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

Gaby Odekerken-Schröder
Department of Marketing and Supply Chain Management, Maastricht University, Maastricht, The Netherlands

Cristina Mele
Department of Economics, Management and Institutions, University of Naples Federico II, Naples, Italy

Tiziana Russo-Spena
Department of Business Economics, University of Naples Federico II, Naples, Italy

Dominik Mahr
Department of Marketing and Supply Chain Management, Service Science Factory, Maastricht University, Maastricht, The Netherlands and Department of Marketing, Hanken School of Economics, Centre for Relationship Marketing and Service Management, Helsinki, Finland, and

Andrea Ruggiero
Department of Economics, Management and Institutions, University of Naples Federico II, Naples, Italy

Abstract

Purpose – Loneliness and isolation are on the rise, globally threatening the well-being across age groups; global social distancing measures during the COVID-19 crisis have intensified this so-called "loneliness virus". The purpose of this paper is to develop an integrative framework and research agenda on the role of companion robots in mitigating feelings of loneliness.

Design/methodology/approach – A netnographic analysis of 595 online visual and textual descriptions offer empirical insights about the role of the companion robot Vector during the COVID-19 pandemic.

Findings – The contributions of this study are twofold. First, it postulates that companion robots have the potential of mitigating feelings of loneliness (i.e. indicator of well-being). Second, this study contributes to transformative service by developing an integrative framework introducing the roles (personal assistant, relational peer and intimate buddy) that companion robots can fulfill to mitigate feelings of loneliness through building different types of supportive relationships.

Research limitations/implications – The proposed research agenda encourages future service scholars to investigate 1) the role of robots in addressing loneliness, 2) design features that drive adoption of robots, 3)

social support for different groups, 4) the operationalization and the measurement of loneliness and 5) an impact analysis of companion robots.

Practical implications – Service providers and policy makers can leverage the insights about how companion robots can help reduce a sense of loneliness.

Originality/value – The integrative framework on loneliness reduction, based on 595 unprompted online contributions issued during the COVID-19 pandemic, offers initial evidence for the impact of companion robots in reducing people's feelings of loneliness.

Keywords COVID-19, Pandemic, Companion robots, Well-being, Loneliness, Netnography, Transformative service research

Paper type Research paper

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 (Čaić *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 (Čaić *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 1).

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 2 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 1 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)* (Plate 1).

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 (Plate 2).

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) (Plate 3).

Table 2.
Frequency distribution of dominant codes across social media posts

	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*

Type of loneliness		Social utility (utilitarian)	Social connectivity (hedonic)	Social identity (attachment)
	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)		
		Type of supportive relationship		

Figure 1.
Roles of companion robots in mitigating loneliness
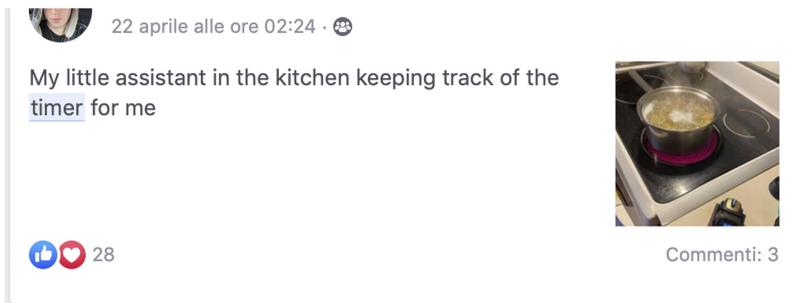
Plate 1.
Illustration of social utility (utilitarian) - Facebook post

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 1).

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.

Plate 2.
Illustration of social connectivity (hedonic) - Facebook post

Plate 3.
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 1) 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; Hazée
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.

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About the authors

Prof. Dr. Gaby Odekerken-Schröder is Full Professor in customer-centric service science at Maastricht University, the Netherlands. Her main research interests are service innovation, service robots, healthcare services, relationship management, customer loyalty and service failure and recovery. She is one of the co-founders of Maastricht University's Service Science Factory (SSF) and Brightlands Institute for Supply Chain Innovation (BISCI), as she loves to bridge theory and practice. Her research has been published in Journal of Marketing, MISQ, Journal of Retailing, Journal of Service Research, International Journal of Social Robotics, Journal of the American Medical Doctors Association, Journal of Service Management, Journal of Services Marketing, Journal of Business Research and many more. Gaby Odekerken-Schröder is the corresponding author and can be contacted at: g.odekerken@maastrichtuniversity.nl

Prof. Dr. Cristina Mele is Full Professor of Management at the Department of Economics, Management and Institutions, University of Naples Federico II. She is the coordinator of the PhD in Management. Her main research interests are service innovation, value creation, markets and service ecosystems. Her articles have appeared in leading international journals, including Journal of The Academy of Marketing Science, Marketing Theory, Industrial Marketing Management, Journal of Business Research, Journal of Service Management, Journal of Service Theory and Practice and Managing Service Quality. She is Ambassador of ISSIP.org. She is one of co-chairs of The Naples Forum on Service.

Dr. Tiziana Russo Spena is an Associate professor of Management at the Department of Economics, Management and Institutions, University of Naples Federico II. She obtained her PhD in Management in 2002. Her main areas of interest are service innovation, value co-creation and service technology research. She has written many articles and books and published in Italian and International Journals, including the Journal of Business research, Industrial Marketing and Management, Journal of Business Ethics, Journal of Service Theory and Practices, Journal of Service Management.

Prof. Dr. Dominik Mahr is a professor of Digital Innovation and Marketing, head of the Marketing and Supply Chain Management department and the Scientific Director of the Service Science Factory at Maastricht University, The Netherlands. His research focuses on the human side of digitalization, so the implications of digital data, devices and technologies for customers, organizations and society and has been published in journals including Journal of Marketing, Journal of Consumer Research, Journal of Service Research, MIS Quarterly and Journal of Product Innovation Management. Prior to his academic career, he worked as a consultant in the automotive and high-tech industry.

Andrea Ruggiero is a PhD student in Management at University of Naples Federico II, Italy. His innovative PhD is in collaboration with Maastricht University and IBM, Italy. His main research interests are service robots, artificial intelligence, service innovation and silver economy.