl-Kennedy, J. R., Cheung, L. and Ferrier, E. (2015), "Co-creating service experience practices", Journal of Service Management, Vol. 26 No. 2, pp. 249-275.
McColl-Kennedy, J. R., Hogan, S. J., Witell, L. and Snyder, H. (2017), “Cocreative customer practices: Effects of health care customer value co-creation practices on well-being”, Journal of Business Research, Vol. 70, pp. 55-66.
McColl-Kennedy, J. R., Vargo, S. L., Dagger, T. S., Sweeney, J. C. and Kasteren, Y. V. (2012), "Healthcare customer value co-creation practice styles", Journal of Service Research, Vol. 15 No. 4, pp. 370-389.
Mehrabian, A., & Russell, J. A. (1974). An Approach to Environmental Psychology. MIT Press, Cambridge, MA.
Mele, C. and Russo-Spena, T. (2019), "Innovation in sociomaterial practices: The case of IoE in the healthcare ecosystem", Maglio, P., Cheryl A. K.,. Spohrer, J.C., Lyons, K., Patrício, L. (Eds), Handbook of Service Science, Volume II, , Springer, Cham, pp. 517-544.
Mele, C., Russo Spena, T., Kaartemo, V. and Marzullo, M. L. (2021), “Smart nudging: How cognitive technologies enable choice architectures for value co-creation”, Journal of Business Research, Vol. 129, pp. 949-960.

Mele, C., Russo-Spena, T., Marzullo, M., & Ruggiero, A. (2021). Boundary work in value co-creation practices: the mediating role of cognitive assistants. Journal of Service Management.
Mele, C., Sebastiani, R. and Corsaro, D. (2019), “Service innovation as a social construction: The role of boundary objects”, Marketing Theory, Vol. 19 No.3, pp. 259-279.
Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook. Sage, Thousand Oaks, CA.
Mkono, M. and Markwell, K. (2014), “The application of netnography in tourism studies”, Annals of Tourism Research, Vol. 48, pp. 289-291.
Mollenkopf, D.A., Ozanne, L.K. and Stolze, H.J. (2020), “A transformative supply chain response to COVID-19”, Journal of Service Management.
Mordor Intelligence (2021), “Global Social Robots Market - Growth, Trends, Covid-19 Impact, And Forecasts (2022 - 2027)” available at: https://www.mordorintelligence.com/industry-reports/social-robots-market
Mori, M., MacDorman, K. F., & Kageki, N. (2012). The uncanny valley [from the field]. IEEE Robotics & Automation Magazine, 19(2), 98-100.
Morse, J. M. (2007) ‘Sampling in Grounded Theory', in Bryant, A., Charmaz, K. (Eds.) The Sage Handbook of Grounded Theory. London: Sage, pp. 229-244.
Moyle, W., Jones, C., Sung, B., Bramble, M., O’Dwyer, S., Blumenstein, M., & Estivill-Castro, V. (2016). What effect does an animal robot called CuDDler have on the engagement and emotional response of older people with dementia? A pilot feasibility study. International Journal of Social Robotics, 8(1), 145-156.
Murphy, J., Gretzel, U., & Pesonen, J. (2019). Marketing robot services in hospitality and tourism: the role of anthropomorphism. Journal of Travel & Tourism Marketing, 36(7), 784-795.
Newmark, Z. (2020), “We can stop loneliness while we stop coronavirus: Dutch King”, available at: https://nltimes.nl/2020/03/20/can-stop-loneliness-fight-coronavirus-dutch-king (accessed on 25 April 2020).
Nicolini, D., Mengis, J., & Swan, J. (2012). Understanding the role of objects in cross-disciplinary collaboration. Organization science, Vol. 23, No. 3, 612-629.
Nunez, E., Hirokawa, M., & Suzuki, K. (2018). Design of a huggable social robot with affective expressions using projected images. Applied Sciences, 8(11), 2298.
Odekerken-Schröder, G., Mele, C., RussoSpena, T., Mahr, D. and Ruggiero, A. (2020), "Mitigating loneliness with companion robots in the COVID-19 pandemic and beyond: an integrative framework and research agenda", Journal of Service Management, Vol. 31 No. 6, pp. 1149-1162.
Odlum, M., Davis, N., Owens, O., Preston, M., Brewer, R., and Black, D. (2018), "Correlates and aetiological factors associated with hedonic well-being among an ageing population of US men and women: secondary data analysis of a national survey", BMJ open, Vol. 8 No. 11, pp. 32-45.
Onnasch, L., & Roesler, E. (2020). A taxonomy to structure and analyze human–robot interaction. International Journal of Social Robotics, 2020, 1-17.
Osei-Frimpong, K., Wilson, A. and Lemke, F. (2018), "Patient co-creation activities in healthcare service delivery at the micro level: The influence of online access to healthcare information", Technological Forecasting and Social Change, Vol. 126, No. 1, pp. 14-27.
Ostrom, A. L., Field, J. M., Fotheringham, D., Subramony, M., Gustafsson, A., Lemon, K. N., ... & McColl-Kennedy, J. R. (2021). Service Research Priorities: Managing and Delivering Service in Turbulent Times. Journal of Service Research, Vol.24; No.3, pp. 329-353.

Patrício, L., Teixeira, J. G. and Vink, J. (2019), “A service design approach to healthcare innovation: From decision-making to sense-making and institutional change”, AMS Review, Vol. 9 No. 1, pp. 115-120.
Peine, A. and Moors, E. H. (2015), Valuing health technology–habilitating and prosthetic strategies in personal health systems. Technological Forecasting and Social Change, Vol.93, No.1, 68-81.
Pike, J., Picking, R., & Cunningham, S. (2020). Robot companion cats for people at home with dementia: a qualitative case study on companotics. Dementia, 20(4), 1300-1318.
Pitardi, V., Wirtz, J., Paluch, S., & Kunz, W.H. (2021). Service robots, agency and embarrassing service encounters. Journal of Service Management, Vol. ahead-of-print No. ahead-of-print
Puntoni, S., Reczek, R.W., Giesler, M. and Botti, S. (2021), “Consumers and artificial intelligence: an experiential perspective”, Journal of Marketing, Vol. 85 No. 1, pp. 131-151.
Rafaeli, A., Ziklik, L. and Doucet, L. (2008), “The impact of call center employees’ customer orientation behaviors on service quality”, Journal of Service Research, Vol. 10 No. 3, pp. 239-255.
Research and Markets (2018), “Social robot market: forecasts 2018–2023”, available at: https://www. researchandmarkets.com/research/5vc2c8/global_social?w55 (accessed on 8 June 2020).
Research and Markets, (2021), “Companion Robots Market Research Report by Age Group, by Type, by Region - Global Forecast to 2027 - Cumulative Impact of COVID-19” available at: https://www.researchandmarkets.com/reports/5337505/companion-robots-market-research-report-by-age
Rizo, C. G. (2018). The Digital and In Silico Therapeutics Revolution. In Rivas, H., & Wac, K. (Eds.), Digital Health (pp. 197-214). Cham, Switzerland: Springer International
Robinson, H., Broadbent, E., & MacDonald, B. (2016). Group sessions with Paro in a nursing home: structure, observations and interviews. Australasian Journal on Ageing, 35(2), 106-112.
Robinson, H., MacDonald, B. and Broadbent, E. (2014), “The role of healthcare robots for older people at home: a review”, International Journal of Social Robotics, Vol. 6 No. 4, pp. 575-591.
Rosenbaum, M. S., & Massiah, C. A. (2007). When customers receive support from other customers: exploring the influence of intercustomer social support on customer voluntary performance. Journal of Service Research, 9(3), 257-270.
Rosenbaum, M.S. (2008), “Return on community for consumers and service establishments”, Journal of Service Research, Vol. 11 No. 2, pp. 179-196, doi:.
Ruggiero, A. and Fatigati, T. (2022), “Silver Economy & Technology”, Tendenze nuove, vol. 1, pp. 1-6.
Ruggiero, A., Mahr, D., Odekerken-Schröder, G., Russo-Spena, T., Mele, C. (2022). Companion robots for well-being: a review and relational framework. In “Research Handbook on Services Management”, Edward Elgar Publishing.
Russell, D., Cutrona, C.E., Rose, J. and Yurko, K. (1984), “Social and emotional loneliness: an examination of Weiss’s typology of loneliness”, Journal of Personality and Social Psychology, Vol. 46 No. 6, p. 1313.
Russo Spena T., Mele C., Marzullo M. (2019), Practising value innovation through artificial intelligence: The IBM watson case. Journal of Creating Value, Vol. No. 1, pp. 11-24.
Russo Spena, T. and Mele, C. (2020), "Practising innovation in the healthcare ecosystem: the agency of third-party actors", Journal of Business & Industrial Marketing, Vol. 35 No. 3, pp. 390-403.

Salem, M., Eyssel, F., Rohlfing, K., Kopp, S., & Joublin, F. (2013). To err is human (like): Effects of robot gesture on perceived anthropomorphism and likability. International Journal of Social Robotics, 5(3), 313-323.
Sanderson, W. C. and Scherbov, S. (2010), Remeasuring aging. Science, Vol. 329 No. 5997), pp. 1287-1288.
Schuessler, K. F., & Fisher, G. A. (1985). Quality of life research and sociology. Annual Review of Sociology, 11, 129-149.
Schwarzer, R. and Knoll, N. (2007), "Functional roles of social support within the stress and coping process: a theoretical and empirical overview", International Journal of Psychology, Vol. 42 No. 4, pp. 243-252.
Sharkey, A., & Sharkey, N. (2012). Granny and the robots: ethical issues in robot care for the elderly. Ethics and Information Technology, 14(1), 27-40.
Siddike, M., Kalam, A., Spohrer, J., Demirkan, H. and Kohda, Y. (2018), "People's interactions with cognitive assistants for enhanced performances", In Proceedings of the 51st Hawaii international conference on system sciences. pp. 5394-5401.
Singh, J., Brady, M., Arnold, T., & Brown, T. (2017). The emergent field of organizational frontlines. Journal of Service Research, 20(1), 3-11.
Sorkin, D., Rook, K.S. and Lu, J.L. (2002), "Loneliness, lack of emotional support, lack of companionship, and the likelihood of having a heart condition in an elderly sample", Annals of Behavioral Medicine, Vol. 24 No. 4, pp. 290-298.
Sparrow, R., & Sparrow, L. (2006). In the hands of machines? The future of aged care. Minds and Machines, 16(2), 141-161.
Spohrer, J. and Banavar, G. (2015), "Cognition as a service: an industry perspective", AI Magazine, Vol. 36 No. 4, pp. 71-86.
Star, S. L. (1989), "The structure of ill-structured solutions": Boundary objects and heterogeneous distributed problem solving", Gasser, L. and Huhns, M.N. (Eds), Distributed artificial intelligence, Morgan Kaufmann Publishers Inc., Los Angeles, pp. 37-54.
Star, S. L. (2010), "This is not a boundary object: Reflections on the origin of a concept", Science, Technology, & Human Values, Vol. 35 No.5, pp. 601-617.
Sundar, S. S., Jung, E. H., Waddell, T. F., & Kim, K. J. (2017). Cheery companions or serious assistants? Role and demeanor congruity as predictors of robot attraction and use intentions among senior citizens. International Journal of Human–Computer Studies, 97, 88-97.
Sundar, S.S., Jung, E.H., Waddell, T.F. and Kim, K.J. (2017), "Cheery companions or serious assistants? Role and demeanor congruity as predictors of robot attraction and use intentions among senior citizens", International Journal of Human-Computer Studies, Vol. 97, pp. 88-97.
Sweeney, J. C., Danaher, T. S. and McColl-Kennedy, J. R. (2015), "Customer effort in value cocreation activities: Improving quality of life and behavioral intentions of healthcare customers", Journal of Service Research, Vol. 18 No. 3, pp. 318-335.
Taiminen, H.S.M., Saraniemi, S. and Parkinson, J. (2018), "Incorporating digital self-services into integrated mental health care: a physician's perspective", European Journal of Marketing, Vol. 52 No. 11, pp. 2234-2250.
Theofilou, P. (2013). Quality of life: definition and measurement. Europe's Journal of Psychology, 9(1), 150-162.
Trepte, S. and Scharkow, M. (2016), "Friends and lifesavers: how social capital and social support received in media environments contribute to well-being", in Reinecke, L. and Oliver, M.B. (Eds), Handbook of Media Use and Well-Being, Routledge, London, pp. 305-316.

Tuzovic, S. and Kabadayi, S. (2020), “The influence of social distancing on employee wellbeing: a conceptual framework and research agenda”, Journal of Service Management.
Twenge, J. M., Martin, G. N., & Campbell, W. K. (2018). Decreases in psychological well-being among American adolescents after 2012 and links to screen time during the rise of smartphone technology. Emotion, 18(6), 765-780.
van den Berghe, R., Verhagen, J., Oudgenoeg-Paz, O., Van der Ven, S., & Leseman, P. (2019). Social robots for language learning: A review. Review of Educational Research, 89(2), 259-295.
Van Doorn, J., Mende, M., Noble, S.M., Hulland, J., Ostrom, A.L., Grewal, D. and Petersen, J.A. (2017), “Domo arigato Mr. Roboto: Emergence of automated social presence in organizational frontlines and customers’ service experiences”, Journal of Service Research, Vol. 20 No. 1, pp. 43-58.
Van Oerle, S., Mahr, D. and Lievens, A. (2016), “Coordinating online health communities for cognitive and affective value creation”, Journal of Service Management, Vol. 27 No. 4, pp. 481-506, doi: 10. 1108/JOSM-09-2015-0264.
Vargo, S. L., & Lusch, R. F. (2014). Service-dominant logic: Premises, perspectives, possibilities, Cambridge University Press.
Veenman, S. A. (2013), "Futures studies and uncertainty in public policy: A case study on the ageing population in the Netherlands", Futures, Vol. 53 No. 42-52.
Verleye, K. (2019), "Designing, writing-up and reviewing case study research: an equifinality perspective", Journal of Service Management, Vol. 30 No. 5, pp. 549-576.
Walters, M. L., Syrdal, D. S., Dautenhahn, K., Te Boekhorst, R., & Koay, K. L. (2008). Avoiding the uncanny valley: robot appearance, personality and consistency of behavior in an attention-seeking home scenario for a robot companion. Autonomous Robots, 24(2), 159-178.
Wang, X. and Krumhuber, E.G. (2018), “Mind perception of robots varies with their economic versus social function”, Frontiers in Psychology, Vol. 9, p. 1230.
Warde, A. (2005), “Consumption and Theories of Practice”, Journal of Consumer Culture, Vol. 5 No. 2, pp. 131-153.
Weiss, R.S. (1973), Loneliness: The Experience of Emotional and Social Isolation, MIT Press, Cambridge.
Wenger, E. (2000), Key to Knowledge Strategy. Knowledge and communities, Woburn, Butterworth-Heinemann, Vol.1, No.2, pp. 3-21.
Wirtz, J., Kunz, W. and Paluch, S. (2021), “The Service Revolution, Intelligent Automation and Service Robots”, European Business Review, Vol. 29, No. 5, p. 909.
Wirtz, J., Patterson, P., Kunz, W., Gruber, T., Lu, V., Paluch, S. and Martins, A. (2018), “Brave new world: service robots in the frontline”, Journal of Service Management, Vol. 29 No. 5, pp. 907-931.
World Health Organization, Ageing (2021) available at: https://www.who.int/health-topics/ageing#tab=tab_1 (accessed on 26 April 2020)
Xiao, L. and Kumar, V. (2019), “Robotics for customer service: a useful Complement or an ultimate substitute?”, Journal of Service Research.
Zhao, J., Wang, T. and Fan, X. (2015), “Patient value co-creation in online health communities”, Journal of Service Management, Vol. 26 No. 1, pp. 72-96.
Zsiga, K., Tóth, A., Pilissy, T., Péter, O., Dénes, Z., & Fazekas, G. (2018). Evaluation of a companion robot based on field tests with single older adults in their homes. Assistive Technology, 30(5), 259-266.

APPENDICES

Appendix 1: Literature review table

Reference	Type of article	Study context	Robot name and tasks	Interface	Interaction	Companionship	Support	Well-being
Bradwell et al. (2019)	Empirical	Domestic /Nursing home	Paro; Joy for all; Furby; Miro; Pleo rb; Perfect Petzzz dog; Hedgehog - React - Express emotions	Users prefer features that make companion robots more realistic.	Responsiveness plays a key role in interaction, and it determines the acceptance.	Companion robots can understand and communicate in a manner similar to human communication (e.g. touch and hearing).	N/A	Companion robots have well-being benefits, particularly for individuals with dementia.
Dautenhahn, K. (2007)	Empirical	Domestic	Kaspar - Provide expressions Robota - Imitate movements	Users have different preferences and perceptions about the robots.	Companion robots should act in a manner that is believable and acceptable to humans.	Companion robots must provide companionship and be everyday partners to their users.	Companion robots should provide instrumental support.	N/A
de Graaf, M. M. A., & Allouch, S. B. (2017)	Empirical	Domestic	Pleo - Explore environments - React - Express emotions	Robots are relational artifacts with lifelike appearance.	Robots engage in social interactions and possess social skills.	Gender difference provokes diverse provisions of companionship.	Users develop an emotional attachment to companion robots, moved by the desire to form meaningful and enduring relationships.	Robots can provide users with benefits from their relationship.
Goudey, A., & Bonnin, G. (2016)	Empirical	Domestic	N/A	Human resemblance is not necessary to facilitate the acceptance of intelligent objects.	People find interactions with robots particularly natural.	Robots are designed for use at home.	Product anthropomorphization moderates the emotional stimulation process generated by the robot's appearance.	N/A
Huang, T., & Huang, C. (2019)	Conceptual	Domestic	N/A	Companion robots are usually designed to resemble pets.	N/A	Companion robots should possess social skills to communicate in a manner similar to human communication.	Companion robots can provide elderly with emotional and instrumental support.	Companion robots can improve users' physical and mental health level.
Konok, V. et al. (2018)	Empirical	Domestic	N/A	Users desire human-like communication and speech capabilities in robots, whereas a human-like appearance is less essential.	Companion robots should resemble pets for their ability to develop effective social interactions.	Companion robots exhibit social skills.	Companion robots form enduring relationships with their owners.	N/A
Moyle, W. et al. (2016)	Empirical	Domestic /Nursing home	CuDDler - Perform movements - Provide sounds and speech - Make gestures	The appearance must match the functions the robot performs.	The robot must behave in a way that can be intuitively understood by humans.	The need for companionship is important to overcome	Companion robots have a social utility, acting as a social facilitator.	Companion robots can improve quality of life.

						the notion of a companion robot being a machine.		
Nunez, E. et al. (2018)	Empirical	Domestic	Pepita - Project images - Provide expressions	The design of companion robots needs to meet the user's expectations to be adopted into everyday life.	Functions and actions of robots are important in terms of interaction.	Companion robots are designed to be in home environments and assist humans in everyday life situations.	Companion robots need to be carefully designed to meet the user's expectations to be able to be adopted into everyday life situations.	N/A
Odekerken-Schröder, G. et al. (2020)	Empirical	Domestic	Vector - React - Perform movements - Provide sounds and speech	Without being prompted, users customize their robots.	Users maintain a social interaction with companion robots, based on speech and touch.	Companion robots possess social skills, and they are useful for their users.	Companion robots can provide social utility and social connectivity to users.	Companion robots have the potential to mitigate feelings of loneliness.
Pike, J. et al. (2020)	Empirical	Domestic	Joy for All Cat - Vocalize with meows and purrs - Perform movements - Roll over	Zoomorphism affects the perception of companion robots.	The level of interaction with a companion robot has a variable effect.	Robots can provide family connections and stimulate conversation.	Robots can improve stability in behavior.	Robots can improve users' well-being, through their ability to modify mood and their calming effect.
Sharkey, A., & Sharkey, N. (2012)	Conceptual	Domestic /Nursing home	N/A	Some features can amplify natural anthropomorphism or zoomorphism, encouraging users to interact and to bond in caring relationships.	Companion robots simulate user interaction with other humans.	Humans should always be able to distinguish a robot from a human or pet.	Companion robots are not ready enough to convey emotional and enduring support.	Companion robots could enhance well-being by functioning as social facilitators.
Sparrow, R., & Sparrow, L. (2006)	Conceptual	N/A	N/A	N/A	Robots offer users social interaction and expand opportunities for play and entertainment.	Robots cannot be real "friends" with emotions and intelligence.	Emotional support resulting from the interaction with companionship robots is not genuine.	Robots are detrimental to elderly well-being.
Sundar, S. et al. (2017)	Empirical	Domestic /Nursing home	HomeMate - Play audio	The demeanor of a robot (playful or serious) has several consequences on its perception of appearance.	Robots are evaluated according to human–human interaction rules.	Companion robots provide companionship if they are present in typical everyday environments.	Companion robots provide users with emotional support.	Companion robots can implement overall quality of life for senior citizens.
Zsiga, K. et al. (2018)	Empirical	Domestic	Kompaï - Communication-related functions and giving information	Companion robots need functionalities, such as arms, if they have a caregiving task.	Usefulness and reliability of robot functions are not positively related.	Companion robots can be real partners in the everyday life of older adults.	Companion robots can provide cognitive support.	Companion robots are successful in improving the mood and emotional state of the users.