Tampere University

TUULI TURJA

# Accepting Robots as Assistants

*A Social, Personal, and Principled Matter*

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ACADEMIC DISSERTATION
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## Dedication

I dedicate my dissertation work to my family. A special feeling of gratitude to my loving partner Toni Häkkinen. In his sincere effort of not changing other people, he is actually the one person who has changed me the most. Thank you for the encouragement, support and for being there every time. I give special thanks to Terhi Turja, the best mother and/or agent you could ask for. She has initiated many timely discussions, given academic assistance and most of all, she has been on my side every step of the way. I thank my dear father Teppo Turja for all the interest, assistance and discussions regarding my work, and my brother Pirkka Turja whom I turn to when in need of perspective (or just a laugh).

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# TIIVISTELMÄ

Neljästä tutkimusartikkelista koostuva väitöstutkimus analysoi ja vertailee robottien hyväksynnän sosiaalisia, psykologisia, sosiodemografisia ja kontekstuaalisia tekijöitä. Tutkimus antaa lisäksi ainutlaatuisen yleiskuvan robotiikan hyödyntämisestä ajassa, jolloin palvelualojen robotisaatiota ollaan vasta kehittelemässä. Tutkimuskysymysten teoreettisina viitekehyksinä toimivat robotisaatiovalmius työssä ja teknologian hyväksymismallit.

Ensimmäisessä tutkimusartikkelissa tarkasteltiin Euroopan unionin kansalaisten asenteita robotteja kohtaan ($N = 54\ 552$) hyödyntäen Eurobarometriaineistoja sekä maailmanpankin tilastoja. Toisessa artikkelissa vertailtiin yleisiä robottiasenteita ja robotisaatiovalmiutta kahdessa aineistossa, joista ensimmäinen oli Eurobarometristä poimittu suomalaisen väestön osaotos ($n = 969$) ja toinen tätä väitöstutkimusta varten kerätty suomalaisten hoitoalan ammattilaisten kyselyaineisto ($N = 3\ 800$). Kolmas artikkeli syventyi edelleen hoitoalan ammattilaisten robotisaatiovalmiuteen ja neljännessä artikkelissa tarkasteltiin hoitoalan ammattilaisten hoivarobotin uudelleenkäyttöaikomusta. Neljättä artikkelia varten hoitoalan ammattilaisten kyselyaineistosta poimittiin osaotos vastaajista, joilla oli hoivaroboteista omakohtaista kokemusta ($n = 544$).

Johdonmukaisimmin robottiasenteisiin olivat yhteydessä esimiesasema ja aikaisemmat kokemukset roboteista. Lisäksi hoitoalan ammattilaisten robottihyväksyntään olivat yhteydessä erityisesti minäpystyvyys, sosiaaliset normit, teknologiakiinnostus ja näkemykset teknologisesta työttömyydestä. Yhteisesti väitöskirjan osatutkimusten tulokset viittaavat siihen, että robottihyväksyntä riippuu vahvasti myös arvopohjaisista arvioinneista.

Vaikka robottien hyväksyntää työpaikalla voidaan edesauttaa koulutuksella ja osallistamalla henkilöstöä, olisi tunnistettava myös yksilölliset erot motivaatiossa käyttää robotteja sekä soveltaa tätä tietoa työn uudelleenjärjestelyissä ja työntekijöiden uusissa muutoksenjälkeisissä rooleissa. Robotin käyttämisen vapaaehtoisuus on entistä tärkeämpää tilanteissa, joissa robotin hyväksynnän takana on myös henkilökohtaisia tai jaettuja arvoja. Yhteiskehittämisen tulisi sisältää teknologian käytettävyysarvioiden lisäksi myös tilaisuuden ilmaista, ovatko teknologiat työntekijöiden mielestä työn arvoihin sopivia. Robotisaatio olisi siten tuotava yhteistoimintakeskusteluihin jo harkinta- ja suunnitteluvaiheissa.

# ABSTRACT

Consisting of four separate studies, the aim of this dissertation is to identify and compare social, psychological, sociodemographic, and contextual determinants associated with robot acceptance at work. Analyzing robot acceptance among workers by using large datasets, this dissertation produces also exceptional information about experiences and outlooks concerning service robots. The research questions are based on theoretical frameworks of robotization readiness and technology acceptance.

The first study examined attitudes toward work-related robotization among EU citizens (*N* = 54,552) using Eurobarometer population samples and World Bank DataBank statistics. In the second study, general attitudes toward robots and work-related robotization readiness were analyzed using a Finnish population sample (*n* = 969) and a Finnish care worker sample (*N* = 3,800), the latter of which was collected for this dissertation. The third study examined more closely the robotization readiness among healthcare professionals (*N* = 3,800), and the fourth study analyzed repeat intention to use robots among the minority of the healthcare professionals who reported firsthand experience with care robots (*n* = 544).

Most consistently, robot acceptance was found in respondents who had managerial status and prior experience with robots. Among Finnish healthcare professionals, robot acceptance was also associated with self-efficacy, perceived social norms, interest in technology, perceived effects on employment, and preference of a robot as an assistive tool referring to joint optimization between human and robotic skills. In addition, each of the four studies led to the conclusion that robot acceptance at work is associated with value-based considerations.

The findings provide information for developers and managers looking for ways to predict successful robotization in new fields of work. Although robot acceptance can be promoted in workplaces by educating and incorporating the staff into the technological change early on, individual differences in robot acceptance should be considered when reorganizing roles in the changing organization. The voluntariness of robot use is especially relevant in cases where value-based principles underlie the acceptance. Codesigning robot implementations with employees should include not only assessments of the technology's usability but also personal and shared values. This calls for cooperation negotiations already at the contemplative, deliberating stage of the robotization.

# CONTENTS

# LIST OF EMPIRICAL PUBLICATIONS

I. Turja, T., & Oksanen, A. (2019). Robot acceptance at work: A multilevel analysis based on 27 EU countries. *International Journal of Social Robotics*. doi:10.1007/s12369-019-00526-x

II. Turja, T., Van Aerschot, L., Särkikoski, T., & Oksanen, A. (2018). Finnish healthcare professionals' attitudes toward robots: Reflections on a population sample. *Nursing Open, 5*(3), 300–309. doi:10.1002/nop2.138

III. Turja, T., Taipale, S., Kaakinen, M., & Oksanen, A. (2019). Care workers' readiness for robotization: Identifying psychological and socio-demographic determinants. *International Journal of Social Robotics*. doi:10.1007/s12369-019-00544-9

IV. Turja, T., Aaltonen, I., Taipale, S., & Oksanen, A. (2019). Robot acceptance model for care (RAM-care): A principled approach to the intention to use care robots. *Information & Management*. doi: 10.1016/j.im.2019.103220

# 1 INTRODUCTION

Robots, mechatronic and reprogrammable machines, have been shaping working life for decades in industrial settings. In addition to industrial work, robots have been utilized mainly in agriculture and in the military (Hagele, 2016; Siciliano & Khatib, 2008). Robots have assisted people with *dirty, dull, or dangerous* tasks, which are considered an inconvenient and unpleasant part of any work (Takayama, Ju, & Nass, 2008). However, the more robotics and artificial intelligence advance, the wider the scope of work that can be robotized becomes (Brynjolfsson & McAfee, 2014). It is predicted that not only the undesirable but also some desirable tasks will be delegated to robots in the future. In this scenario, only few skilled professionals will be able to keep up with what Brynjolfsson and McAfee (2011, 2014) describe as the "race against the machines." According to Frey and Osborne (2015), these limited positions for people are then related to so-called engineering bottlenecks, tasks that cannot be substituted by machines because they cannot be defined by coding and algorithms. It is a technologically deterministic view that robots will come and take over jobs. It does not consider that technology eventually rises from social needs and is under constant regulation and evaluation by the people (Green, 2001; Rogers, 2000). In other words, it is not only what the robots can do, it is also what, where, and when we want them to do it that affects the use of robot technology.

As a widely accepted principle, new technology should be codesigned with groups of end users (Dotson, 2015; Šabanović, 2010). Codesigning aims at producing information to the technology developers, service developers and in this case for working places organizing technological changes. In care work context, codesigning also aims to ensure that the focus remains in patient-centeredness (Robert et al., 2015). Thus, instead of repeating the technologically deterministic narrative where users' role is minimized into accepting and admiring the capabilities of new technology, the more voluntaristic and dynamic views are taking over (Šabanović, 2010). As social constructs (i.e., things people give meaning and categories for), technologies find their place and time only when the users define them (Nye, 1997, p. 8). The dynamic view refers to Šabanović's (2010) concept of mutual shaping of robotics and society. In a dynamic interaction, society shapes robots and vice versa. Codesigning robots and robotization with a group of potential end users is the first part. The second, and maybe more challenging part, is to authentically leave room for refusal. Before even opening the robot's capabilities for discussion, there should be an opportunity to express issues of principles, for example, against robotizing a certain line of work or parts of it.

The question of robots replacing desirable tasks becomes especially relevant in a service work context (i.e., social environment or setting) where *fewer* tasks can be categorized as dirty, dull, and dangerous (Brynjolfsson & McAfee, 2014; Takayama et al., 2008). Robotization is not necessarily considered a priority for employees who are psychologically invested in and connected to their jobs. With doctors and nurses, the term *calling* is sometimes used to describe the deep commitment generated from the feeling of doing meaningful work that is also significant to other people (Grant, 2008). While in fact none of the service work occupations seem to stand out with an exceptional sense of calling (Wrzesniewski, McCauley, Rozin, & Schwartz, 1997), people who are motivated to make the world a better place often work in public services (Bakker, 2015). Studies have shown that, for example, nurses' motivation for work depends on the sense of a calling, described as an ability to fulfill personal values at work (Bakibinga, Vinje, & Mittelmark, 2012; Vinje & Mittelmark, 2007).

Motivation is a highly relevant concept when we want to understand human behavior (Pervin, 2003, p. 124), as is technology acceptance. Usually, building on a hierarchy of motives, motivation theories focus on people's intentions, which for example, could be an intention to use robots. Motivation can be explained by three following questions: What triggers an individual? Why does an individual select one choice over the other? Why does this choice vary depending on a situation or context? (Pervin, 2003, p. 105). The working environment's compatibility with personal values is an important motivational factor (Festinger, 1957; Vallerand, 1997). Especially in cases of high professional pride or a vocational choice originating from a calling, robotizing even a part of the job may well lead to decreased motivation (Bjellegaard et al., 2017). In addition, a reluctant yet mandatory use of robots can become a source of cognitive dissonance. *Cognitive dissonance* refers to a conflict between the individual's beliefs and behavior (Festinger, 1957) which originates from our need to have "consistency between our internal and external lives" (Kenworthy, Miller, Collins, Read, & Earleywine, 2011, p. 99). For example, in a case where an employee is required to use robots while thinking this is not consistent with his or her personal values, the logical decision would be not to work in such environment, so staying can cause considerable amount of stress and cognitive dissonance (Kenworthy et al., 2011, 2014).

Also the term paradox is used to describe the contradiction and the dissonance between what people think is morally right and how they actually behave (Loughnan, Haslam, & Bastian, 2014). Facing these kind of paradoxical feelings, typically accompanied by guilt and shame, people have a need to resolve the situation (Kenworthy et al., 2011; McGrath, 2017). According to cognitive dissonance theory, individuals seek a stable state in which there is a minimum amount of mental conflict among values, behaviors, perceptions and attitudes, and do this by altering either their thoughts or their behavior (Festinger, 1957). The main strategies to reduce cognitive dissonance are ignoring the conflicting thoughts, changing the thoughts (i.e. attitudes) or changing the action itself (McGrath, 2017).

Deriving from the theory of cognitive dissonance, the model of *innovative dissonance* has two advantages regarding robotization research. First, it takes in account the peer pressure in evaluations of behavior's congruence with values and attitudes (Rogers & Shoemaker, 1971). Second, it distinguishes a symbolic adoption from an actual adoption (Karahanna, 1999; Rogers, 1983). Symbolic adoption refers to intention to use a certain innovation. Thus, in cases of mandatory use of technology, symbolic adoption represents a more relevant factor than measures of the actual use do. In robot trials, it is common that the robot is introduced to the staff with an expectation of participation, which can be interpreted as mandatory use (Niemelä, Määttä, & Ylikauppila, 2016).

There is already some evidence of the link between the compatibility of personal values and technology acceptance, and more specifically, the perceived usefulness of technology (Karahanna, Agarwal, & Angst, 2006). However, the care context adds another degree of difficulty to the robot acceptance discussions because of the context of human(e) service. First is the question of justifying the renewal of human-centered care via technology. For example, Hofmann (2013) doubts we can ever measure the effectiveness of healthcare technology like we measure the benefits of automatization in the industrial setting. That said, it is also clear that, for example, a heart machine is more effective and reliable than a nurse monitoring and recording the heart rate by hand and a pocket watch. Some parts of the care work have surely and conclusively been taken over by technology, but there still remains a contrast between human-centered services and utilizing technology. Moreover, before the requisition of care work renewal with new technology (e.g., Horizon/2020, 2016), care work has already faced competing demands between, for example, social and empathetic nursing and impersonal and science-based health professionalism (Hirvonen, 2015).

Second, in the care context, we are not only talking about professionals using robots as a part of their job. Care situations involving customers and patients are sensitive, diverse, and difficult to predict or standardize (Sandfort, 2010, p. 269). Care robots are in contact with patients, who sometimes have deficits in terms of coherence and control (Silverstein & Heap, 2015). Is it then acceptable to let robots care for humans, or should robots only be tools for the care personnel? For nurses, patients' well-being is a priority, and hence, nurses' intention to use robots is bound to be reflected in the estimated respectfulness, trustworthiness, and safety of the robot (NMC, 2015; Scammell, Tait, White, & Tait, 2017).

My doctoral thesis is part of a project titled *Robots and the Future of Welfare Services* (ROSE), funded by the Academy of Finland's Strategic Research Council and the Disruptive Technologies and Changing Institutions program. The project's premise is that care robots have great potential in the renewal of health and welfare services, yet challenges lie in the ethical and social issues that are central when it comes to using robots in a care context. ROSE tackles this field of research via a multidisciplinary consortium, giving an exceptionally strong voice to social sciences in robot research. The rationale for this is the emergence of social robots. In contrast to traditional robots, new-generation social robots with a degree of autonomy and position to interact and work with people, constitute a social structure, and thus especially require research in fields outside of engineering and computer science (Nourbakhsh, 2006; Sarrica, Brondi, & Fortunati, 2019).

This doctoral thesis in social psychology is mostly centered on care robots. The term *care robotics* encompasses machines that perform care-related activities for people with age or health-related restrictions (Goeldner, Herstatt, & Tietze, 2015). There are considerable assumptions and theorizations around care robot acceptance, yet representative quantitative data have been lacking. Discussions in the field are mostly based on qualitative or small-sample trial studies (Savela, Turja, & Oksanen, 2018). To test a variety of assumptions and contribute to the care robot acceptance research with more generalizability, broad care worker survey data were collected for the ROSE project. The respondents were care professionals, mostly nurses, drawn from the member registers of two major trade unions in Finland. Depending on whether the respondents had firsthand experience with care robots, this dissertation aims to identify social (e.g., shared norms), psychological (e.g., self-efficacy beliefs), sociodemographic (e.g., age) and contextual (e.g., tasks the robot would be assisting with) determinants in either work-related robotization readiness or repeat intention to use robots. *Robot acceptance at work* is used as an umbrella term (Figure 1) covering both robotization readiness (all potential users) and intention to use robots (those with firsthand experience with robots).

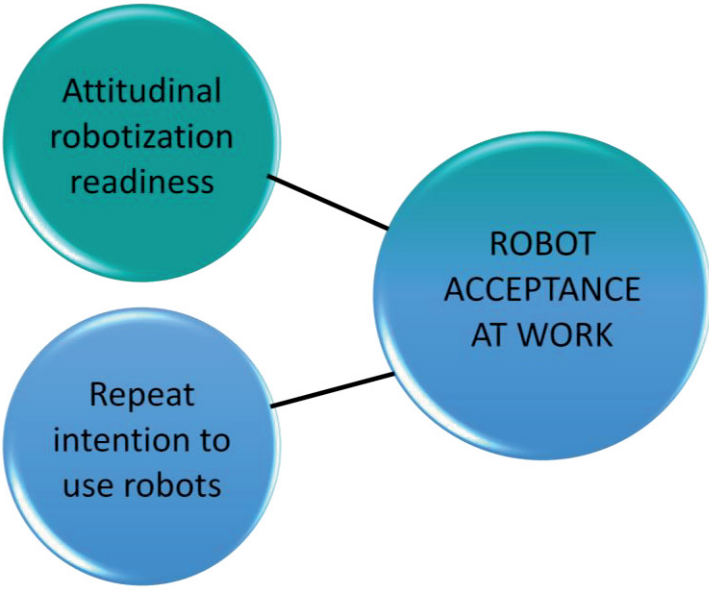


Figure 1. Dependent variables of robotization readiness and the intention to use robots

This dissertation consists of four studies that examine the attitudes toward robots and robotization in general and then consider robotization readiness and the repeat intention to use robots especially in care work. Here, care is understood as a practice-based relation that includes hands-on care taking and emotionally invested caring for another person (Gherardi, & Rodeschini, 2016). Care work refers to the professional healthcare work of nurses and physiotherapists. In addition to healthcare (i.e., treatment of people), care work consists of elements of social care (i.e., people's social welfare), especially when it comes to home care services primarily done by practical nurses (Hirvonen, 2015). Figure 2 shows the studies proceeding in a thematic order from larger populations to more specific groups of interest. The figure also introduces the two datasets and their two sub datasets, as used in the four studies. The first study examined attitudes toward work-related robotization among European Union (EU) citizens. In the second study, general attitudes toward robots and work-related robotization readiness were analyzed using a Finnish population sample and a Finnish care worker sample. The third study examined robotization readiness among the care workers more closely, and the fourth study analyzed the repeat intention to use the robot with which the respondent had already had firsthand experience.

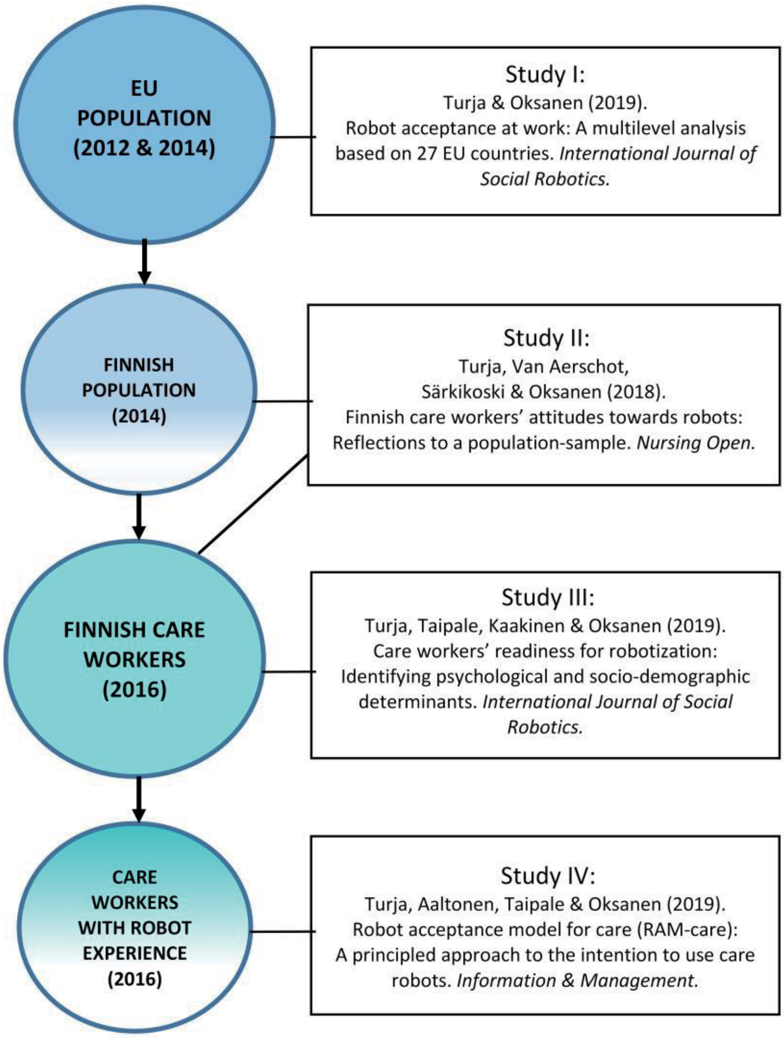


Figure 2. Four research articles proceeding from larger to more specific populations

The study presents evidence of how determinants associating with robotization readiness and the repeat intention to use robots have social, personal, and value-based dimensions. These include psychosocial constructs, such as attitudes, personal preferences, beliefs, values, and norms. The findings provide an overview of robot acceptance in a contemplative stage of service and care work robotization, as well as support the idea of codesigning new technology and its implementations with the potential end users in the organizations. Codesigning robotization with staff members should consider personal and social aspects as part of robot acceptance and take into account both the positive and negative views of the technology.

# 2 ROBOTIZATION READINESS

## 2.1 Changing work in the dawn of service robotization

Working life in Europe has recently been undergoing changes that can be described as the fourth technological revolution (Schäfer, 2018; Schwab, 2016). Following the prior revolutions brought by the steam engines, electricity and mass production, and then information technology, the fourth technological revolution constitutes wide-ranging digitalization and artificial intelligence. By wide-ranging it is meant that the robotization is reaching also service sector work. By definition, service robots perform services that are useful to the well-being of humans outside manufacturing operations (International Federation of Robotics [IFR], 2018). Distinctive to this new era of digitalization, artificial intelligence and service robotization, compared to the preceding era of information technology, is the machines' advances in computing power and self-learning (Dean & Spoehr, 2018; Schäfer, 2018). As far as robots are concerned, the fourth revolution frees them from isolation into working directly with and for people. After robots' 60 years of manufacturing work, they are now being gradually released in social environments and even in the domestic sphere, transcending industrial and economic rationalities and traditions (Taipale, de Luca, Sarrica, & Fortunati, 2015, p. 13; Wang & Krumhuber, 2018).

Robots are typically classified according to their intended context of use (IFR, 2018). As machines and systems, there is no demarcation between industrial and service robots. The same exact technology can work either as an industrial robot or a service robot depending on the context it is being used in. With the same logic, a care robot is a robot working in a care environment and a social robot is a robot socially engaging people. A social robot is specifically defined as an embodied artificial agent that has features of a human or an animal and has been developed to directly interact with people (Broekens, Heerink, & Rosendal, 2009; Nourbakhsh, 2006). Social robots are often humanoid, which means they have some features resembling a human being (e.g., head, torso, and limbs). Similarly, animoid or "zoomorphic" robots resemble an animal of a kind, and mechanoid robots are intended to look like machines.

Industrial robots collaborating closely with human workers are called collaborative robots or cobots. They can work as an interactive part of an assembly line (e.g., "Walt") or be placed at a single workstation (Halme et al., 2018). Some of the industrial cobots are humanoid-shaped (e.g., "Secondhand"), although humanoid robots are a more familiar sight in the human-service field of work because of the higher importance of a pleasant appearance in social acceptance (Čaić, Mahr, & Odekerken-Schröder, 2019; Iwamura, Shiomi, Kanda, Ishiguro, & Hagita, 2011; Prakash & Rogers, 2015).

One way to categorize any type of robot is by its autonomy. The majority of current robots are either preprogrammed or tele-operated, which means they require constant human interference and supervision that can only be reduced by increasing the autonomy of the robot. This notion has lead the robot developers to focus on semi-autonomous human-robot collaboration, regarding both social robots and industrial cobots, in order to replace human workload by robots that take initiative in tasked-based and social behaviors (Hong et al., 2019; Lopes et al., 2015; Pu, Moyle, Jones, & Todorovic, 2019). These complex and dynamic interactions between available technologies and different actors are referred as sociotechnical environments or systems (Geels & Schot, 2007; Trist, 1981). In the sociotechnical system of professionals, technology, and the environment, the aim is to find the optimum balance between useful technology and quality in people's working lives (Trist, 1981). When successful, the outcome is joint optimization of technology and professional work. Sometimes, the term joint optimization refers to quite concrete methods in joining together human and artificial intelligence. In medical diagnostics, human-computer teams have outperformed both doctors and computer algorithms (Gaynor, Wyner, & Gupta, 2014).

Robot-human collaboration is more timely and justifiable field of research and development, because highly autonomous, intelligent and multifunctional social robots are not a reality in the near future (ROSE Consortium, 2017). Despite impressive developments in autonomous vehicles and self-learning virtual agents, for example, artificial intelligence is still considered narrow (Page, Bain, & Mukhlish, 2018). Narrow artificial intelligence operations are confined by programmed scenarios, so they are far from the ideal of general artificial intelligence, which would resemble the versatility of human intelligence (Miailhe & Hodes, 2017). Still, today's artificially intelligent systems are capable of providing meaningful content to a social robot, which is one possible platform for a virtual assistant. Self-learning virtual assistants (e.g., IBM's Watson) collect and recollect information about the interests and behavior of their user to provide individual service.

Out of the roughly 300,000 service robots in professional use in the world, the most common applications are logistic systems, defense drones and vehicles, milking robots and telepresence robots (IFR, 2018). Despite the relatively large media exposure, medical robots (used, e.g., for surgery and therapy) represent less than 3% of the service robots sold (IFR, 2018). Sandfort (2010) divides service sector technologies into human-processing and human-changing functions. Following this line of thought, care work would include human-processing technology, such as a robot guiding patients in a hospital lobby or other "fairly short intervention", whereas human-changing technology would refer to any robots that act to "alter the physical, psychological, social or cultural attributes" of patients (Goffman, 1959; Sandfort, 2010, p. 270).

Telepresence and therapy robots are some of the most common types of robots used in social and healthcare work. A telepresence robot (e.g., "Double"; see Figure 3) enables virtual face-to-face communication for people at different locations, for example, a between-visits checkup call from a nurse to a home care customer

(Coradeschi et al., 2011; Koceski & Koceska, 2016). Therapy robots refer to physiotherapy ranging from robot-assisted gait rehabilitation (e.g., “Lokomat”) to more entertaining robot coaches (e.g., humanoid “Nao”; see Figure 4), as well as affective or cognitive activation in the form of robot-assisted gaming, or for example, caring for a robot animal (e.g., “Paro”; see Figure 5; Johnson, Cuijpers, Pollmann, & van de Ven, 2016; Melkas, Hennala, Pekkarinen, & Kyrki, 2016; Niemelä, Ylikauppila, & Talja, 2016). Social robots as care robots are implemented for example in dementia care to decrease the patients’ loneliness, anxiety, and use of medication and increase their overall psychological well-being (Lane et al., 2016; Marti, Bacigalupo, Giusti, Mennecozzi, & Shibata, 2006; Pu et al., 2018).

Due to its emphasis on health and social care for older people, this thesis excludes robotic surgery from the concept of care robots. Subtracting robotic surgery from the 3% of robots sold in the medical sector, it is evident that care robots have not yet even started to take over care work. However, there are signs of somewhat active piloting of different types of care robots in Finland. By the end of 2016, 11% of Finnish healthcare professionals reported being familiar with some kind of a care robot (Van Aerschot, Turja, & Särkikoski, 2017).

Nieminen and Hyytinen (2015) stress the future orientation in innovation evaluations because of the ever-changing sociotechnical environments. This means that the discussions about robotization in organizations should also focus on the possible outlooks and future scenarios. Technological innovations that change working life can be evaluated for their economic value, as well as their immaterial values of relations, responsibility, and reputation (Beedholm, Frederiksen, Frederiksen, & Lomborg, 2015; Nieminen & Hyytinen, 2015). Again, human-centered service and welfare sectors have distinct features which means that sometimes the traditional rationalities are questioned. In a study of dementia nursing homes, it was found that the motivation to purchase robotic technology for the care facility was more related to increasing the customers’ quality of life and positive public relations than increasing cost efficiency (Niemelä, Määttä, & Ylikauppila, 2016).

Figure 3. Double telepresence robot (photo: Tuomo Särkikoski)

Figure 4. Nao robot demonstrating a daily exercise (photo: Satu Pekkarinen)

Figure 5. Paro, a robot seal, charging (photo: Tuuli Turja)

Applying Geels and Schot's (2007) arguments, the robotization of a certain service field starts with a societal pressure to change, which originates from general societal values and norms, for example, political reforms. These external pressures prime the possible changes and actions made in specific service fields with specific user groups, sociocultural values, and so forth (Geels & Schot, 2007; Pekkarinen, 2011). Future-oriented innovation evaluations would mean that possible users were able to contribute to the codesigning processes at an early stage, when possible futures are only just being assessed (Nieminen & Hyytinen, 2015). However, in robot research, the codesign with possible end users seems to take place when it is already time to measure the acceptance of a produced and tested prototype (Savela et al., 2018), not when the technological change is on the horizon. Another aspect regarding insufficient codesign is that most sociotechnical approaches seem to value the consensus among employees to achieve a successful technological change when in fact it would be productive to consider all the possible, also conflicting, interests and ideas when dealing with an emerging change (Hård, 1993).

A behavioral theory of organizational change views the change process in five stages, which are: precontemplation, contemplation, preparation, action, and maintenance (Prochaska & Velicer, 1997; Prochaska et al., 1994). Robotization in healthcare can be viewed as a change in its contemplative stage, where it is recognized how robots could be part of the solution regarding the growing need for welfare services and the predicted shortage in care personnel (Finland's Ministry of Social Affairs and Health, 2017; Sorell & Draper, 2014; Veruggio & Operto, 2008; Zsiga et al., 2013). However, before the preparatory stage, it must be deliberated whether or under what terms the change should be implemented. This is then comparable with Geels and Schot's (2007) sociotechnical model in the sense that the precontemplative stage is driven by general societal values, in this case, a growing need for services and technology as one solution to that. The politically defined priorities work as external pressures, but those aims are to be deliberated (and rejected or implemented) among the specific occupational groups at the contemplative stage.

In this dissertation, care robotization is considered as a job or a task change (Schyns, 2004) and not an organizational change that would focus on separate institutions or companies. It is fair to assume that there are organizations where care robotization is in the precontemplative stage because they have refused robotization as a future strategy. There are also organizations in further stages and robots already implemented to work. Widespread job and task change is still very much in the contemplative stage, and robots have not largely influenced care work. Besides, the robots used in care today provide little actual assistance to the nursing staff. Instead, they are something additional or complementary. Humanoid robots, for example, entertain care home residents with physical activities, but when nursing work is concerned, the non-autonomous robots are not yet decreasing the workload but rather perceived as time consuming and laborious to use (Melkas et al., 2016).

## 2.2 Job or task change as a personal and social matter, particularly in a care context

Robotizing work is a personal matter when it challenges developments in individuals' career, employment, well-being, or occupational identity. Public debates center on technological unemployment—a reduction of human labor due to technical progress. In this thesis, the focus is not on the arguments questioning or supporting the volume of technological unemployment, but rather, the individual perceptions of this phenomenon. When it comes to unemployment caused by robotization, Finns are less likely (59%) to think robots will take over people's jobs compared with the EU average (72%) (Turja & Särkikoski, 2018: Eurobarometer 2017). Changing the focus to the respondent's own field of work and the risk of technological unemployment there, the opinions are even more optimistic. Only about 25% of employed Finnish citizens are unsure about future work opportunities despite automation and robotization (Ministry of Economic Affairs and Employment, 2018).

Personal identity—Who am I and where do I belong?—is connected to what we do for a living. In some cases, to challenge our professionalism and expertise with rival robots is to challenge our identity (Sætra, 2018). An identity crisis can be caused by an individual threat of losing a job or feelings of competence, but when artificial intelligence shows signs of surpassing human intelligence, it can even affect a collective crisis for a certain group of professionals or all humankind for that matter (Sætra, 2018, p. 64). Losing a job is one thing; losing a job one has a calling for is another. If one has a calling to a certain work, it is presumably an even more significant part of one's identity, and certainly, a part of one's occupational identity — the overlap between who am I and wish to become as a professional (Phelan & Kinsella, 2009). In welfare service work particularly, occupational identity is a socioculturally developed concept of the professional self that is based on the life history, aspirations for the future, relatable aspects in the work, as well as values and ethics associated to the work (Hirvonen, 2014: Laiho & Ruoholinna, 2012).

There is a chance of conflict between a job change and the identity, since we tend to retain our identity and keep it stable (Anthony & Tripsas, 2016, p. 417). This means that any change may threaten our identity and even lead to an identity crisis. That said, a job reform can also support occupational identity if the changes are in line with an individual's self-conception as a professional. An additional notion to occupational identity is career identity, which is especially relevant in discussions of change readiness. Career identity answers to the question of where does one stand and wish to achieve career-wise. It is a broader construction than occupational identity is, since it is not tied to a particular profession, but rather, to a possible future working life role (Fugate, Kinicki, & Ashforth, 2004; LaPointe, 2010). Career identity is considered part of career commitment and a factor in the ability to adapt to changes at work, such as robotization (Carson & Bedeian, 1994; Savickas & Porfeli, 2012).

Technological changes like robotization are social matters, especially in human-centered service work. In a context where robots are interacting with people, the challenge is to design social environments that foster positive robot–human collaboration (Gaynor et al., 2014; Šabanović & Wang-Lin, 2016). Robotization in a care context is particularly complex for at least three socially constructed reasons. First, care services are highly legislated, for example, by the Act on the Status and Rights of Patients and the Act on Health Care Professionals in Finland. Second, the laws are complemented by occupational ethical standards, which in nursing work include respectfulness, compassion, partnership, trustworthiness, competence, and safety (NMC, 2015). These values of practice are recommendations and principles that nurses are expected to commit to as individuals and a community (Benjamin & Curtis, 1992, p. 6). Essentially, practicing a profession by following its ethical norms requires the ability to assess occupational operations, actions, changes, and decision-making (Rautava-Nurmi, Westergård, Henttonen, Ojala, & Vuorinen, 2013).

The third reason that makes robotization complex in the context of care is the understanding care work as consisting of multiple tasks that are all more or less holistic in nature. The term holistic care means that the tasks consist of a variety of cognitions, emotions, motivations, and discretion, and care has no clearly defined composition, beginning, or ending—all of which would make care slightly more encodable or understandable in a mechanical or analytical sense (Van Aerschot, 2014; van Wynsberghe, 2013; Waerness, 2005). Extensive robotization in care work would have an effect on how we understand care work, the distribution and hierarchy in care work, and other standards and values shared in care work (Sellman, 2010). Would it be possible to maintain the current ethical standards of nursing work after robotization, and if not, how can the values of, say, respectfulness and compassion be rearticulated? Alternatively, are these norms, in fact, hindering robotization because for the technological change to be approved by care workers, it must be congruent with the shared practice values (Vallor, 2011)?

In addition to occupational ethical standards, nursing work is guided by the care worker's personal values and principles, such as empathy, humanness, friendliness, and reciprocity when interacting with patients (Rautava-Nurmi et al., 2013). Based on the patient-centered values associated with professional care, Aimee van Wynsberghe's (2013) basic premise of is that care robots should be designed to support and promote patients' safety, dignity and well-being, as well as other values of care. The nature of activities approach distinguishes different values in the variety of care tasks and offers a basis for evaluating how robotization would endanger or foster those values (Santoni de Sio & van Wynsberghe, 2016). Care tasks can be categorized, for example, by their practice orientation or goal orientation. Practice-oriented activities are tasks defined by good quality care; attentiveness, namely responsibility, competence and reciprocity – and should therefore done by care workers, while goal-oriented activities are more mechanical procedures that are successful just as the goals are attained (Santoni de Sio & van Wynsberghe, 2016). However, pure goal-orientation is difficult to identify particularly in interactive patient work because of its holistic essence, so one way is to consider direct care tasks as practice-oriented and indirect care tasks as goal-oriented. This care task segmentation categorizes direct and interactive patient work as practice-oriented activity leaving indirect care tasks, such as documenting and logistics, to the category of goal-oriented tasks (Ballermann, Shaw, Mayers, Gibney & Westbrook, 2011).

Practice orientation is a mind-set where giving good quality care to people is one of the key motivators of healthcare workers (Liveng, 2008). Despite this, practice orientation is not always recognized in organizational changes (Liveng, 2008: Nabe-Nielsen, 2005). An example of this is the politically driven agenda of increasing home care and reducing institutional care. Following the agenda, home care is organized in such a way that a minute schedule dictates the amount of time spent with a home care customer. Instead of home care workers making a professional decision about the time needed for each visit, the workers are given a schedule to follow. This kind of time-based care takes away the professional estimation of the customers' true needs (Liveng, 2008), and it is sometimes even assimilated to "robotizing" human care work (Bjellegaard et al., 2017). Taking away from professionalism is adopting effectiveness at the expense of excellence, as Sellman (2010) has described in his analysis of contradicting values in care organizations.

Another socially and ethically interesting debate concerns the question of how a social robot could address the requirements of care ethics when it does not have motivations or moral thinking of its own (Laitinen, 2018). In fact, most of these requirements are even beyond any authentication when it comes to people. Compassion is considered to originate from human empathy, but even this can be a mere performance. In some occupations, we are expected to provide emotional labor, where we express emotions like kindness toward a customer, regardless of what we feel and think in reality (Hochschild, 1983). For example, nurses are required to signal their empathetic concern regardless of their genuine feelings (McQueen, 2004). To condemn robots as carers because of their lack of genuine feelings of empathy, for example, would almost be a double-standard for humans versus robots. Intelligent robots have the potential to present—and to be perceived—as compassion-simulating, ever-patient, ever-friendly, trustworthy companions (Bickmore, Caruso, & Clough-Gorr, 2005; Damiano, Dumouchel, & Lehmann, 2014; Seibt, 2017; Stahl, McBride, Wakunuma, & Flick, 2014). Clearly, an important difference remains, where humans are capable of feeling true empathy, whereas robots are not (Sparrow, 2007). So in reality, we would have to have a lower standard for a robot carer. Although an artificially intelligent robot is not genuinely capable of being kind, it can simulate kindness. Although it is not capable of deliberating on what is safe or unsafe, by programming, it can predict what a human would evaluate as such (Laitinen, 2018, p. 324). Thus, we would merely expect robots to make the right predictions for situations in which to express and not to express for example empathy, trustworthiness, and reciprocity.

Reciprocity, including emotionally responsive and favor-exchanging social behavior, is essential in human interaction (Falk & Fischbacher, 2006; Gouldner, 1960). It sounds like a tall order for human–robot interaction even if we adjusted our expectations to lower standards for a robot carer. Consequently, the key is not to think that humans would reciprocate with robots in the same way they reciprocate with humans (Sandoval, Brandstetter, Obaid, & Bartneck, 2016; Seibt, 2017). Additionally, people have some tendency to see interaction in situations there is none, and thus, sometimes one-sided in perceived as two-sided. Although people recognize they are dealing with an object, they sometimes view it and feel about it similarly to how they would do so with humans. This type of anthropomorphic thinking has been linked to reciprocity because it seems that people are reciprocal with machines they benefit from, but are also expected to take care of them in return (Fogg & Nass, 1997; Nass & Reeves, 1996). Returning the favor to the machine is an important part of human–robot reciprocity even though every action of maintenance is logically aiming to keep the machine working and benefitting the user (Sandoval et al., 2016). While anthropomorphic interaction is definitely one-sided, it does not prevent people from thinking, "If you are nice to me, in the future I will be nice to you" (Sandoval et al., 2016, p. 306).

In addition to the anthropomorphic thinking, people have a varying tendency toward parasocial interaction, where they fabricate a relationship with a mediated fictional character, such as an avatar in a game or character on a television show (Banks & Bowman, 2016). People with a higher tendency for anthropomorphic thinking and parasocial interaction have more positive attitudes toward robots than people in which such tendencies are weaker (Lee, Shin, & Sundar, 2011). These individual tendencies support the importance of voluntariness when there are human and robotic carers or coworkers to choose from. Some people see a greater difference between a human and a humanoid robot.

That some people are more prone to accept robots than others does not efface the challenges set by nursing ethics, care work practices, and the limitations in defining the algorithms of care. For a line of work to be robotized, bottlenecks for unencodable parts must be identified (Frey & Osborne, 2015). Are there additional parts of work that should be off limits when it comes to robotization? Should the robot be alone with a patient under any circumstance? Parviainen, Turja, and Van Aerschot (in press) write about triadic care, which refers to human–robot–human interaction: Embodied practices in care work, even if robot-assisted, "require reciprocal interaction between the care-receiver and the caregiver" (van Wynsberghe, 2013, p. 420). Thus, patient–robot interaction would be inadequate in robot-assisted patient moves, for example, but in triadic care, robotics is a part of the interaction and can mediate the reciprocity in the nurse–patient relationship (Parviainen et al., in press). In patient–robot–nurse interaction, even if the robot works at a highly autonomous level, its role would be considered that of an instrument between human caregiving and care receiving. In addition, when the nurse is responsible for the robot and its actions, the patients are not required to use the technology independently.

Summing up, the values and principles of nursing work are understood as beliefs of what feels right or socially more acceptable, thus values are considered both individual and shared in nature (Rautava-Nurmi et al., 2013). Shared values can also reach a shared social identity, where people categorize themselves in relation to a certain group of people (Haslam, 2003; Tajfel, 1978). While Kielhofner (2008, p. 106) defines occupational identity as an individual construct of volition, habituation, and experience, there are theories that understand occupational (or any) identity as having a social dimension as well (Phelan & Kinsella, 2009). For example, in social constructionism, occupational identity is viewed as being constructed in a dynamic interplay of an individual and the social environment, history, and culture (Berger & Luckman, 1996; Phelan & Kinsella, 2009).

Sometimes, the construct of social identity brought into a work context is also referred to as an organizational identity, which is about questions of "who we are and what should we do as a community" (Anthony & Tripsas, 2016, p. 418). The latter question is future-oriented and directs the occupational group's shared thoughts on how to conduct the job. In other words, it relates to evaluations of which potential changes are preferable and which are unacceptable. Internalized social identity makes one listen to the group and often speak for that group (Haslam, Reicher, & Platow, 2011; Reicher, Haslam, & Hopkins, 2005). An example of internalized social identity and the use of the first-person plural while speaking for an in-group is found in a Finnish care robot study, where a caregiver stated that "robots should not replace us because we are not in a factory" (Niemelä, Määttä, & Ylikauppila, 2016).

## 2.3 Attitudinal readiness for change

Individual readiness for change refers to a positive evaluation of organizational change and leads to change supportive behaviors (Rafferty, Jimmieson, & Armenakis, 2013). The established view in the literature is that readiness for change becomes most relevant in organizational settings where the work depends on teamwork and collaboration because implementing the change requires collective understanding among the staff (Hård, 1993; Weiner, 2009). Readiness can be measured at a stage where employees have some degree of opinion on how much they appreciate the change at hand and a somewhat concrete view on demands, resources, and situational factors regarding the change (Armenakis, Harris, & Mossholder, 1993; Weiner, 2009). Because of the emerging state of robotization in the service fields of work, and hence, the lack of concreteness and coherence in assessing the change, readiness for change is considered future-oriented, at least for the large part. Thus, in this dissertation readiness for change is limited to an attitudinal readiness for change, fitting the contemplative stage of service work robotization.

Although readiness for change also consists of concrete evaluations about the specific changes in work tasks or environment, a large part of it is attitudinal in the sense that employees explicitly evaluate the change (Fabrigar & Wegener, 2010; Greenwald & Banaji, 1995; Haddock & Maio, 2008). Explicitness refers to reflective and more gradually forming attitudes in comparison with implicit attitudes guiding the individual in more spontaneous situations (Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997). Attitude is evaluative readiness organized by past experiences (Allport, 1935, p. 810). It has components that are cognitive, affective, and behavioral in nature (Fishbein, 1963; Rosenberg & Hovland, 1960). Thus, attitudinal readiness for robotization would comprise cognitive (e.g., expecting robots to provide support in the current job), affective (e.g., feelings of anxiety toward new technology), and behavioral (e.g., prior experiences with nonfunctional robots) attitudes (Broadbent et al., 2010; Haddock & Maio, 2008).

Attitudinal readiness for robotization is a belief that it would be justifiable and comfortable to receive robot assistance in a certain, known context. Readiness for change is considered also a propositional attitude where one forms a hypothesis on how the change would be, basing this on a variety of beliefs (Willard, 1976, p. 250). These attitude-forming beliefs are known to contradict each other, which reflects on more complex predictability. For example, a social norm influences the formation of a propositional attitude, but it does not necessarily affect the subject's behavior since there may be more persuasive beliefs regulating the attitude to the other direction, such as from prior firsthand experience (Stamper, Liu, Hafkamp, & Ades, 2000).

The cognitive-affective–behavioral construct of attitude has been extended into the metacognitive model (MCM) of attitude by Petty, Briñol, and DeMarree (2007). In the MCM, people retrieve information from their memory to evaluate an object—in other words, to form an attitude—but they do this with self-awareness. The metacognitive process of self-awareness allows the individual not only to evaluate something but also to modify this evaluation according to the current situation—for instance, "I generally approve of using care robots, but in this context, I must reject the idea"—and furthermore question the formed attitude—"I find care robots useless, but why do I think this way?" or "I generally approve of using robots, but can I really express this to others?"

In the functional approach to attitude, people have motivation-driven attitudes that help them achieve their goals (Katz, 1960; Maio & Olson, 2000). The functional attitude is relevant when dealing with changing attitudes through persuasion. To convince people to change their attitude, one must know a functional, motivational basis for their current attitude (Shavitt & Nelson, p. 138). Regarding robotization readiness, a motivational base, such as perceived utility of the technology, norms, values, and self-efficacy beliefs, are all defining factors of attitudes toward robots. Persuasion to a more positive attitude toward robotization, then, would necessitate ensuring the employee of the benefits of the change while supporting the professional norms, skills, and identity.

Readiness for change has been studied extensively in the organizational change literature. Yet, affective elements of readiness, such as feelings of excitement, annoyance, and approval, have received less attention (Rafferty et al., 2013). Supporting this claim, in human–robot interaction studies, the attitude toward robots is often considered as a cognitive mind-set, and affective processes are mentioned rather as a parallel concept to the attitude (e.g., Broadbent et al., 2010). As an exception to this, in Eurobarometer's (2014) "Public Attitudes towards Robots" questionnaire, the emphasis is on the affective attitudes: "How comfortable would you feel accepting assistance from a robot at work?"

## 2.4 Predictors of readiness for change

Rafferty et al. (2013) identify three core categories predicting change readiness among employees. These are external pressures (e.g., industry changes and government regulation modifications), internal enablers (e.g., opportunities to participate), and individual characteristics (e.g., values, general self-efficacy, and dispositional attitudes). To avert the misconception of attitudes predicting attitudes, the difference must be made between dispositional and evaluative attitudes. Dispositional attitudes are traits of personality, for example, a tendency toward conservativism or openness. They are perceived as regulating an individual's evaluative attitude, which refers to explicit, cognitive, and affective decision-making and attitudinal readiness (whether something is favorable/unfavorable, comfortable/uncomfortable, etc.; Fabrigar & Wegener, 2010; Schwarz & Strack, 1991). Thus, dispositional attitude is also described as a pre-existing attitude before forming a context-related attitude leading to a specific behavior (Hepler & Albarracin, 2013). One could say that a positive disposition toward robot use is a prerequisite for evaluating the opportunities and benefits of robotization.

In sociocognitive theory (Bandura, 1977, 1986, 1997), behavior is not seen merely as a mechanical consequence of environmental forces and motivators, but rather, as a process where behavior, personal factors, and environment dynamically shape one another. Looking at the model of change readiness (Rafferty et al., 2013) from the sociocognitive perspective (Bandura, 1977, 1986, 1997), the individual characteristics would simply equate to personal factors of the sociocognitive theory. However, the external pressures and internal enablers in Rafferty et al. (2013) would refer to environmental factors, and through involvement and experiences, behavioral factors as well. To visualize the dynamics between sociocognitive factors (Bandura, 1977, 1986, 1997) and the attitudinal change readiness introduced in this dissertation, Figure 6 is presented.

To summarize, attitude and motivation have a dynamic or at least a bidirectional relationship. In functional attitude theories, an attitude has a motivational basis (Katz, 1960; Maio & Olson, 2000; Schwartz, 2012), while in the sociocognitive and change readiness theories attitudes lead to motivational intention. (Bandura, 1977, 1986, 1997; Rafferty et al., 2013). In Chapter 3, we find that the theory of planned behavior (TPB) and technology acceptance models (TAMs) also follow the causal assumption in which an attitude predicts target behavior. In the same vein, motivation has a bidirectional relationship with individual factors and behavior (Bandura, 1997). Motivation is not only seen as primed by individual factors, such as personal values and self-efficacy (Komarraju & Nadler, 2013; Miles, 2015), but for example different moods can be directed by motivation (Coutinho & Neuman, 2008; Ford, Smith, Weissbein, Gully, & Salas, 1998; Schwartz, 1992). Similarly, motivation does not only regulate behavior but also behavior, for example via routines, regulate motivation.

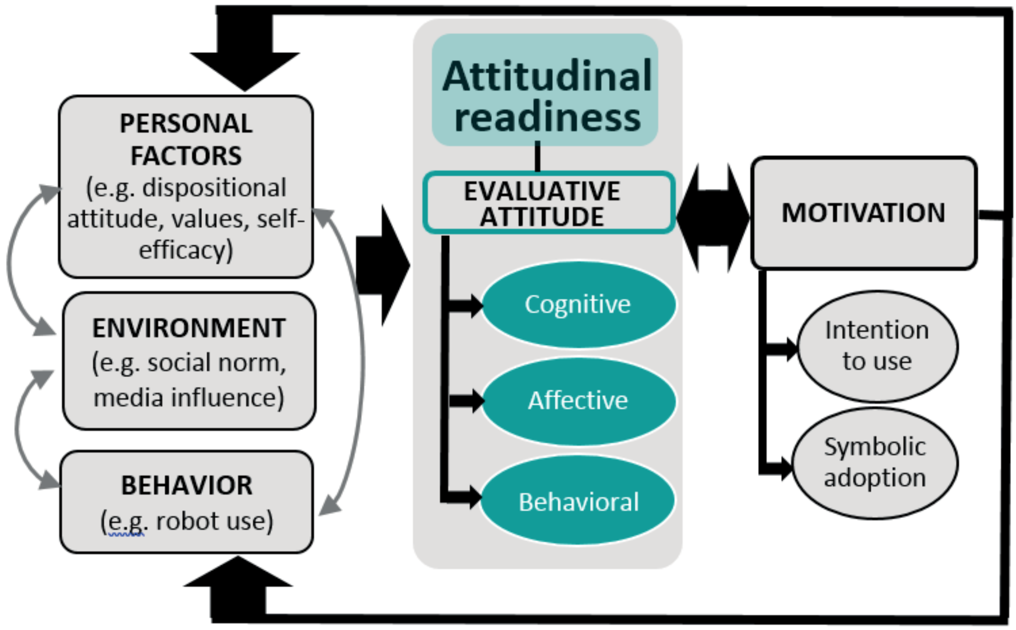


Figure 6. Conceptual map of sociocognitive determinants for behavior, adapted to the context of attitudinal change readiness

## 2.4.1 External pressures

An occupational group may feel pressured toward a change from outside, or rather from the top, by the renewal of regulations, general norms, or political outlooks (Rafferty et al., 2013). The Finnish minister of transport and communications, Anne Berner (2015), articulated the political outlook of Finnish policymakers as follows: "The government should commit to capitalizing the opportunities that robotization brings to almost every working sector." This is only one example of the statements regarding political will in service sector robotization. There are signs that the fourth technological revolution is aiming to change the welfare sector and care work as well. Hence, new-generation intelligent robots are being developed to either assist healthcare professionals in their work or the care receivers directly. In truth, rather than signs, political outlooks are sociotechnical imaginaries. To suggest the idea for a robot does not equal developing, testing, or implementing the robot. Sometimes, an initiative to use robots does not have much to do with the reality or motivation of solving practical challenges, but instead, the robots merely present an ideal or a symbol for modernity (Jasanoff & Kim, 2015; Nickelsen, 2018, p. 213).

The attitudes of an employee facing an organizational change are culturally dependent, as concluded in cross-country studies of attitudes and values (Inglehart & Welzel, 2014; Ronen & Shenkar, 1985). When it comes to robot acceptance, attitudes toward robots vary between countries (Li, Rau, & Li, 2010). In addition, apparent individual characteristics, such as a gender predicting robot acceptance, are possibly culturally transmitted. For instance, in Finland, there is still a clear divide between masculine technological and feminine social professions. Women represent just one-fifth of all graduations in higher technological education but two-thirds of graduations in social and healthcare education (Statistics Finland, 2015).

In social cognitive theory, mass media are recognized as having an influential role in society as a significant promotor of changes (Bandura, 2009, p. 94). The influence is based on social learning, providing a model of how to think, behave, or for example, value a certain change (Bandura, 2009, p. 98). The role of the mass media, informing, motivating, and guiding—or misguiding—people, is even greater when dealing with novel issues with no information available in the social environment beyond the media (Bandura, 2009, p. 112). This is the situation with service robots not coming across in everyday life but instead massively showcased in the media.

In the media, developments in technology are often presented in an overly optimistic manner (Ventä et al., 2018). Innovations still in a demo stage are praised, and for example humanoid robots that are not yet used outside trade shows are described as something that will change the near future (Parviainen, 2019). This causes a framing bias, where more than facts, the way information is presented influences people's mind-sets and decision-making (Entman, 2007). Assessing the possibility of technological unemployment, people may be triggered by the mass media and overestimate the developments of artificial intelligence and capabilities of robots, which may cause excessive fear of robots replacing jobs (Ventä et al., 2018). Finnish caregivers are aware of the public discussions about robots taking jobs from people and view that as a threat in their own field of work, as well, as reported in a qualitative study of Niemelä, Määttä and Ylikauppila (2016).

In predictions based on the report by Pajarinen and Rouvinen (2014), technological unemployment in Finland affects various occupational groups differently, even within the social and healthcare sector. It has been estimated that automation either decreases or considerably changes work in professions like those of pharmacists and housekeepers, while this is less the case for psychologists, head nurses, and paramedics (Turja & Niemelä, 2018). Forty percent of Finnish care workers fear robot-related technological unemployment when robots replacing human work is considered on a general level (Turja & Särkikoski, 2018). Few Finnish care workers have used any kind of care robot in their work, but they have heard about care robots, mostly from documentaries and newspapers (Van Aerschot et al., 2017). This underlines the responsibility of the news media, which often exaggerates both the risks and developments of technology.[1]

### 2.4.2 Internal enablers

Organizational and occupational factors have substantial effects on readiness for change. These include information flow and its possible hierarchy in the organization, social norms, staff involvement in prior changes, and employees'

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[1] See e.g. in English: https://futurism.com/artificial-intelligence-hype
and in Finnish: https://yle.fi/uutiset/3-10459806

opportunities to influence own job descriptions after the change (Rafferty et al., 2013). Reflecting this line of thought to a contemplation stage of service work robotization, the most relevant internal enablers to robot acceptance among the staff would be prior experiences with technology, prior opportunities to participate in the change processes, and perceived social norms toward work-related robotization. The opportunities to influence own job after the change would include the voluntariness of the robot use. In the best possible scenario, the organization would be prepared to distribute work in a new way depending on each of the employees' willingness (or refusal) to work with robots.

As a typical finding in empirical robot studies, prior experience with robots or even technology in general manifests in more positive views on future robot use (Heerink, Kröse, Evers, & Wielinga, 2010; Katz & Halpern, 2014; Louie, McColl, & Nejat, 2014; Nomura, Kanda, & Suzuki, 2006). Individual factors may even lose their predictive relevance after people have firsthand experience with a new practice (Bandura, 1986; Flandorfer, 2012; Hartwick & Barki, 1994; Venkatesh & Davis, 2000; Wanberg & Banas, 2000). This is especially plausible in the robotization context since people have varied mental representations (i.e., perceptions and imaginations) of robots (Höflich & El Bayed, 2015). Many people have only indirect experience of robots from the media or coworkers, and hence, their opinions can be understood as vague or ill-informed (Hartwick & Barki, 1994). Although typically the direct experience leads to more positive attitudes, in some circumstances, those with the most experience with robots levy the most criticism (Jokinen & Wilcock, 2017). In both scenarios, however, firsthand experience is a powerful explanatory factor in robot acceptance.

In a context of care work, robot acceptance varies between the different tasks the robot is supposed to assist with. In our review, we found that telepresence robots stand out as the most agreeable form of care robots, whereas some other applications were seen as decreasing human interaction or simply useless in the bigger picture of care work (Savela et al., 2018). One theoretical explanation for the reluctance to accept different types of care robots is the lack of innovative imagination in a time where robots are a rare sight in care environments (Baron & Ensley, 2006; Nelson & Irwin, 2014). The innovative imagination refers to recognizing opportunities outside the current technological frame, the way we are used to utilizing technological applications (Bijker, 1997; Orlikowski & Gash, 1994). The imagination also depends on how we view our profession and ourselves as professionals. Occupational identity can either support or interfere with the initial identification of opportunities (O'Connor & Rice, 2001; Tripsas, 2009). However, this goes both ways, and technological change can either support and modify or challenge and contradict individual identity (Anthony & Tripsas, 2016, p. 421). One may find participating in a technological change intriguing enough to adopt the new practices as a part of their new occupational identity.

According to Schyns (2004), an early stage participation in organizational and job changes lead to higher readiness for change. In a contemplation stage of robotization, this would mean employees' participation in rationalizing purchases of robotic systems in their organization, or even participating in a wider scale by planning the renewal of the workflow and setups in the gradual steps of robotization. Professionalism includes the idea of expertise. Occupational experts know what is acceptable and useful in their work, and to disregard this in the midst of a technological change is an effective way of decreasing the willingness to participate in the change (Nelson & Irwin, 2014). Unfortunately, the opportunities to affect organizational changes, among care staff, for example, have been declining in recent decades (Henriksson, 2011; Hirvonen, 2015). There is also evidence that, after the change has been initiated, a consensual adaptation among the staff leads to the successful use of the technology (Koistinen & Lilja, 1988). This implies the important dynamic relationship between an individual readiness for robotization and shared norms toward robotization. Furthermore, the consensual adaptation may also refer to consensus between the national (e.g., industrial) needs and organizations changing their operation (Ornston, 2012), this time highlighting the dynamic relationship with external pressures and internal enablers.

Employees' shared views toward organizational or job changes are important for change management and can be influenced also by informing the staff early on about the plans (Schyns, 2004; Wanous, Reichers, & Austin, 2000). This is within an organization's interests, because without sufficient and relevant information, the social norm toward the change relies heavily on rumors, which often tend to focus only on the negative (Bordia, Hobman, Jones, Gallois, & Callan, 2004; Lewis & Seibold, 1998). One way of examining the social norms of the workplace or an occupational group is the subjective, perceived social norm: Do employees think that robotization is accepted among their colleagues? The presumption is that perceived group norms play a significant part in forming individual attitudes, for example, change resistance (Chen & Huang, 2016; Haslam, 2003). As argued by Lam and Schaubroeck (2000), individuals' attitude and reactions toward a change can spread in the organization, especially when they source being so-called opinion leaders—individuals who are particularly able to influence others' attitudes and behaviors.

As a final note, since perceived social norms are in reality the individuals' subjective interpretations of the average stance of the group, this way operationalized social norms could also be included in the individual characteristics.

### 2.4.3 Individual characteristics

Individual characteristics are a relevant part of robotization readiness in fields where technological change is just being introduced, and people assess their attitudinal readiness based on limited sources of information. In this dissertation, individual characteristics include sociodemographic background, personality, and psychological well-being. Among adults, younger age, male gender, and higher education have been shown to correlate with robot acceptance (de Graaf & Ben Allouch, 2013; Eurobarometer, 2014), but this is not always the case when it comes to change readiness. Higher organizational change readiness is associated with higher education, but also with older age, deviating from findings in technology acceptance (Madsen, Miller, & John, 2005). Job satisfaction and perceived effects on employment have also been previously identified as predicting change readiness. The more employees report job satisfaction (Lipińska-Grobelny & Papieska, 2012) and the less they report fear of unemployment (Davis, Bagozzi, & Warshaw, 1992), the more they seem to show readiness for an organizational change.

Personality refers to psychological traits and constructs that, rather than being shared by all people, vary between individuals (McAdams, 2006; Mischel & Shoda, 1995). Personality traits, such as extraversion or introversion, are dispositional, and to a certain extent, allow people to be categorized according to the way they are prone to think or behave (Allport, 1961; McAdams, 1985). An individual and fixed temperament is a base for personality traits, which in turn, may change over time and develop in the influence of the social environment (McAdams, 2006; Roberts & Mroczek, 2008; Rothbart, Ahadi, & Evans, 2000). In addition to traits, there are even more time-, place-, or social role–dependent constructs in personality. Encompassing motivational, social–cognitive, and developmental constructs, these parts of personality include personal interests, attitudes, values, and self-efficacy (Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003; McAdams, 2006). While the social environment regulates the expressions of our personality traits, the environment's influence is even greater when it comes to role- and context-dependent constructs of personality (McAdams, 2006). Stances toward technology may be even opposite when comparing interests and attitudes between home and work.

Another ever-developing part of our personality is the narrative identity that integrates important episodes of our memories into the thoughts of our imagined future (Hänninen, 1999; McAdams, 1985; McAdams & McLean, 2013). Unlike other parts of personality, the variation in this individual life story between people is infinite (McAdams, 2006). The concept of self is defined by the personality as a whole, but personal values seem to have a special role in the development of self and its ideality (Arieli, Sagiv, & Roccas, 2019). People are highly satisfied and identified with their personal values, which is not the case with personality traits people would sometimes be willing to trade off (Roccas, Sagiv, Oppenheim, Elster, & Gal, 2014).

Self-efficacy and personal values are considered as psychological resources that regulate our motivation, and for one thing, predict change readiness (Armenakis & Harris, 2002; Avey, Wernsing, & Luthans, 2008; Cunningham et al., 2002; McDonald & Siegall, 1996; Rafferty et al., 2013; Schwartz, 1992, 2012; Vallor, 2011; Wanberg & Banas, 2000). Self-efficacy stands for the individual's cognitive belief in the ability to cope with new, different and challenging situations (Bandura, 1977, 1986). It develops by mastery experience affected by previous successes and failures, vicarious experience by social learning, and social persuasion where the individual is convinced by others that they are able to execute the goal behavior (Bandura, 1977, 1997; Schyns, 2004). In theory, higher robotization readiness would be accomplished by employees' self-efficacy manifested in greater confidence, initiative, and effort (Bandura, 1984).

Self-efficacy can have a direct effect on the individual's behavior or affect changes in motivation, which again, affect behavior (Bandura, 2006; Komarraju & Nadler, 2013). Sometimes, the difference between being self-efficient and motivated is difficult to detect (Williams & Rhodes, 2014). For minimizing this complexity, it is important to evaluate the level of self-efficacy in "Would you trust in your ability to" format and avoid questions concerning what an individual's capabilities really are or what he or she would choose to do (Rhodes & Courneya, 2004). For example, with robotization readiness, we want to know whether the employees believe in their ability to use robots—not whether they can use robots already or would like to use robots. Trusting in own capabilities to use care robots is an example of domain-specific self-efficacy, namely, robot-use self-efficacy (Turja, Rantanen, & Oksanen, 2017), which is to be separated from general self-efficacy indicating individuals' beliefs in their ability to cope, generally speaking, with different and challenging situations they come across in their lives.

Originating from the sociocognitive theory, self-efficacy is difficult to apply in causal argumentation (Bandura, 1997, p. 6). In other words, there is a two-way causality between robot-use self-efficacy and using robots. The more one succeeds in using robots, the stronger is the trust in the ability to use robots. Yet again, the more one feels self-efficient in using robots, the more appealing the robot use appears. However, in the contemplative stage of robotization and the little or no firsthand experience of robot use, self-efficacy is understood as a predictor for behavior rather than the other way around. First, Rahman, Ko, Warren, and Carpenter (2016) have found that self-efficient people have more positive attitudes toward the use of health technologies. Second, there is evidence that self-efficacy is the most relevant in the contemplative stage of organizational change (Deci & Ryan, 1985; Wanberg & Banas, 2000).

Self-efficacy develops by personal experiences of, say, mastery or anxiety, and by influence originating from the social environment (Bandura, 1986). Employees' self-efficacy beliefs can be enhanced by supporting their academic goals and advancements (Winslow, DeGuzman, Kulbok, & Jackson, 2014). In emerging job changes, managers could benefit from acting as role models who help employees reach their potential at work (Bandura, 1986). Building up the employee's confidence would also call for opportunities to update their current education and training to meet the future demands.

Burkhardt and Brass (1990) highlight the early adopters of technology as change agents in the workplace. Change agents have high motivation and self-efficacy beliefs when it comes to technological change (Schyns, 2004). Because they are willing to spread particularly a positive attitude toward the new technology, change agents are used as promotors in the preparatory stage of an organizational or job change (Schyns, 2004). This is not to say that change agents are effective instruments for persuading reluctant staff into accepting a technological change even if it does not seem to fit their personal motivations; rather, change agents can be useful in gathering and sharing information, as well as decreasing perhaps overestimated hopes and fears among the staff (Curtis & White, 2002; Lam & Schaubroeck, 2000).

Schwartz's (1992) theory of basic psychological values aims to understand and cover the major basic motivations behind personal values. For attitudinal readiness for robotization, Schwartz (1992) offers an interesting theoretical frame, especially with its continuum between values of conservation and openness to change. A similar continuum is known from the traits in personality psychology (Allport, 1961); yet, Schwartz's basic values are about principles rather than practice. For example, one can appreciate conservative values but not exhibit those values in action. Regarding work-related change readiness, this is an important difference. In a working life context, voluntariness in using systems and equipment is not given. Thus, the examination preceding the change is aimed at the principles of robot use: "Would the robotization be compatible with your personal values?" When this was first inquired of Finnish nurses, physiotherapists, and other care workers, less than one-third responded that it is appropriate to use robots in care work (Van Aerschot et al., 2017). The dissonance between care robotization and value congruence is named hereby as the care robot paradox.

# 3 INTENTION TO USE CARE ROBOTS

## 3.1 The Almere model of robot acceptance

An essential part of the human–robot interaction studies is measuring robot acceptance among users. The concept of robot acceptance is based on a wider tradition of TAMs. The backbone of TAM is made up of the theory of reasoned action (TRA) and TPB, both of which explain people's intentions and behavior by attitudes (Ajzen, 1991; Ajzen & Fishbein, 1980). Here, the attitude is considered as an affected response to the thought of performing a specific behavior (Hale, Householder, & Greene, 2003). It is "affected" because it consists not only of individual attitudes but also perceptions of social norms. Expanding the TRA model to the TPB, behavior intention is explained by three underlying mechanisms, which are attitude, perceived social norm, and perceived behavioral control (Ajzen, 1991). The latter refers to the perceived effortlessness of the action and includes elements of self-efficacy (Bandura, 1986; Compeau & Higgins, 1995), perceived controllability (e.g., ease of use in TAMs), and facilitating factors (e.g., sufficient knowledge about the robot).

The intention to use robots measures the behavioral decision to use or not to use robots. Despite its theoretical roots in the TPB, the TAM initially explained the attitude leading to the intention to use in a quite simplified manner by perceived ease of use and perceived usefulness (Davis, 1989). It was only later expanded by explanatory factors, such as perceived social norms and enjoyability of the technology, in the TAM2 model (Venkatesh, 2000; Venkatesh & Davis, 2000) and its adjusted version, TAM3 (Venkatesh & Bala, 2008). To find a synthesis among different theories regarding technology acceptance, Venkatesh, Morris, Davis, and Davis (2003) compared the TRA, TPB, and versions of TAM to the motivational model (Davis et al., 1992), model of PC utilization (Thompson, Higgins, & Howell, 1991), innovation diffusion theory (Rogers, 1983), and social cognitive theory (Compeau & Higgins, 1995). These theories were tested empirically in four organizations implementing an information system change. Technology acceptance was first tested right after the training, then after a month of use, and finally, after three months of use (Venkatesh et al., 2003). They ended up with a unified theory of acceptance of and use of technology (UTAUT), which explains real use and the intention to use technology via four core constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003).

In UTAUT, self-efficacy does not have a direct effect on the intention to use, but the effect is captured by performance and effort expectancy (Heerink et al., 2010). Performance expectancy means the gain the technology is expected to bring to the work, and it has been identified as the most effective predictor for the intention to use technology (Venkatesh et al., 2003, pp. 447–448). Performance expectancy refers to the usefulness, effort expectancy to the perceived ease of use and social influence to the external expectations toward the use of the technology (Venkatesh et al., 2003, pp. 450–451). The social influence is typically operationalized by a question of perceived social norms: How do the end-users think the people in their social environment (sometimes "the important ones") view the use of this technology (Heerink et al., 2010)? Due to the subjective nature of this perception, it is also called a subjective norm. Finally, the facilitating conditions include environmental (e.g., employer support in using the technology) and educational (e.g., the opportunities to learn the use) factors (Venkatesh et al., 2003, p. 451).

The Almere model was developed from the UTAUT model due to a specific need to understand acceptance of assistive social robots (Heerink et al., 2010). The model uses constructs (e.g., attitude, trust, perceived ease of use) to predict the end user's actual use and/or intention to use a robot (Figure 7). In Study IV of this thesis, the most central dependent variable is the repeat use intention, which means the motivation to use a certain robot type the user already has experience with. The Almere model has been applied in studies focusing on telepresence robots (Cesta et al., 2016), animoid robots (Heerink et al., 2010; McGlynn, Kemple, Mitzner, King, & Rogers, 2014), and humanoid robots (Karunarathne, Morales, Nomura, Kanda, & Ishiguro, 2019; Piasek & Wieczorowska-Tobis, 2018), and there is wide agreement on the validity of Almere constructs measuring robot acceptance (Whelan et al., 2018).

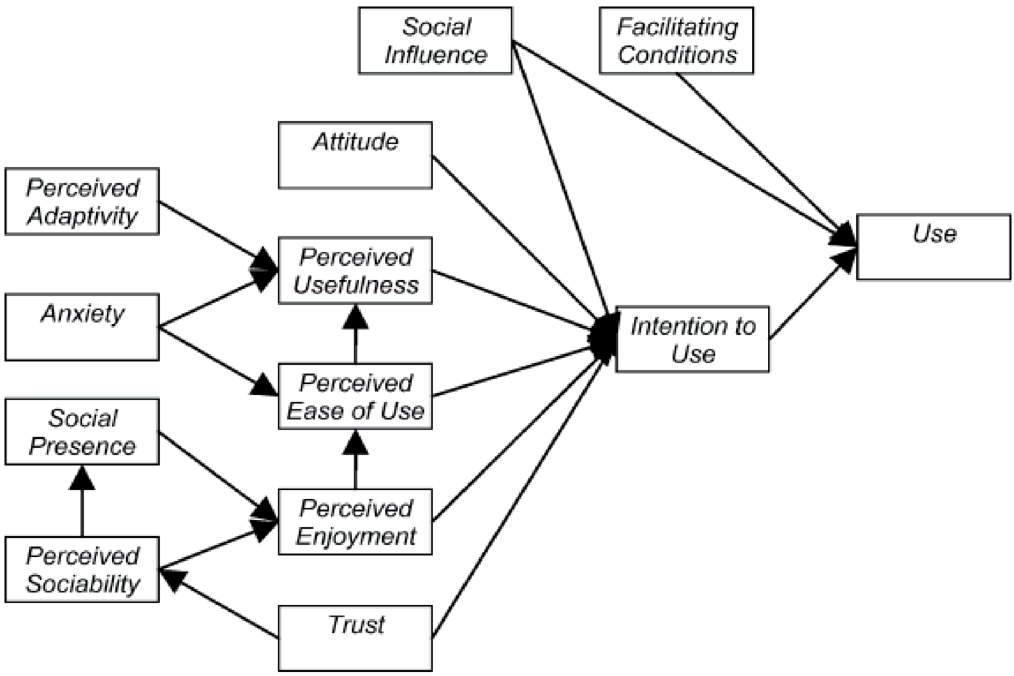


Figure 7. Almere model of robot acceptance among older adults (Heerink et al., 2010)

In the Almere model, the intention to use robots is predicted by functional and social aspects (Heerink et al., 2010). The functional predictors are perceived usefulness, perceived ease of use, and perceived adaptivity (i.e., the robot's suitability and adaptiveness to the users' needs). The social predictors are dispositional attitude toward robot use, social presence and perceived sociability of the robot, perceived enjoyment and anxiety toward the use, social influence, and trust (i.e., perceived safety of the robot). Actually developing the Almere model, Heerink et al. (2010)

changed the functional emphasis of the UTAUT model to cover more social psychological aspects of technology acceptance. Thus, they took again a step toward the TRA and TPB. The additions, for example, of attitude, anxiety, enjoyment, and trust, were rationalized by the social nature of assistive robot use (Heerink et al., 2010).

Also considering the interplay of affect and cognition (Edwards, 1990), the Almere model returned more attention to affective constructs and discourse in the TAMs. For example, looking at the core of the UTAUT model, performance and effort expectancy are instrumental constructs and based on cognitive judgements about the technology (Bagozzi, 2007). Yet, assessing whether a robot is likeable, we may retrieve information from our internal feelings about the robot. Affects influence evaluative judgements. Especially when knowledge is low, people tend to rely on affect in determining the perception of risks and benefits of new technology (Slovic, Finucane, Peters, & MacGregor, 2007). Having robots to assist in one's work can trigger affects like pride or fear, whether it is fear of technological unemployment or technology use itself. Affective evaluation is sometimes even viewed as the basis for the total assessment of risks and opportunities of new technology (Slovic et al., 2007).

## 3.2 Personal moral values and robot acceptance

After the several versions and modifications of TAM, there is still no consensus about the determinants behind adopting or refusing technologies (Thatcher & Ndabeni, 2013), which has provided reasons to carry out context-specific TAMs, such as a TAM for information systems used in nursing work (e.g., Chen, Wu, & Crandall, 2007; Tung, Chang, & Chou, 2008). In their review of healthcare technology acceptance, Holden and Karsh (2010) found that the studies differ considerably in samples, settings, and information technology used, as well as results. This may imply that even more specific contexts, user groups and the types of technology should be defined in TAMs (Hartwick & Barki, 1994). As for the context, the UTAUT is used for modeling technology acceptance in the workplace, but it is still very general and does not consider any specific professional characteristics (Chau & Hu, 2002). Moreover, there is a call for the valuation criteria of innovations beyond the technological and economic aspects, which are still dominating the technology acceptance discussions (Djellal & Gallouj, 2013).

By suggesting a new robot acceptance model for care in Study IV, it was hypothesized that healthcare work has distinct value-based characteristics that affect the intention to use care robots. Values are ideals and guiding principles that people are both internally and externally driven to fulfill in their lives (Maio, 2010; Schwartz, 1992). In other words, values motivate action, but at the same time, they are more widely applied representations of goals in life. In addition, values define the justifiability of actions of self and others (Schwartz, 1992). In moral psychology personal values refer to inner conscience and ethical evaluation of what is wrong and right, and even if conceptualized as moral decision-making, values are acknowledged as a separate emotion-based construct and a precursor to a cognitive and future-oriented structure of the intention to act (Clark & Dudrick, 2007, p. 216; Haidt & Joseph, 2014).

In ethical decision-making, the emphasis is on the personal moral values, a humane worldview and the virtue ethics of being a moral actor promoting people's well-being (Sire, 2004; Wallach, Allen, & Smit, 2008). An individual worldview is a view on life, the world, and humanity (van der Kooij, de Ruyter, & Miedema, 2013, p. 210). A worldview comprises personal moral values of right and wrong and affects how people act and think (Sire, 2004). According to Haidt and Joseph (2004), the foundation for ethical decision-making can be traced to five psychological systems: harm/care, fairness/reciprocity, ingroup/loyalty, authority/respect, and purity/sanctity. These systems triggered cause emotional and intuitive reactions. For example, observing a person in need of care involves feelings of compassion. In the moral foundation theory, moral intuitions (i.e. compassion) generate culturally variable values (e.g., virtue of a good carer). Thus, personal moral values not only motivate and regulate what we ought to strive for and what we feel is right or wrong, but they are also a central part of the self (Arieli et al., 2019; Erickson, 1995; Miles, 2015). They fall into a category of concrete values that describe our ideals (e.g., trustworthiness) and valuations (e.g., well-being) and are also manifested in cultural norms and traditions (Haidt & Joseph, 2014; Kumar, 2019; Nagórka, 2017).

While the intention to use technology is explained by a wide, selected range of functional and social constructs in the TAMs, moral principles that may underlie this motivational intention are left aside. Ward (2013) views this as a sign of TAMs' positivistic approach that does not give enough consideration to the qualitative, emotional, and cultural components of decision-making. A nurse may know that using a robot animal supports patients' emotional well-being (positive attitude), that the head nurse has encouraged to use the robot on daily basis (positive social norm), that they are capable of using the robot (positive behavioral control), but still refuse to use the robot animal (Bagozzi, 2007; Piçarra & Giger, 2018). It may be that the intention to use care robots is partly explainable by value-based factors.

The recent finding that most Finnish healthcare professionals do not view robots as suitable assistants (Van Aerschot et al., 2017) underlines the need for value-based approaches in care robot acceptance. Values are an important part of decision-making, and on a larger scale, values are motivators of behavior because people strive toward things they value and act against things they find unacceptable (De Bruin & De Bruin, 2009; Russell, 2001). Hence, in theory, having a worldview in which patients are to be touched with only human, not machine hands, would not motivate using robots in care (Sharkey & Sharkey, 2012). Then again, viewing a particular part of robotization as improving the quality of care would motivate to promote such a change (Hofmann, 2013).

Moral values have a more social dimension, not to mention that this is the case in almost all human activity as social entities (Granovetter, 1985). In addition to reflecting their inner moral values, people evaluate actions in terms of the degree to which those actions represent the community's moral values (Durkheim, 1947; Rutten & Boekema, 2007). That said, people have free will to follow or not follow social norms or codes of conduct (Granovetter, 1985), and sometimes, people are in a situation where they must choose between personal or mutual benefits. In a study by Crocker, Niiya, and Mischkowski (2008), people were prone to affirm values that are social in nature, and the value affirmation was mediated by its impact on feelings of connectedness to others. This brings us back to social identity theory, where the cohesiveness of a social group, such as nurses, explains the influence social norms have on personal values (Collin-Jacques & Smith, 2005; Granovetter, 1985; Haslam et al., 2011; Rutten & Boekema, 2007).

In social cognitive theory, individuals are acknowledged as active influential agents who observe, react, and (sometimes) adopt attitudes and behaviors from their environment (Bandura, 1997). Thus, personal values and social norms dynamically shape one another. Furthermore, personal values are considered as socioculturally shaped factors that, depending on compatibility, either increase or decrease enthusiasm to use new innovations (Rogers, 1983). In TPB, the relationship between the two is viewed more causally in terms of the magnitude in which people would accept a social norm as their personal value (Ajzen, 1991, 2002). As evidenced in educational technology studies, use intention is not only about the technology itself, but more about social goals embedded in and distinctive to a specific context (Bagozzi, 2007; de Oca & Nistor, 2014). Context is also highlighted in theories of affective design, which attempt to understand how users' feelings toward a system influence their likelihood of adoption (Helander & Khalid, 2006; Sharp, Rogers, & Preece, 2007). Following this line of thought, in a care work context, it is social norms and personal moral values together that play an important role in robot acceptance among healthcare professionals.

Schwartz (1992) considers the values of benevolence and universalism as moral values because they express the motivation to promote the welfare of others. Benevolence aims at enhancing the welfare of an in-group—the people with which one has frequent personal contact. Benevolence values include responsibility and loyalty, and due to its voluntariness in enhancing the in-group's welfare, benevolence is considered an internalized motivational base for cooperation (Schwartz, 1992). In nursing work, benevolence may arise in guarding the occupational and ethical norms, but the norms definitely refer also to universal values. Universalism is a moral value aiming to understand, appreciate, and protect all people and nature instead of just a specific in-group (Schwartz, 1992). The occupational code of conduct, performance, and ethics for nurses and midwives include requirements like being trustworthy to the care receivers, being honest and nondiscriminating, being personally accountable, and involving people in decisions about their care (NMC, 2015).

Values in the working life are usually studied by separating intrinsic work values of finding meaning and interest in work from extrinsic values, which are more instrumental and can include the values of status, respect, and income (Ros, Schwartz, & Surkiss, 1999). Values have not been totally neglected in the care robotization discussions either, and the arguments are divided between the ideas of robotization supporting and contradicting values in nursing. Some view robotization as a means of allocating nurses' time for social and humane tasks instead of indirect care tasks, such as documenting and dispensing medication, while others view robotization as another way of letting technicists and economists further dominate human-centered care (Drummond & Standish, 2007; Sellman, 2010). Karahanna et al. (2006) were the first to include value-based factors in an empirical work–related TAM study. An information system was assessed as more useful among bank officials (N = 278) who found the system use compatible with their personal values, measured by statements like, "Using the system does not fit the way I view the world" (Karahanna et al., 2006, p. 794). The statements in Karahanna et al. (2006) fall into the categories of universal ethics and ethical decision-making.

Robot acceptance does not have to precede expectations from others to have a contradiction, but there are also situations of internal innovative dissonance. In a study conducted in the ROSE project, a physiotherapist who could not tolerate technology on a personal level nevertheless had a positive attitude toward using it at work because of the possible gains the customer could experience from the technology (Melkas et al., 2016). This may be a good example of relieving innovative dissonance by adjusting your attitude (Elliot & Devine, 2009). This case can also be seen as challenging the paradox of expertise theory where personal values lead individuals to consciously dismiss an opportunity because of their lack of innovative imagination and fixed conceptualization of current working methods (Bijker, 1997; Orlikowski & Gash, 1994). In the paradox of expertise, a strong occupational identity or contradicting personal values can cause the professional to stop developing in his or her work (Nelson & Irwin, 2014). Because of the irony of professional pride causing one to miss out on big changes in one's field of work, paradox of expertise is viewed as a negative, progress hindering phenomenon. However, it would be important to know if the conscious decision to reject a new practice actually stems from ethical decision-making, not change resistance per se.

The discourse of paradox of expertise by Nelson and Irwin (2014) is truly technologically deterministic, where implementations of new innovations are always considered a positive thing and a step forward, whereas any opposition is futile or needs fixing. Technological determinism is a belief that technology automatically drives history, so it changes us and our environment without needing permissions or authorization on the way (Dotson, 2015). However, there are relevant questions of, for example, "why the efficiency and quality of human service delivery are often framed as technical problems that call for technological solutions" (Hirvonen, 2015, p. 81; see also Barry, 2001). According to Dotson (2015), technological determinism is possible where human values are eliminated from technological decision-making and antidemocratic technological innovation policy regimes need reproducing. The latter refers to a technology-determined political outlook and the rhetorics that come with it (see Berner, 2015). Thus, prioritizing efficiency as the most important value of work and presenting wide-range robotization as a national strategy are actions supported by technologically deterministic ideas. At the same time, those actions are psychocultural barriers to democratizing robotization (Dotson, 2015) and will minimize any constructive codesign and critical feedback (Šabanović, 2010).

The technologically deterministic views do not effortlessly integrate into human-centered services and the healthcare work, which is controlled by laws and occupational standards. As van Wynsberghe (2013) has straightforwardly concluded, if care robots are implemented, they should first and foremost support and promote the fundamental values of care. Human values would be extreme to eliminate from the decision-making in care, and political outlooks concerning robotization may not be seen as relevant in the context of care-oriented and human-centered work. There are also empirical implications that in a care work culture, technological changes receive more critique than they do in many other environments (Watanabe, Hyytinen & Koivula., 2018).

# 4 STUDY OBJECTIVES

This dissertation identifies and compares sociopsychological determinants leading to robot acceptance. I approach robot acceptance as robotization readiness and the repeat intention to use robots, which are measured to gain understanding of the needs and opinions of the end users. The more the users' preferences are met, the greater the possibility becomes that the technology will be approved in consensus as a part of a new way of working (Dotson, 2015; Nye, 1997; Venkatesh et al., 2003). The aim is investigating individual characteristics to reveal enablers and motivations underlying robot acceptance. However, parting from traditions in change readiness, innovation adoption, and TAM studies (Rogers, 1983; Venkatesh & Davis, 2000; Weiner, 2009), the aim is not to profile resistance or "slow adoption" to find ways to approach and convince people to accept the technology. Rather, the codesign of new technology could benefit from more critical voices (see Savela et al., 2018).

Consisting of four separate studies, this dissertation first examines the attitudes toward the robotization of work in general, and second, robotization readiness and the repeat intention to use robots, particularly in care work. Hypotheses are represented later in this Chapter study by study, and in example the first hypothesis of Study I is marked as "SI-H1". When the thesis progresses from robots in general to robots used as assistants in care, the research questions focus on care workers' readiness and acceptance of robotization. Care robot use has rarely been studied among groups other than (potential) patients (Kachouie et al., 2014), and this is especially evident in quantitative studies (Savela et al., 2018). At the same time, Finnish policy and decision-makers state that care workers should have a strong say in welfare service robotization (Pekkarinen, Tuisku, Hennala, & Melkas, forthcoming). Sellman (2010) implies that nurses' voices are often marginalized in the decision-making processes in a hierarchical context of healthcare. On the other hand, care sector managers have been found to suffer from professional dissonance when economic and ethical values emerge as equal yet competing interests included in the manager's responsibilities (Deery, Hughes, & Kirkham, 2010). These findings lead to one of the main interests while planning the study, that is, differences between professional groups.

Because of the still sporadic use of service robots, there are limited ways of studying new-generation robotization and its acceptance. Typical of the contemplative stage of a technological change, the attitudes of potential users form an important area of research and complement the technology-centered trial studies of new innovations (Mendell et al., 1991). As we found in our earlier systematic review, robot acceptance seems to attract studies in this time of emerging service robots, while there are not many studies from the several decades of the robotization of industrial work (Savela et al., 2018). In 2016, when I started working on this doctoral thesis and its data collection, there were no statistics on how much service robots are being used in the world or how many nurses have ever used a robot. Searching for "Readiness for robotization," "Robotization readiness," or other formats of the concept, search engines did not return any results.

**The first study** examined attitudes toward work-related robotization among EU citizens. Using technologies at work is typically mandatory rather than voluntary, as it is in a consumer context. As an example of this particularity of the work context, cultural norms are hypothesized as having a smaller role in work-related robot acceptance than in home-related robot acceptance (Brown & Venkatesh, 2005). We hypothesized that individual factors play a more significant role in robot acceptance at work than societal factors do:

> *SI-H1: Age, gender, occupation, employment, Internet use, and robot experience together have a more significant association with robot acceptance at work than the variables of national technology orientation.*

Next, we concentrated on national factors and more precisely technological orientation associated with robot acceptance at work. The reason for this was that there are already Eurobarometer publications concerning the individual factors in attitudes toward robots, but the multilevel examination – adding levels of time and country to the analysis – was a novel approach to the research question. Hypothesis 2 and 3 were represented as competitive with each other: Does the attitude toward robots depend more on the country's technological developmental history (Fernández-Macías, 2012; Ronen & Shenkar, 1985; Venkatesh & Davis, 2000) or predictions of work automation in the future (Acemoglu, 1999, 2002; Autor, Levy, & Murnane, 2003; Fernández-Macías, 2012; Saner & Wallach, 2015)?

> *SI-H2: Technological development in the country (information and communication technology [ICT], export rate and cellular phone ratio) correlates positively with robot acceptance at work.*
>
> *SI-H3: The job automation risk rate correlates negatively with robot acceptance at work.*

In **the second study**, general and work-related attitudes toward robots among the Finnish population were reflected on the similar attitudinal constructs among Finnish healthcare professionals. We also investigated how much experience Finnish people have with robots at work. In addition, we brought in contextual content by analyzing how robot assistance is approved depending on the care task in question. The latter research question stemmed from the ROSE project's objective of codesigning the contents of a multifunctional care robot early on with possible end users.

Hypotheses for healthcare data regarded tasks for which healthcare professionals would find robot assistance most agreeable. They were based on nature of activities theory (Santoni de Sio & van Wynsberghe, 2016) and segmentation of care tasks (Ballermann et al., 2011). In addition to the theoretical background, the hypotheses were specified after empirical indication of the particular burden in indirect care (Ausserhofer et al., 2014; Ball, Murrells, Rafferty, Morrow, & Griffiths, 2014; Menon,

2015) and physical demands of care work (Erkkilä, Simberg, & Hyvärinen, 2016; Kodama & Fukahori, 2017; Trydegård, 2012):

> *SII-H1: Robot assistance receives more approval for indirect patient tasks rather than direct and practice-oriented tasks.*
>
> *SII-H2: Robot assistance receives more approval in physically burdening tasks compared with less physically burdening tasks.*

**The third study** more closely examined the robotization readiness among healthcare professionals and identified its psychological and sociodemographic determinants. Based on prior studies on the readiness for organizational or job change and technology acceptance in healthcare, we hypothesized the following:

> *SIII-H1: Robot-use self-efficacy correlates positively with robotization readiness.*
>
> *SIII-H2: Subjective norms that are accepting toward robots correlate positively with robotization readiness.*
>
> *SIII-H3: Individual factors determine robotization readiness more strongly among respondents without firsthand robot experience compared with respondents with such experience.*

**The fourth study** analyzed the repeat intention to use robots among those healthcare professionals who reported firsthand experience with care robots. The Almere model was used as the basis of the first hypothesis:

> *SIV-H1: A direct positive relationship exists between the intention to use and social influence (a), attitude toward the use (b), perceived usefulness (c), perceived ease of use (d), perceived enjoyment (e), and trust (f).*

Next, we moved on to our suggested expansion of the Almere model. The compatibility between personal values and care robot use was the starting point of analyzing the possible principle level in robot acceptance. Inquiring the respondents' value-based view on robots' suitability in care work, we were interested in their rapid intuitive reaction in such a suggestion (Haidt & Joseph, 2004). In Karahanna et al. (2006), perceived usefulness mediates the relationship between compatibility with values and technology use. However, following innovation diffusion theory (Rogers, 1983), the compatibility between personal values and robot use could directly explain the variation in the intention to use robots. Hence, we established the following competing hypotheses:

> *SIV-H2: Compatibility between personal moral values and robot use associates with a stronger intention to use care robots.*
>
> *SIV-H3: Compatibility between personal moral values and robot use associates with the intention to use robots indirectly via perceived usefulness.*

Finally, viewing ethical and instrumental values from an experimental motivation psychology perspective, it was considered that instrumental motives (e.g., economic) causally influence the ethical motives of right and wrong (Christensen, 2000). The causal relationship is to be understood as a technical part of the study and hypothesis design without an implication that the result could be interpreted in terms of cause and effect. In addition, it was hypothesized that the interaction between personal values and social norms would relate to the intention to use care robots (Bardi & Schwartz, 2003; Shoda, 1999):

> *SIV-H4: Perception of technology unemployment predicts a lower compatibility between personal moral values and robot use.*
>
> *SIV-H5: Personal moral values relate to a stronger intention to use robots indirectly via social influence.*

## 4.1 Data and methods

The primary data used in the dissertation were drawn from the Eurobarometer and from the care worker survey data I was in charge of designing and collecting for the ROSE project. The mostly cross-sectional, quantitative analysis was based on data gathered from interviews and online survey questionnaires, and hence, it was founded on self-reports (Figure 8). Constructs such as attitudes and beliefs are introspective and are well measurable by self-reports instead of observing test subjects.

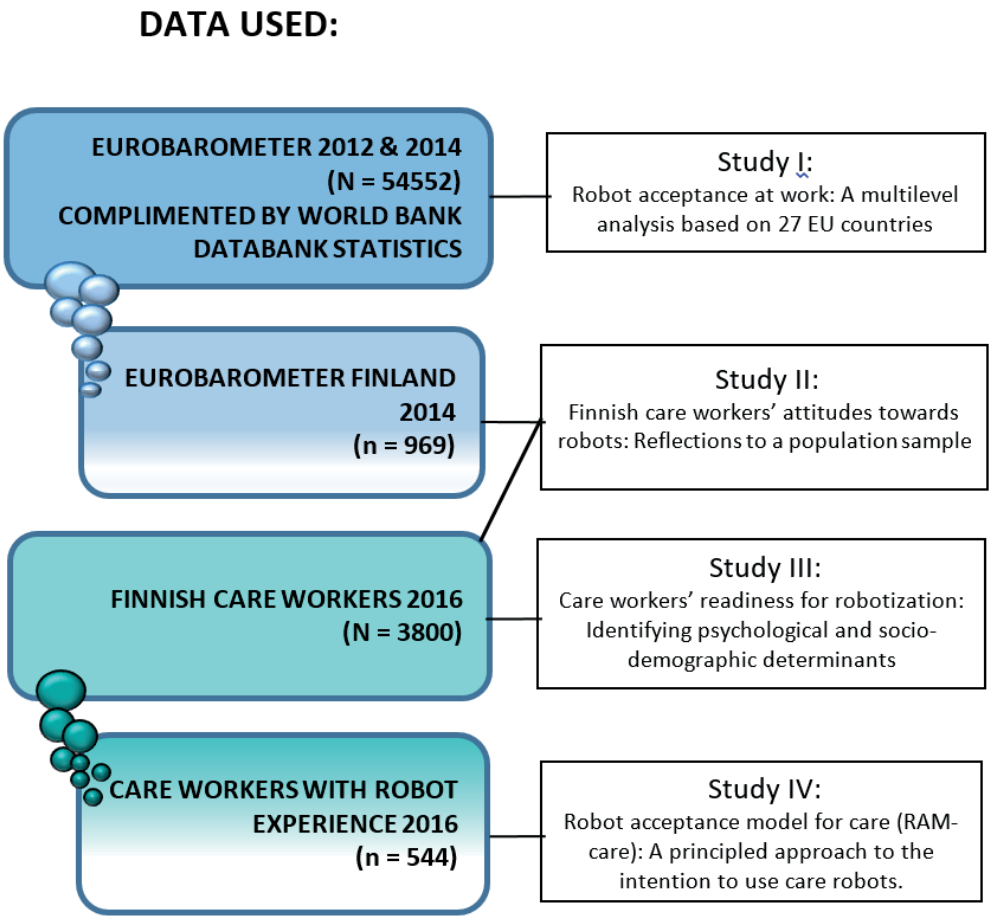


Figure 8. Datasets and their sub datasets used in the four studies

Two different Eurobarometer datasets were used. In Study I, a representative population sample of EU citizens from repeated interview data collections in 2012 ($N$ = 26,751) and 2014 ($N$ = 27,801) was employed, and in Study II, a subsample was used that included only the Finnish participants from the data collection of 2014 ($n$ = 969). In addition to the Eurobarometer data, Study II also used care worker data ($N$ = 3,800) that I collected for my doctoral research in the ROSE project. Here, care workers include nursing and physiotherapy professionals. The combination of the two datasets allowed us to reflect the attitudes among the population to the attitudes of a specific group, namely, Finnish care workers. Study III again used the whole sample of care worker data. Then, for Study IV, a subsample ($n$ = 544) was drawn from the care worker sample for analyzing the repeat intention to use robots among only those care workers who had firsthand experience with care robots.

The rationale behind collecting the care worker data was producing generalizable data by gathering survey responses from a substantial portion of the population of Finnish care professionals working (also) with older patients. The exclusive interest in care workers working in geriatric care originated from the ROSE project's emphasis on the challenges in welfare services due to the predicted sociodemographic change. This, however, was not a significant limitation at the practical level, since older people comprise the largest patient group in Finland (Suhonen, 2012). As in many Western countries, the Finnish population is ageing, and the number of people aged 85 and over is predicted to be greater than 219,000 individuals in 2030 (National Institute of Health and Welfare, 2018).

The proportion of the working age population is decreasing, which has been a trend in this decade in Finland (Statistics Finland, 2018), and social and healthcare services have already been suffering from the lack of skillful professionals (Finland's Ministry of Economic Affairs and Employment, 2019). In Finland, practical and registered nurses are all educated (Azimova et al., 2016; see also Evetts, 2013, p. 781) and licensed professionals, regulated by the National Supervisory Authority for Welfare and Health. Practical nurses assist patients and perform supportive nursing tasks, while registered nurses have a higher degree of autonomy and responsibilities, for example, in the administration of medicine (Finnish Nurses Association, 2019).

Survey data on Finnish care professionals were collected in collaboration with two trade unions. The first sample was drawn from the members of The Finnish Union of Practical Nurses, who were currently working in geriatric care (N = 41,513). The invitation to the study was sent to every other member with an equal likelihood of selection. From the 20,755 invitations, 2218 participants responded to the survey resulting in a response rate of 11%. The second sample was collected from The Union of Health and Social Care Professionals in Finland. The invitation was sent to every one of the 7,000 nurse and physiotherapist currently working at geriatric and home care services and also to a random selection to every third of the 37,000 nurse and physiotherapist working at a health center or a hospital (N = 19,333). This resulted in 1,782 participants and a response rate of 9%. After eliminating insufficient responses from the data of these total of 4,000 care workers, the sample n = 3,800 represents approximately 5% of the total population of Finnish care workers (Ailasmaa, 2013). The significant percentage of the population adds precision to the found associations and effect sizes in the analysis of Study III in particular (see: Senousy & Mazen, 2014).

The structure of the online questionnaire for care workers is presented in Table 1. Psychosocial constructs and their internal consistency reliability statistics are reported in the separate articles. The questionnaire mostly included items that have been used in prior studies. The advantages of this practice are using already tested and validated variables and cumulating knowledge. This is the case, for example, with the intention to use robots. Following the Almere model of robot acceptance, the study produced information that is comparable to findings from previous studies predicting the intention to use technology.

Similarly, using items from the Eurobarometer questionnaires allows comparisons between population data and the care worker data. However, some items were self-developed. These parts of the questionnaire highlight novel themes and ways of operationalizing them. For example, questions about assistive equipment use and the scenarios of robot assistance in care measuring robotization readiness had no previous studies to draw questions from. Thus, they are self-developed, although guided by theoretical and empirical knowledge.

Table 1. Structure of the Care Worker Questionnaire

| | |
|---|---|
| **Background information** | Single items on age, gender, native language(s), family members, highest level of education, any degree in technology, occupation and working sector, primary field of work, managerial experience, years in care work, years in geriatric services, working with people with dementia, interest in technology, overall video call experience<br>15 items |
| **Working conditions** | Single items on job satisfaction (Nordcare, 2015), change fatigue (McMillan & Perron, 2013; Reineck, 2007), equipment sufficiency regarding physical strain, use of equipment for patient moves, reasons not to use patient moving equipment, participating in equipment purchases<br>6 items |
| **Personality** | Extraversion (2-item measure in Gosling, Rentfrow, & Swann, 2003), general self-efficacy (6-item measure [GSE-6] in Romppel et al., 2013)<br>8 items |
| **Familiarity with care technology** | Technology types listed<br>13 items |
| **Familiarity with care robots** | Robot types listed and illustrated<br>5 items |
| **Robots in general** | Firsthand robot use (six contexts listed), gained information about robots (eight sources listed; Bruckenberger et al., 2013), attitude toward robots (four-item measure from Eurobarometer, 2014)<br>18 items |
| **Care robots** | Robot-use self-efficacy (3-item measure in Turja et al., 2017), compatibility with personal values (3-item measure in Karahanna, 2006), social norm in care robot use (3-item measure in Ajzen, 1991)<br>9 items |
| **Care robot acceptance (only for the respondents with experience with 1–4 care robots)** | For each of the four care robot types, a question about the extent of the robot use and a 10-item measure from the Almere model (Heerink et al., 2010)<br>44 items |
| **Robotization readiness, care work in general** | Scenarios of robot assistance in care work (e.g., Eurobarometer, 2014), willingness to act as a robot coordinator in the organization<br>14 items |
| **Robotization readiness, older patient care** | Scenarios of robot assistance in elder services (human-operated and autonomous robots), open question of ideas outside the scenarios<br>39 items |

In addition to the corresponding questions, the care worker questionnaire also built on robot definitions and illustrations of the Eurobarometer questionnaires. The definition priming the robot-related questions was the following: A "[r]obot is defined as a machine which can assist humans in everyday tasks without constant guidance or instruction, e.g., as a kind of coworker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans, like search and rescue in disasters. Robots can come in many shapes or sizes and some may be of human appearance" (Eurobarometer, 2014). Pictures shown to the respondents presented a food-processing industrial robot gripper and a butler-like service robot (Care-O-bot 3) serving a drink.

The care worker survey had a total of 171 items when counting all the listed multiple options (e.g., technology types) as separate items. However, none of the respondents received the full-length online questionnaire because of the conditional branching coded into the survey. Most of the respondents who did not have any firsthand care robot experience received a questionnaire of 127 items. Those with firsthand care robot experience typically had used a single robot type, and hence, received a questionnaire of 138 items. From the 3,800 respondents who gave answers to more than just background questions, 75% finished the whole survey. The average response time was 19 minutes.

## 4.2 Dependent variables

Distributions for the dependent variables in all four studies are presented in Table 2. The dependent variable in Study I is robot acceptance at work, which was measured with a Eurobarometer question of how the respondent feels about "having a robot assist them at work (e.g., in manufacturing)." The scale for the answers ranged from 1 (totally uncomfortable) to 10 (totally comfortable). In Study II, a second dependent variable was introduced. The Finnish population and care workers were examined in their variance of robot acceptance at work and general attitude toward robots. The general attitude was measured by the following question: "Generally speaking, do you have a 'very positive' (4), 'fairly positive' (3), 'fairly negative' (2) or 'very negative' (1) view of robots?" This question was presented identically in the Eurobarometer and care worker questionnaires. In the care worker questionnaire, robot acceptance at work was summed from 13 questions concerning robots assisting in different care work scenarios. The scale for the answers ranged from 1 (totally uncomfortable) to 10 (totally comfortable). The composite variable (range 13–130) was returned to the original scale and tested for its reliability (mean [*M*] = 6.57; standard deviation [*SD*] = 2.19; α .933).

Table 2. Dependent Variables of the Four Studies (M = mean, SD = standard deviation)

| *Study* | *Variable* | *N* | *Scale* | *M* | *SD* |
|---|---|---|---|---|---|
| I | Robot acceptance at work / EU population | 53543 | 1–10 | 6.24 | 3.11 |
| II | Robot acceptance at work / Finnish population | 969 | 1–10 | 5.99 | 2.95 |
| II | Robot acceptance at work / Finnish care workers * | 3399 | 1–10 | 6.57 | 2.19 |
| II | General view of robots / Finnish population | 969 | 1–4 | 2.85 | 0.71 |
| II | General view of robots / Finnish care workers | 3399 | 1–4 | 2.57 | 0.71 |
| III | Robotization readiness / Finnish care workers * | 3399 | 1–10 | 6.57 | 2.19 |
| IV | Intention to use care robots / Finnish care workers | 544 | 1–5 | 3.93 | 1.10 |

The questionnaire for the care workers was constructed around two major dependent variables, the robotization readiness (Studies II and III) and the repeat intention to use care robots (Study IV). In Study IV, robot acceptance was operationalized as the intention to use the type of care robot(s) the respondent already had some experience with. The statements followed the Almere model (Heerink et al., 2010). The intention to use was measured by statements like, "If the telepresence robot was available, I would use it," with a 5-point Likert response scale from "*totally disagree*" to "*totally agree.*"

Robotization readiness did not have the same presumption of having firsthand experience with at least one care robot type, and it measured all the respondents' technological change readiness regarding the emerging care robotization. In Study III, the term *robot acceptance* was narrowed down to robotization readiness to describe the attitude toward assistive robots, including among those with no experience with robots. To measure care robotization readiness, healthcare-work-related scenarios and their potential robot assistance were presented. The question format, with a response scale from 1 (*totally uncomfortable*) to 10 (*totally comfortable*), was adapted from the Eurobarometer questionnaire and was the same as that used in Study II. Evaluating 13 different tasks, the care workers responded to how comfortable they would feel if a robot were to assist them in the given scenarios. Some of the scenarios had illustrative examples, presenting cartoon-like illustrations of Care-O-bot in care for older people (Cavallaro et al., 2011, pp. LXII–LXIII).

Considering the psychological construct of an attitude (Dovidio et al., 1997; Rosenberg & Hovland, 1960), the scenarios were designed to provoke the respondents cognitively (i.e., reflecting different robot-assisted tasks to current care guidelines; Duodecim, 2018), affectively (i.e., opinions on which tasks should be robotized), and behaviorally (i.e., practical credibility of the scenario). By choosing to measure readiness by separate tasks, I wanted to highlight the situationality in technological change readiness (Weiner, 2009). Thus, instead of direct questions on how the respondents' would value the change and appraise the task demands and resource availability (Weiner, 2009), change readiness was measured in a more covert way, via hypothetical scenarios of robot assistance. Especially in a study where technological change is in its contemplative stage, it would not be well founded to use a questionnaire like Bouckenooghe, Devos, and Van den Broeck's (2010) organizational change questionnaire—climate of change, processes, and readiness (OCQ–C, P, R), which focuses on the advanced and more concrete phases of the change process and includes, for example, questions about the management giving sufficient support and keeping their promises along the change.

In a contemplative stage of robotization, the contents of the emerging change are largely hypothetical. In this preliminary stage, people recognize that there may be a need for change, but they do not yet know whether or how the change should be taken forward (Prochaska & Velicer, 1997; Prochaska et al., 1994). Due to this abstract nature of the emerging change, it would not be valid to ask directly how robotization ready the respondents think they are. Moreover, the somewhat covert battery of questions was used to minimize the policy-oriented motives to either highly promote robotization or strictly reject it as a whole (Marshak, 2006). Partly, the scenarios represent the sociotechnical imaginaries of the researcher, or "the imaginary of robotized welfare," where it is suggested that some of the care tasks may be robot assisted (Nickelsen, 2018, p. 215). It is then for the respondents to use *their* sociotechnical imaginaries to evaluate the scenarios and how they would perceive robot assistance in said situations.

The agreeableness of robot assistance, worded as "being more comfortable or not," is copied from the Eurobarometer questionnaire. Here, comfortability does not refer to a nonreflective feeling of comfort (Russell, 2003), but rather, to an evaluative attitude toward an idea (Broadbent et al., 2010; Haddock & Maio, 2008). The validity of the composite variable robotization readiness (in Studies II and III) was tested as a post hoc exploration by adding it to the regression model predicting the perceived usefulness of care robots (Study IV). The validation is based on examinations between technology readiness and technology acceptance (Lin, Shih, & Sher, 2007; Walczuch, Lemmink, & Streukens, 2007). Robotization readiness was added to the Almere model's predictors of perceived usefulness of robots along with perceived ease of use, perceived adaptivity, and use-related anxiety (Heerink et al., 2010; see also Figure 7 in Chapter 3). The results showed that care robotization readiness is strongly linked to the perceived usefulness of care robots (Appendix A). This is in line with the previous findings between technology acceptance and technology readiness (Walczuch et al., 2007), and it provides support to the validity of the robotization readiness construct used in Studies II and III.

## 4.3 Statistical techniques

The **first study** examined attitudes toward work-related robotization among EU citizens. In a multilevel analysis at the individual, country, and time levels, robot acceptance at work was predicted in a mixed model of fixed and random effects. Two data collection years and 27 countries were considered as random effects. Clusters of countries (e.g., "Nordic countries" and "Mediterranean countries") as a fourth level would have complemented the study design, but in this case, there was no theoretically sensible way to divide the EU countries into 10 or more clusters, as is required in assumptions of multilevel analysis (Klein & Kozlowski, 2000).

Individual-level factors (gender, age, full-time education completion age, employment status, Internet use at work, experience with robots at work, and experience with robots elsewhere) and national-level factors (job automation risk, cellular phone ratio, and ICT exports) were the fixed effects of the models. Because the individual attributes behind attitudes toward robots have been studied before using the Eurobarometer data, we concentrated on national-level variance in our analysis. Variance analysis and Tukey's tests were used for examining the differences and clusters between countries and data collection years. The multilevel analysis was presented in the three following models: national-level effects, individual-level effects, and national- and individual-level effects together. Unstandardized regression coefficients and their standard errors, along with model fit statistics, were reported in the models. Because of the large sample size, in addition to $p$ values, coefficients of determination ($R^2$) and Cohen's $d$ effect sizes were reported. Also, to indicate the within-group correlation in the nested data, we reported the intraclass correlations.

In the **second study**, general and work-related attitudes toward robots among the Finnish population were reflected to the similar attitudinal constructs among Finnish healthcare professionals. Variance analysis and Dunnett's T3 tests were used for examining differences between occupational groups. The relationship between attitudes toward robots and different experiences with robots, as well as some important background variables (gender, age, employment status, managerial status), were tested using multiple ordinary least squares (OLS) regression analysis. The results were presented in four models: separately for the population data and care worker data and separately for two dependent variables, namely, robot acceptance at work and general views on robots. It should be noted that the hypotheses were further tested in Chapter 5 of this dissertation.

The **third study** identified psychological and sociodemographic determinants of robotization readiness among Finnish care workers. The independent variables chosen for the final models were robot-use self-efficacy, general self-efficacy, social norms, job satisfaction, view in robots taking people's jobs, current profession, age, and gender. Chi-square tests and variance analysis were used for group comparisons. The hypotheses were tested in OLS regression analysis and presented in the two following models: respondents who have never used robots and respondents who have used a robot in at least one context. Fisher's $Z$ test was performed for testing the difference in predictive power between these models. Interactions between the explanatory factors in the linear models were tested as post hoc analysis.

The **fourth study** of the repeat intention to use care robots was analyzed in a generalized structural equation model (GSEM), which allowed us to investigate simultaneous regressions in one model and present a new model for care robot acceptance (RAM-care). The GSEM was fitted onto the Almere model of robot acceptance (Heerink et al., 2010) and then extended by our additional factors of personal moral values and perceived technology unemployment. All the variables were observed (none latent) and reported as unstandardized coefficients. The model fit was examined using McFadden's pseudo $R^2$ (McFadden, 1979).

# 5 OVERVIEW OF THE MAIN RESULTS

## 5.1 Study I: Robot acceptance depends also on the technology orientation in the country

In the article "Robot acceptance at work: A multilevel analysis based on 27 EU countries," we analyzed how robot acceptance at work varies between individual and societal attributes in the EU countries. We were the first to add country-level and time-level determinants to the Eurobarometer statistics in order to explain robot acceptance in a multilevel setting. The aim was to contribute to the discussions of social geography, in this case, attitudes toward robots in an examination of countries, individuals and time. In the study design, the countries in the EU were viewed as culture-specific regulators of robot acceptance. Despite the globalizing of Europe and unquestionable difference of culture and country, design was grounded on the varying technological profiles found among countries (Madsen & Farhadi, 2018; Napoletano, Tacchella, & Pietronero, 2018).

Most variance in robot acceptance at work was captured by individual-level factors, supporting our first hypothesis (SI-H1). Relatively positive views were found in males who had studied longer, were not employed at the time of the data collection, and had personal experience with robots at work or elsewhere. At a national level, countries with higher levels of ICT exports, more cellular phones per capita, and lower job-automation risk had higher robot acceptance, supporting the second and third hypotheses (SI-H2 and S1-H3). Moreover, a national orientation toward manufacturing and using high technology increases robot acceptance more than the relative risk of jobs being automated in the country reduces it. Individual and national level predicted 17.5% of the variance in robot acceptance at work.

The countries did not cluster distinctively in accordance with value orientation (see: Inglehart, & Welzel, 2014). However, viewing the differences between countries, the results suggest that Europe is roughly divided between conventional and innovative countries. Innovativeness can refer either to active product developer countries or subcontractor countries investing highly in robotizing production lines. Comparing the two years of data, the robot acceptance did not change on average. However, significant "two-year trends" were found in country-specific examinations. The greatest increase in robot acceptance at work in time occurred in Luxembourg and Austria. Respectively the most decrease in robot acceptance was found in the Slovak Republic and Finland.

## 5.2 Study II: Care workers stand out as a distinct group of potential robot users

The second study concentrated on the individual differences in robot acceptance but kept the focus also on the social environment, since the study design included a population-based sample comparison to a specific occupational sample of care workers. In the article "Finnish care workers' attitudes towards robots: Reflections to a population sample," we examined the experience healthcare professionals have with robots and how it is associated with attitudes toward robots. Two dependent variables were used: general views of robots and robot acceptance at work. Regarding robot acceptance in care work, we also analyzed how robot assistance is accepted depending on the care task in question.

General views on robots were more positive among the Finnish population compared with the Finnish healthcare professionals, but this difference was not repeated in analyzing robot acceptance at work. Managerial status and firsthand experiences with robots, consistently associated with higher robot acceptance in all the regression models of both samples and both dependent variables. Among the population, also male gender, not working at the time of the study, and younger age were associated with higher robot acceptance. Among healthcare professionals, in contrast, younger age predicted a lower level of robot acceptance at work.

In the first hypothesis (SII-H1), we assumed that robot assistance is more accepted for indirect tasks rather than direct and practice-oriented tasks of care work. This hypothesis was rejected after viewing the robot-assisted tasks with the highest agreement along with their standard deviation errors. However, testing the hypothesis further, I found that the tasks of indirect patient care (summing up different tasks of logistics and documenting) received higher scores on average ($M = 7.43$, $SD = 2.27$) than the tasks of direct patient care (patient moves, translation, threatening situations, telepresence, and planning care or medication) did ($M = 6.30$, $SD = 2.31$). Hereby, the *t*-test for dependent samples gives new support to the hypothesis of higher acceptance of robot assistance in indirect care tasks ($t = 40.53$; $p < .001$). Our second hypothesis (SII-H2), concerning the higher acceptance of physically burdening care tasks, was initially supported, and it is reinforced by further statistical testing. The tasks regarding handling patients or heavy materials ($M = 7.17$, $SD = 2.21$) would be more accepted for assisting care work than other tasks would be ($M = 6.06$, $SD = 2.41$; $t = 40.27$; $p < .001$). Also regarding handling patients, the robot's autonomy was a relevant factor. Moving a patient using an autonomous stretcher was not as pleasant an idea ($M = 5.74$, $SD = 2.99$) than a patient move with the help of a robot assistant ($M = 7.66$, $SD = 2.84$; $t = 38.37$; $p < .001$) or with an exoskeleton power suit for the nurse to wear ($M = 6.22$, $SD = 3.18$; $t = 8.44$; $p < .001$).

A little over one-tenth (11.9%) of Finnish care workers in our samples had used robots at (any) work, home or elsewhere. Understandably, in the world of industrial robots, experiences with robots were relatively more frequent (16.2%) among the general population than they were among the healthcare professionals.

## 5.3 Study III: Care workers willing and able to use robots in their work

The article "Care workers' readiness for robotization: Identifying psychological and socio-demographic determinants" showed that, among Finnish care workers, some feel willing and almost all feel able to use new technology in their work. Higher robotization readiness was associated with the care workers' interest in technology, robot-use self-efficacy (SIII-H1) and beliefs that there was no robot-rejecting norm in the workplace (SIII-H2) or that robots are stealing jobs in general. In addition, among those respondents who had no experience with robots, older aged male practical nurses who had lower job satisfaction reported the highest robotization readiness. Hence, in line with our third hypothesis (SIII-H3), experience with robots faded out the effect of certain background variables had on robotization readiness, namely age, gender, and job satisfaction. In other words, firsthand robot experience diminished the effect age, gender and poorer work satisfaction had on robotization readiness

Robot-use self-efficacy was the most significant explanatory factor for robotization readiness, regardless of whether the respondent had firsthand robot experience. Moreover, the care workers reported exceptionally high self-efficacy in using robots as assistants (published previously in Latikka, Turja, & Oksanen, 2018; Turja et al., 2017). A clear majority (87.2%) of care workers felt confident in learning to use care robots in their work. The registered nurses and head nurses reported higher robot-use self-efficacy on average compared to the practical nurses.

## 5.4 Study IV: Personal values in care robot acceptance

In the article "Robot acceptance model for care (RAM-care): A principled approach to the intention to use care robots", we proposed a new robot acceptance model for care, promoting the importance of profession-specific context in robotization. The first step was empirical testing, where we fitted our care worker data to the existing robot acceptance model, hypothesizing that the intention to use care robots can be predicted in line with the more general Almere model of intention to use robots. The results confirmed how social influence (SIV-H1a), attitude (SIV-H1b), perceived usefulness (SIV-H1c), and perceived enjoyment (SIV-H1e) are linked to the higher intention to use care robots. However, our data differed from the Almere model by not supporting the effect of perceived ease of use (SIV-H1d) and trust (SIV-H1f) on the intention to use robots.

The next step was theoretical testing, where, to include the principle level in the robot acceptance, we added two new components to the GSEM—first, the perceived compatibility between care work robotization and personal moral values, and second, beliefs about robots causing technological unemployment in general. Compatibility with personal values did not directly associate with the intention to use care robots, and thus, the second hypothesis (SIV-H2) was rejected. However, personal values had an important role in the robot acceptance model via interaction effects with two other explanatory variables. Both perceived usefulness (supporting SIV-H3) and social influence (supporting SIV-H5) moderated the link between compatibility with personal values and the intention to use robots. In support of the fourth hypothesis (SIV-H4), the less participants felt that robots would cause technology unemployment, the more they felt like robot use was compatible with their personal values.

This study also produced more detailed information about the scope and prevalence of care robot usage in Finland. Most of the participants were familiar with only one type of care robot, with a therapy animal robot being the single most recognized robot. According to the results, these robot experiences originated from nonrecurring trials rather than constant use. Partly because of this, the tested scope and frequency of care robot use did not significantly correlate with the intention to use robots, which was the reason they were left out of the model.

# 6 DISCUSSION

## 6.1 Determinants of robot acceptance

The main objective of this dissertation was to analyze the acceptance of assistive robot use at work, especially in relation to its determinants. As presented in Figure 6, robotization readiness is an attitudinal readiness for technological change and explains the motivational intention to use robots, similarly to the TAMs, where attitude is one of the predictors of repeat use intention. The following chapters present evidence on the social, individual, sociodemographic, and contextual determinants of robot acceptance. Figure 9 summarizes the findings categorized according to whether they originated from population-level samples or the care worker data. The emphasis in the discussion is on care workers potentially facing or already having experienced robot use in their work.

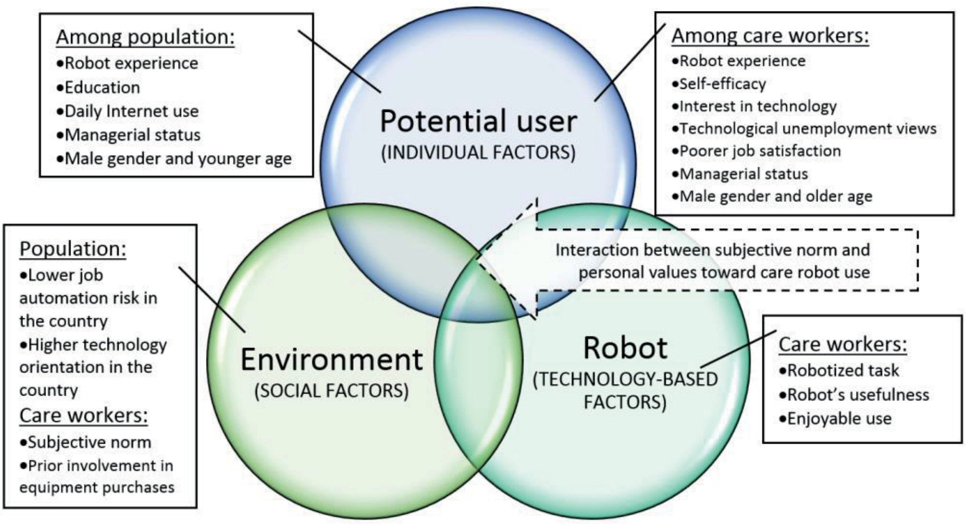


Figure 9. Individual, social, and technology-based determinants of robot acceptance at work

### 6.1.1 Potential users with efficacy and experience

Managerial status and any experience with robots have important and overlapping roles in robot acceptance. In the population samples and the Finnish care worker data, prior firsthand experience with robots emerged as one of the primary determinants of robot acceptance. Tested now in service and care robot contexts, the finding adds to the already extensive literature showing the link between prior experience and acceptance of technology (Heerink et al., 2010; Katz & Halpern, 2014; Louie, McColl, & Nejat, 2014; Nomura, Kanda, & Suzuki, 2006). Head nurses and other respondents with managerial status in the care worker data reported more extensive experience with robots and higher robotization readiness compared with the other care workers. The differences found in occupational status supported the argument of average managerial views often being at odds with the average views of the workers (Sellman, 2010; MacIntyre, 1988). These findings also support a qualitative study in which managers of a care center reported more positive views of a bathtub robot than the other members of the staff because the managers appreciated the corporate image-elevating advantages of using new technology, whereas the nursing staff was more concerned about possible ethical challenges regarding the robot use (Beedholm et al., 2015).

Managers are prone, and also expected, to look at things from the organization's perspective. The other reason explaining the higher status employees' more positive views of robots may be that higher education is perceived as insurance for future employment and a protector against technological unemployment (Arntz, Gregory, & Zierahn, 2016; de Graaf & Ben Allouch, 2013; Turja & Niemelä, 2018). Then again, robot experience and acceptance going hand in hand in organizations might emphasize the need to reduce the hierarchy in the workplace. By including different levels of workers in the plans for technological changes, positive attitudes toward robots could be promoted more broadly in the workplace. Beedholm et al. (2015) found that the difference between managers and other employees lies in the ethical deliberation on robotization because the managers did not even mention the need to consider moral aspects in the use of the bathtub robot. This raises the question of whether robot acceptance among nurses is not only about the familiarity with technology but also about the more basic principles behind robot use.

Moreover, the results show that it is not just the amount of experience and education but also cognitive self-efficacy beliefs that are significantly associated with robotization readiness. That said, higher self-efficacy can partly originate from educational background (Winslow et al., 2014). Self-efficacy was measured among Finnish care workers, who reported exceptionally high technology-use self-efficacy (compared with, e.g., Maillet, Mathieu, & Sicott, 2015). This result may be explained by the well-established use of computers, patient information systems, and a wide range of healthcare and hospital technologies in Finnish care work, as well as education. The knowledge of information and healthcare technologies may reflect on the high confidence in learning different kinds of new technologies. Furthermore, the high self-efficacy among care workers implies that there might not be valid reasons for the care technology to remain as a "black box" (Sandfort, 2010, p. 271) for nurses. According to the findings presented here and previously in Turja et al. (2017), care professionals are notably trusting of their ability to learn to use robots, even when it comes to basic programming.

The care workers who reported being more confident in their ability to use robots were significantly more ready for care robotization, and the opposite was true for those with lower confidence. Care workers' self-efficacy beliefs play a big part in robotization readiness, supporting the idea of a strong occupational group identity correlating with an open and innovative mind-set (Anthony & Tripsas, 2016, p. 431). Nurses have a strong identity as professionals, giving them the confidence to be opinionated and proactive when facing any job changes (Collin-Jacques & Smith, 2005). Related to the previously found connection between robot-use self-efficacy and robot acceptance is a qualitative finding where Finnish caregivers were concerned about whether using a robot therapy animal would require certain professional skills and personal characteristics of the caregivers. In the study by

Niemelä, Määttä, and Ylikauppila (2016), the care workers highlighted that they would have to be able to read the situation, understand how the older patients reacted to the robot therapy animal, and understand the kind of situation in which using a robot animal would be appropriate and beneficial. Adding ethical norms to the equation, even if able, the caregivers were not always willing to play the deceptive role that seems to come along with using robot therapy animals, namely pretending that the robot is a real pet (Niemelä, Ylikauppila, & Talja, 2016). However, in other cases, it has been observed that care workers sometimes try to maintain the illusion of a robot's aliveness when presenting it to the care home residents (Parviainen et al., 2016).

Interest in technology is another consistent determinant of robotization readiness. It is notable that self-efficacy as the belief in one's abilities to use new technology and the general interest in technology as the dispositional attitude toward technology were fitted together in the same statistical models without them invalidating each other's explanatory power. Technology orientation on its own is a strong correlate in robotization readiness, which is in line with the theory of vocational interests motivating people's work-related choices (Arieli et al., 2019; Dobson, Gardner, Metz, & Gore, 2014) and the theory of job crafting, in which the characteristics of one's own work are proactively modified and tailored to better agree with personal motives, interests, assets, and values (Mäkikangas, Aunola, Seppälä, & Hakanen, 2016; Wrzesniewski & Dutton, 2001). An organizational change is more likely to be welcomed while maintaining work engagement if the change is compatible with the employees' personal views of how they would craft their job (Seppälä, Hakanen, Tolvanen, & Demerouti, 2018; Petrou, Demerouti, & Xanthopoulou, 2017).

Work-related autonomy and the possibility to integrate personal interest in work are viewed as a precursors to and stimulators for job crafting, which leads to better work engagement (Mäkikangas et al., 2016; Wrzesniewski & Dutton, 2001). Hence, the theory of job crafting underlines the importance of *autonomy given and initiative* *taken* in engagement with work and its changes. The ideology of job crafting emphasizes the importance of giving every employee the choice of whether he or she wants to work with robots. By supporting job crafting, the employer would also adapt employee-driven job redesign, which has considerable promise, particularly when it comes to changing and complex work environments (Demerouti & Bakker, 2014).

The more unexpected result is the lower job satisfaction associated with higher robotization readiness when a prior study of change readiness has shown the opposite (Lipińska-Grobelny & Papieska, 2012). As a conclusion to this contradiction, the care context, contemplation stage of technological change, and perhaps even a Finnish sample have distinctive features when it comes to organizational changes. Lower job satisfaction was associated with higher care robotization readiness for respondents who did not have firsthand robot experience. When this is added to the findings that robot assistance is most acceptable in physically straining tasks and that older respondents are more ready for care robotization on average, the conclusion is that there are high expectations toward care robotics and its potential to relieve the physical strains of care work. Older care workers are a group that might emphasize the need for assistance with physical labor they have presumably endured for a longer period of time. The link between older age and change readiness has been found before, and in those cases it has been argued to be moderated by the higher positions of older employees (Madsen et al., 2005). The interaction between age and managerial status was not found in our analysis. Overall, older age predicting higher robotization readiness in the care worker data is indeed in line with studies on organizational change instead of studies on technology acceptance, which supports the conceptual decision to include the attitudinal robotization readiness under the umbrella of robot acceptance in this dissertation. Following this line of thought, care robotization is considered more of a job change than a technological change.

### 6.1.2 Care robots assessed by their task and autonomy

Although somewhat doubtful of the benefits of robotization, Finnish care workers approved of the idea of robot assistance in certain types of care tasks. Robot assistance was found to be highly welcomed in physically straining care tasks and more acceptable in indirect than in direct care. The almost consensual popularity regarding robotic assistance in physically demanding tasks implies that there is a need for change that has to be recognized. A clear majority of the respondents would welcome robots to assist them in heavy lifting tasks, and at the same time, less than half of the respondents were keen on using telepresence robots in remote health checks. This may be a sign of the attention telecare developments have already received in comparison with the efforts to reform care work so that it would be less physically burdening. Also quite surprisingly, one of the major indirect tasks in care work, documentation, was not at the top of the list of robot-assisted tasks either. One of the reasons may be that nursing personnel describe the often changing and updated patient record systems as unreliable and even more troublesome than the traditional paperwork used to be (Hirvonen, 2015). This prior experience could result in a negative attitude toward future system changes and be a sign of change fatigue, where new changes are viewed as too frequent, incomplete, and futile (McMillan & Perron, 2013).

Regarding robots in moving patients, previous qualitative findings underline the need for nurse-operated robot assistance instead of autonomous robots (Alaiad & Zhou, 2014). In a study by Niemelä, Määttä, and Ylikauppila (2016), robots that would be used to lift older residents were not perceived as trustworthy by the caregivers. The critique was aimed specifically at the idea of a robot replacing a human coworker. There were quite reasonable doubts voiced about any robot's abilities to reach the intuitive and effortless way of communicating that care workers are used to when interacting with human coworkers: "You only need to look the other in the eye and we *know*" (Niemelä, Määttä, & Ylikauppila, 2016, p. 8). In addition, the caregivers doubted whether a robot could ever notice, let alone react appropriately, if an individual felt pain, anxiety, or fear during physical contact (Niemelä, Määttä, & Ylikauppila, 2016). These examples paint a correct picture of the current state of development, where artificial intelligence is not yet intuitive or empathetic (Huang & Rust, 2018).

The results of Study II are not in line with prior research literature that claims care robots would be most accepted in tasks of therapy, outdoor walking support, medical dispensing, and entertainment (Glende et al., 2015; Hebesberger, Körtner, Pripfl, & Hanheide, 2015). However, the results support the previously expressed need for robotic assistance in communication, reminding, object transportation, and surveillance (Glende et al., 2015; Hebesberger et al., 2015). Prior findings have also implied that nurses appreciate robots as assistive tools and monitoring devices but not for tasks that require social interaction (Alaiad & Zhou, 2014; Jenkins & Draper, 2015). This claim was not exactly supported by our data because robots assisting in translation and patient moves, for example, would require a substantial amount of interaction.

The expectations toward care robots consist an idea of new technology taking over routine work, allowing more time for quality human care while also reducing costs (Glende, Conrad, Krezdorn, Klemcke, & Krätzel, 2015). The simultaneous gain of quality care and cost effectiveness has been criticized as, if not misleading, at least naiive by, for example, Sharkey and Sharkey (2012), who view automation as aiming to reduce the number of care workers. In addition, the promise of robotizing dirty, dull, and dangerous tasks (Takayama et al., 2008) may even appear to be a Trojan horse. Looking back at industrial robotization, many employees on the manufacturing floor have found themselves performing even more mundane work, such as monitoring the robot's operation day in and day out (Leamer, 2008). Ultimately, the second technological revolution was more about the cost effectiveness of production than handing off unpleasant tasks from people to robots. The future will show if robotizing healthcare work is any different.

If anything, research literature seems to point out that interaction with patients declined after the third technological revolution and healthcare computerization (Bensing et al., 2006; Menon, 2015). Similarly to industrial work, care tasks may suddenly center on monitoring work instead of direct patient work. The development of care work into monitoring work could possibly challenge nurses' identification with their job because of the sudden devaluation of embodied competence or identification with their customers and patients, which could again have negative effects on motivation and well-being at work (Bjellegaard et al., 2017; Gherardi & Rodeschini, 2016). Does care robotization have the potential to change this course we have witnessed during the second and third technological revolutions? The first priority would be to consider which tasks the employees want to delegate to a machine. Studies show that robots rather than people are viewed as suitable for monitoring work (Alaiad & Zhou, 2014; Jenkins & Draper, 2015). Second, the holistic nature of care work should be resolved in robotization. For example, nursing work consists of several tasks, many of which are emotionally complex and interactive. This makes the tasks inaccessible by the logic of algorithms and makes many parts of care work even beyond robotization (Autor, 2014; Frey & Osborne, 2015; van Wynsberghe, 2013, p. 427).

The results presented in this dissertation and in our own previous studies (Parviainen et al., in press; Savela et al., 2018; Turja & Niemelä, 2018) support the notion that care workers would prefer human-operated robots over autonomous robots. For care workers, it seems to be crucial that robots do not replace care staff but instead are given more of an instrumental role (Alaiad & Zhou, 2014; Niemelä, Määttä, & Ylikauppila, 2016). In care work, rather than autonomous robots interacting with patients directly, the more acceptable norm would be triadic patient–robot–nurse interaction (Parviainen et al., 2018). The idea of nurse–robot teams can also refer to joint optimization between human and artificial intelligence, as well as other competences that are extremely different between people and machines (Gaynor et al., 2014). The idea of a joint optimization between a nurse and a robot is roughly illustrated in Figure 10. Humans excel in versatile intelligence, although they can lose focus quite easily in repetitive tasks. The advantages of robots, on the other hand, are machine power and high endurance.

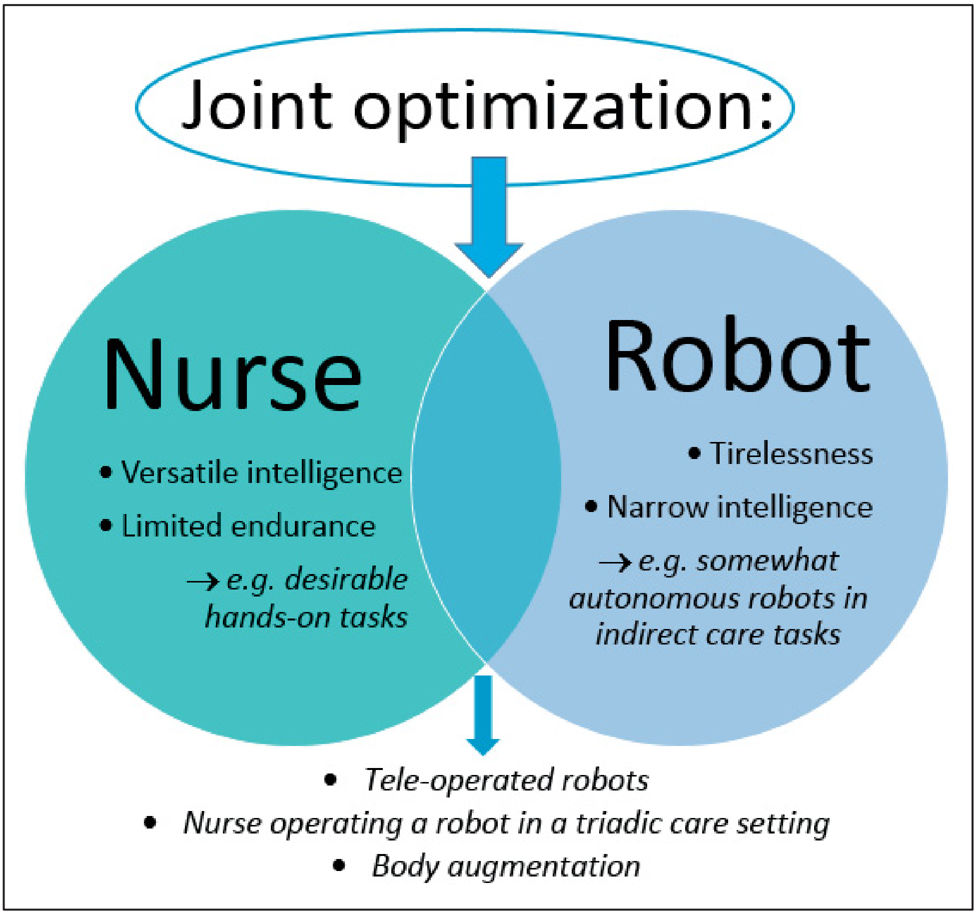


Figure 10. Joint optimization of humans and robots in nursing work

Robots with high autonomy but restricted functions seem fit for background work, assisting in indirect care tasks. In this scenario, the role of humans is minimized to managing and monitoring the robots. Especially regarding direct care work, nurses do not appreciate the idea of autonomous robots. Their attitude is quite negative, although there are promising systems already in use, such as a medicine-dispensing robots for home care (e.g., Evondos). Sometimes robots are viewed as useful assistants, but nurses do not need robotic assistance for tasks they want to do by themselves, even if it means physical effort. These tasks are the ones nurses would choose to do with their own hands in comparison to a scenario in which they would stand beside a robot, controlling and operating its actions.

Joint optimization, then, would aim at finding excellence in combining human and robot competences. Tele-operated robots combine human intelligence (the operator) and artificial intelligence (e.g., robot's navigation and bump prevention) and enable people to interact in more than one environment at the same time. Robots can also be human-operated while sharing the same space with their operator. In this scenario, the nurse uses a robot as an assistant or an assistive tool. An example of triadic care, referring to human–robot–human interaction, is robot-assisted physiological gait rehabilitation. This type of robotics is used, for example, when a patient is learning how to walk again after a stroke or a spinal cord injury. The physiotherapist is in control of the rehabilitation robot and supervises the therapy session as he or she would without any robot assistance.

Body augmentation is another example of joint optimization between robots and people. It can be viewed as either machine power or artificial intelligence enhancing a human body. A nurse wearing an exoskeleton while performing physically demanding tasks, such as lifting materials or assisting a patient in moving to and from a wheelchair, combines machine power with human intelligence (see: Kumar, 2018). Combining artificial intelligence with a human body, then, refers to wearable smart devices, skin implants, and even brain–computer interface devices (see: Kaplan, 2012). Smart clothes, watches, and rings monitor people's physical functions at a level at which people themselves could not make the observations. Microchip skin implants are typically used as an alternative to an access or identity card (Petersén, 2019). Brain implants are not yet a reality, but they entail a promise, for example, for people to learn new languages faster and with less effort (Bouskill, Chonde, & Welser, 2018). Besides new technology, immigration is seen as a partial solution to the care worker shortage. However, Japan, for example, has found it challenging to draw in and educate immigrant nurses due to the language barrier (Watanabe et al., 2018). It is more cost effective to install a language module in a robot (or a dozen of them), at least until we can insert information into the human brain as well.

The idea of joint optimization instead of autonomous robots is in line with David Mindell's (2019) perspective of how artificial intelligence should augment intelligence, not replace it. For this discussion, we need to look at the various types of intelligence recognized in people and machines. In their artificial intelligence research, Huang and Rust (2018) separate the mechanical, analytical, intuitive, and empathetic types of intelligence required in service work. Mechanical intelligence is simple predefined reasoning, and it is especially suitable for artificial intelligence, as it repeats the same logic with a limited variance of stimuli. Analytical intelligence is also rule based, but it requires the ability to accumulate information and to make logical decisions based on it. Thus, it is associated with self-learning machines, which allow artificial intelligence to be used to perform tasks that are impossible for a simple computer but at the same time are notably effortless when it comes to humans' cognitive abilities, for example learning from prior mistakes (Dunjko & Briegel, 2018; Huang & Rust, 2018). However, the patterns in uncontrolled machine learning may differ from human logics, which makes uncontrolled machine learning's decisions potentially untraceable, or a "black box" as described in Sandfort (2010). Connected to sensors that exceed human senses and observations in precision and reactivity, self-learning artificial intelligence has the potential to surpass human performance even in complex environments (e.g., traffic).

Intuitive intelligence is something that artificial intelligence struggles to even mimic, as intuitiveness requires reasoning in complex, changing, and unpredictable social environments (Huang & Rust, 2018). Intuitive reasoning seeks to answer the question "why" instead of just "what." It is a long way from strictly analyzing physical wounds (analytical intelligence) and understanding why the patient is in pain (intuitive intelligence). Decision-making in nursing work, for example, does not involve only "conscious choices between competing goals" (O'Keefe et al., 2015, p. 1), which would go with machine logics. Instead, decision-making is largely based on interpretations of social and clinical cues (O'Keefe et al., 2015; Weick, Sutcliffe, & Obstfield, 2005). This leads us to empathetic intelligence, which is an extension of intuitive intelligence and refers to interpreting, understanding, responding, empathizing, and influencing human emotions (Huang & Rust, 2018). In addition to compassionate and ethical decision-making, empathetic intelligence includes, for example, the concept of humor. A major challenge exists in making a sensor of humor account for a sense of humor. Some say that artificial intelligence will never achieve this level of reasoning and reactivity, yet developments have been made in the area of simulating empathetic intelligence. Certain applications of artificial intelligence already recognize emotions, learn from their discussions with people, and mimic conversing (Huang & Rust, 2018; Huet, 2016; Stuart, 2017). The new era of artificial intelligence carries great promise, but it is also proposed to challenge human identity, not only via automation and technological unemployment but also by challenging the mental superiority that humans have prided themselves on for thousands of years (Sætra, 2018).

Every scenario of joint optimization between a nurse and a robotic device presented demands that nurses have certain technical skills, and therefore, robotization will also affect nursing education (Parviainen et al., 2018). It has been theorized that the major risks associated with the use of robotization in healthcare may be the staff's inability or reluctance to use technical devices due to a lack of experience. These risks also include motivational issues, such as a fear of technological unemployment or protecting the quality of care (Beedholm et al., 2015; Glende et al., 2015; Sharkey & Sharkey, 2012). Indeed, in addition to ensuring the quality of care, the fear of technological unemployment speaks for using robots as nurses' tools instead of as autonomous agents of care.

Beliefs about robots taking people's jobs were associated consistently with lower robot acceptance in the data. Most of the Finnish care workers somewhat agreed on or were not sure about robots taking jobs from people, whereas in a survey of 1,024 Finnish workers, about 75% reported trust in the sustainable employment situation in their own fields of work despite automation and robotization. In this survey, younger adults (<30 years) were considerably more pessimistic than the older respondents were, and almost one-third of younger adults (29%) did not see enough work opportunities in their fields of work due to the technological change (Ministry of Economic Affairs and Employment, 2018). In this dissertation's analysis of both care robotization readiness and the intention to use robots, no interaction was found between age and perceived technology unemployment stemming from the use of robots.

Technological unemployment, or the fear of it, affects several working sectors. Robot acceptance at work was found to vary between countries and their technology orientations, but also in time. The greatest decrease in robot acceptance was found in the Slovak Republic and in Finland. These nations are also countries where high-wage job opportunities decreased just before the study, in 2011–2013 (Fernández-Macías, 2015). Robot acceptance at work was also higher in countries with higher information technology exports and a lower risk of job automatization. These findings in Study I imply that robot acceptance is higher in environments where robotization creates and does not replace high-end skilled jobs. In conclusion, perceived work opportunities and the fear of technological unemployment affect robot acceptance, but the mechanism varies between working sectors and along changes in time and circumstances.

Care workers' assessments of robots assisting them in various tasks provide a conclusive view of the possible benefits and risks of care robotization. As Wang and Krumhuber (2018) state, similarly to industrial robots, service robots are meant to add value to humans' lives whether by fulfilling economic needs (i.e., financial profits and productivity) or meeting social needs (i.e., support and companionship).

However, at the same time, care robotization has risks regarding economic and social needs. If robots replace human nurses, this may be perceived as threatening care workers' personal incomes and leading to lower-quality care (Rantanen, Lehto, Vuorinen, & Coco, 2018; Sellman, 2010; Sharkey & Sharkey, 2012). This is especially true if the promise of routine work robotization (Glende et al., 2015) is not what care workers expect from the change.

### 6.1.3 Synthesis in values

The four studies in this dissertation highlighted several findings related to value-based attitudes toward robot acceptance. In this subchapter, the findings are reflected in the values of self-transcendence and the continuum between the values of conservation and openness to change from Schwartz's (1992) theory of basic values. The values of self-transcendence include benevolence and universalism, which both reflect an interest in the welfare of others (i.e., pro-others values). The continuum between conservation and openness includes the values of conformity/tradition, self-direction, stimulation, hedonism, and security, which are considered as pro-self values. The values of openness compete with the values of conservation. For example, emphasizing the conservative values of security and conformity would lead a care worker to choose a regular video call instead of using a telepresence robot because this is an activity that has been used in the organization many times, aligns with the norm, and has highly predictable outcomes (Arieli et al., 2019). This choice would be incompatible with the openness values of self-direction or stimulation, as it would not allow for novelty, a challenge, or "thinking outside the box". Although this individual variation indicates that values are a part of our personality, it should be recalled that values are distinct constructs from motivation and personality traits and that they refer to the principles that the person has, rather than his or her actions or intentions (Maio & Olson, 2000; McAdams, 2006; Mulligan, 1998; Parks-Leduc, Feldman, & Bardi, 2015).

The study of robot acceptance at work among European Union countries and their citizens showed traditional values as playing a part in people's attitudes toward robots. Robot acceptance at work was lower in Mediterranean countries compared with, for example, Northern and Eastern European countries. Of these, the countries that rejected robots the most—Cyprus, Portugal, Malta, Greece, Italy, and Spain—are categorized as traditionally Catholic, Mediterranean countries that embody conservative cultures and quite persistent traditions (Inglehart & Welzel, 2014). Prevalent ideals (e.g., religion over science; family care over professional care) and occupational heritage and appreciation (e.g., handcrafted over factory-made products) are passed on from one generation to the next (Brey et al., 2015; Engelbrekt & Nygren, 2014, p. 32) and may be a reason for lower robot acceptance in Mediterranean countries. The cultural emphasis on traditions may also limit the innovative imagination (Bijker, 1997; Orlikowski & Gash, 1994) and hence prevent wide-range robotization in new sectors of work.

The values of conformity and tradition also emerge in the robotization readiness and repeat robot use intention of Finnish care workers. If the attitudes toward care robots in a work community were perceived as approving, the care workers reported higher robot acceptance. The perceived social norm is closely associated with the ethical standards of nursing (NMC, 2015; Scammell et al., 2017) and how robotization is reflected against those standards. The shared ethical standards of nursing work are mostly linked to the value of universalism, as it is a moral value aimed at understanding, appreciating, and protecting people (Schwartz, 1992)— in this case, patients. However, internalizing a social norm as a personal value is sometimes motivated by conformity and the need to belong, rather than by pro-others values (Kelman, 1961; Sleebos, Ellemers, & De Gilder, 2006). Conforming to existing norms is exceptionally relevant in the case of care work robotization due to the ethical standards of nursing. By disciplinary power, care workers are expected to integrate the ethical standards of nursing into their practices (Holmes, Murray, Perron, & McCabe, 2008). If the nurse has committed to ethical standards on a personal level (Benjamin & Curtis, 1992, p. 6), compliance with the occupational norms is understood as stemming from the self-transcendence pro-others values associated with ethical care work. If, however, the nurse follows the rules only because he or she knows that this is expected of him or her, this compliance stems from conformity and the pro-self motivation to avoid conflict with the peer group. Presumably, depending on the mechanism based on the values of either self-transcendence or conformity, the shared standards and norms influence personal values and the intention to use robots in a different manner (Kelman, 1961).

The idea that the values of universalism, conformity, and tradition stem from the standards of nursing work, which again regulates robot acceptance, is supported by the views collected from national and local decision-makers in Finland. The findings showed that policy and decision-makers think that the care culture is the most significant factor in hindering care work robotization (Pekkarinen et al., forthcoming). For example, care workers' culture-laden hesitance toward autonomous care robots would be interpreted as indicating the values of universalism (ethical care), conformity (social norm), and traditions (a human-centered field of work) together. The pivotal role of ethical dilemmas concerning care robot use is shown in the study where home care personnel felt that robotization carries the risks of inhumane treatment and increased loneliness (Rantanen et al., 2018). At the same time, the promise of social robots decreasing loneliness and increasing the overall psychological wellbeing of older patients (Lane et al., 2016; Marti et al., 2006; Pu et al., 2018) would be very compatible with nursing values.

Also, the value of benevolence plays a part in evaluating a job change in terms of whether the change enhances the welfare of an in-group, such as a care worker community (Schwartz, 1992). It would be benevolent to make an effort to implement robots in the workplace for them to assist in physically demanding tasks, even if those tasks do not concern one personally. It would also be benevolent to reject robotization if robotization would mean unemployment for many but a promotion for oneself. Both values of benevolence and conformity promote collaborative and supportive social relations (Schwartz, 1992). However, benevolence provides an internalized motivational base for a selfless and pro-others behavior, whereas conformity promotes cooperation to fit in and avoid negative outcomes for the self (Schwartz, 1992). Again, benevolence is a self-transcendental value, whereas conformity refers to conservative values as opposed to values of openness.

Openness to change in the context of emerging robotization includes valuing novel challenges and the possibilities of new ways of working. On the other end of the continuum, the conservative values include more critical and guarded views toward changes (e.g., "Why fix what is not broken?"). The mechanism between social norm and robotization readiness may be that both care workers who are open to robotic innovations in the workplace and those who resist the idea of robotization spread their attitudes openly, thus affecting the shared readiness for robotization. Signs exist that low-hierarchy workplaces with high employee autonomy provide a better chance for the staff to openly speak their minds (Detert & Burris, 2016). However, nurses' voices are often marginalized and disempowered in the decision-making processes in the hierarchical environment of healthcare work (Kuokkanen et al., 2007; Matheson & Bobay, 2007; Sellman, 2010), and Finland does not seem to be an exception to this (Kuokkanen & Katajisto, 2003; Kuokkanen & Leino-Kilpi, 2001). Still, Finnish nurses have relatively high autonomy when it comes to practical-level independence and decision-making in the workplace (Peltomaa et al., 2013). The shared feeling of occupational autonomy could manifest as an open-discussion culture, where opinions are freely voiced among colleagues. At the same time, some voices will perhaps be "louder" than others are, as Burkhardt and Brass (1990) claim that change agents and early adopters have a relatively strong role in determining the acceptance of new technologies throughout an organization.

The data used in this dissertation do not specifically provide information on early adopters, but the care worker data make an exception. Care robot experience typically originated from single trials, so the respondents with higher repeat use intention can be considered to be early adopters of care robots. The discovered occupational group differences in robot experience reflect the values of the working culture. Those with managerial status had more robot experience and also more positive views toward care robotization. However, even in traditionally hierarchic care work (Kuokkanen & Katajisto, 2003; Kuokkanen & Leino-Kilpi, 2001; Kuokkanen et al., 2007; Matheson & Bobay, 2007; Sellman, 2010), it is ultimately an issue of organizational values whether to include all staff in experimenting with new technology. It is an unbalanced situation in the organization if the managers are the only group of early adopters who are open to the possibilities that robotization offers. This situation may be an indicator of an unfavorable hierarchy in the workplace. However, it could also indicate that a significant number of unresolved questions exist regarding how the change would change work and its inherent values.

Personal moral values and perceived social norms were considered to be separate factors in the analysis due to the evidence of personal values predicting behavioral intentions independently of social norms (Maio & Olson, 1995, 2000). In some conceptualizations, personal moral values are explained as what individuals think they ought to strive for, and social moral values are what individuals are expected to strive for from society's point of view (Skitka, 2002; Vauclair, 2009). In this dissertation, social influence was found to boost the positive effect that compatible personal values have on the intention to use robots. However, it is plausible that the relationship between personal values and social norms is dynamic. Personal values are often expressed to others, and therefore, they contribute to the social norms, which, in turn, contribute to individuals' personal values and their view of the world. The claim of personal values affecting social norms is grounded on the model where individual robot acceptance is transmitted into wider networks (e.g., professional groups) by the process of diffusion (Ward, 2013). In innovation diffusion theory, technology adoption is considered to be a process where people seek new ways of working, test the systems and methods they have found, re-evaluate them, and like or dislike them (Rogers, 1983).

In the care robotization case, the claim of social norms affecting personal values, then, involves the human-centered work context. It also involves the fact that care work is highly regulated by laws and ethical standards of nursing, which can be deemed no less than a cornerstone for this field of work, the traditions of work, and the working culture. Due to the significant role of occupational norms in nursing work, concerns have been raised about how nurses can hold to their ethical standards if the demands of effectiveness are dominant (Sellman, 2010). Because of this value conflict between ethicalness and effectiveness, care workers may be jointly wary when it comes to emerging robotization. The conflict between cost effectiveness and nursing values has not only been acknowledged but also found to be especially emergent during technological changes in care organizations (Mulligan, 1998; Varcoe et al., 2007). Furthermore, according to Sennett (1998), constant changes, along with the requirements of effectiveness and flexible teams, may even have negative effects on social interaction in the workplace by weakening the trust, loyalty, and communality among employees. Instead of forming a cohesive in-group, people identify with their work and community less because strong personal relationships, shared values, trust, and solidarity are not supported (Sennett, 1998 p. 84; Svensson, 2011).

In line with theoretical and empirical studies (Bardi & Schwartz, 2003; Shoda, 1999), robotization-compatible personal moral values and perceived positive social norms toward robots interacted with each other, thus predicting a greater intention to use care robots. The perceived social norm of using robots is understood to amplify the association between robot use's compatibility with personal values and the repeat intention to use robots (see also Figure 9). The effect can also be viewed as personal moral values and social norms working dynamically, influencing one another. In cohesive social groups, such as nurses, social norms have been found to have a greater influence on personal values (Collin-Jacques & Smith, 2005; Granovetter, 1985; Haslam et al., 2011; Rutten & Boekema, 2007). Thus, the finding in this dissertation speaks volumes for the need to consider occupational norms in the discussions of new technology implementations (see Ward, 2013).

Proceeding to the values of self-direction and stimulation, we return to the pro-self values included in the values of openness to change. The self-direction values refer to the autonomy and independence of thoughts, feelings, and actions, whereas stimulation values refer to the goals of excitement, novelty, and challenge in life (Schwartz, 1992). Self-direction and stimulation values link to self-efficacy, which was found to be the most significant explanatory construct behind robotization readiness. Self-efficacy can also be seen as underlying the intention to use robots through performance expectancy (perceived usefulness) and effort expectancy (perceived ease of use), as Heerink et al. (2010) state, in line with Ajzen (2002) and Bandura (1997). Finnish care workers are highly confident in their ability to use robots in their work, so in theory, this gives them good opportunities to remain independent (self-direction) and motivated (stimulation) in a robotized environment. Self-direction and stimulation values are intertwined because stimulation values are theorized to arise from self-direction values (Schwartz, 1992). Perceiving robot use as a positive challenge would then emerge from a choice to make such a judgment.

Modeling the relationship between personal moral values and the intention to use care robots, we controlled the respondents' beliefs about technological unemployment resulting from robotization. The fear of robots taking people's jobs did indeed have a major role in personal values' compatibility with care robot use. The conclusion is that in addition to standards of ethical care work, more instrumental values, such as a secure career and earning a living (Christensen, 2000; Toode, Routasalo, Helminen, & Suominen, 2015), affect how people are willing to see robots as part of their work. According to functional attitude theory, the motivation to keep one's job may underlie an attitude against robotization (Katz, 1960). The security of one's career, employment, and earning a living also reflect Schwartz's (1992) security values, which are aimed at the safety and stability of the self. Therefore, the care workers' hesitance, for example, toward autonomous robots would not only stem from the values of universalism, conformity, and traditionalism but also from the value of security. Sometimes the value of security is not restricted to the safety and stability of the self; rather, it is extended to cover an in-group as well (Schwartz, 1992). Especially in our case, where technological unemployment is referred to as "robots stealing people's jobs," we would be considering wider group interests instead of, say, the hedonistic value of maintaining a personal living standard.

Hedonistic values—the goals of pleasure and enjoyment—did stand out in Study IV. In this study, personal moral values emerged as an interesting factor in care robot acceptance, but the perceived enjoyment of the robot use directly explained the intention to use care robots again in the future. In the questionnaire, enjoyment was operationalized as pleasantness of the use experience, showing that there is also an undeniable hedonistic side to care robot acceptance. Robots also form a distinct study object because emotions, such as the enjoyment of the use, do not typically predict the intention to use computers (de Graaf, Ben Allouch, & van Dijk, 2019; Heerink et al., 2010; Teo & Noyes, 2011). Moreover, the major role of hedonistic values in the intention to use care robots implies that the Schwartzian values of openness may truly have a more significant role in robot acceptance compared with the values of self-trascendence. The early adopters of care robots valued the pleasantness of the robot above anything else. Thus, care workers are ultimately willing to use robots if they find the use to bring an enjoyable change to their own work.

Some of the results, such as the enjoyability of robot use, can be explained by the maturity of technology. Ward (2013), for example, concludes that the human and organizational factors are commonly valued secondarily to the technology in implementation projects. If the robots introduced to care work are considered to be trivial, almost toy-like but also a fun change to the workday, it is understandable that—more than trust and personal moral values—the acceptance is about the enjoyment of the robot use.

### 6.1.4 Contradictions and dissonance in care robotization

Supporting Varcoe et al. (2004), the results in this dissertation imply that although anticipating a technological change, care workers keep a keen eye on how the change will affect the practice as a moral context. A part of the social normativity in robot acceptance comprises social moral values, which can originate from the general standards of implementing new technology (Friedman & Kahn, 2007; Schot & Rip, 1997) and from more context-dependent norms—in this case, ethical standards of nursing work (NMC, 2015; Scammell et al., 2017). Conforming to occupational norms to belong can also be viewed as a building block for moral identity, which is a subcategory for occupational identity and refers to expectations directed to a profession group (Turner, Hogg, Oakes, & Wetherell, 1987).

Moral identity makes professionals express themselves in a way that reflects high morals and humanitarian values, allowing then to receive appreciation and respect from the occupational group committed to such ethical standards. Moral identity also includes the thought of making a difference, so it is a somewhat parallel concept to a sense of a calling and fulfilling personal values at work (Bakibinga et al., 2012; Pask, 2013; Vinje & Mittelmark, 2007). Moral identity is especially associated with professionals, such as care workers, who are distinguished by ethically charged core expertise and decision-making, and who are confronted with occupational moral dilemmas in their work (Jonge, 2014). Jonge (2014) even claims that it is first and foremost moral identity that determines what belongs or does not belong to the occupation in terms of tasks, roles, expertise, and practices.

Speaking of personal moral values or moral identity, the conflict between personal values and the opportunities or constraints of the (social) environment can be a major cause of stress (Leiter & Maslach, 2000). The contradiction in mandatory robot use when one feels it is unacceptable can be a cause of cognitive and innovative dissonance (Festinger, 1957; Rogers and Shoemaker, 1971; Vallerand, 1997). This kind of a conflict or dissonance is also mentioned in the person-organization fit model, where a significant predictor of employees' poor motivation is when their personal values are not compatible with the organization's values (Chatman, 1989).

Even when the person and organization generally fit together in terms of values and principles, situations may still emerge where an employee is forced to act against his or her personal values, or against an occupational norm. When repeated, these ethical dilemmas can accumulate into the psychological stress of ethical strain (Huhtala, Feldt, Lämsä, Mauno, & Kinnunen, 2011). Does the personal-organizational compatibility mean that, after robotization, only people with no particular calling for human-centered care work would work as nurses? Or could ethical standards of nursing be preserved even in robotization? In compliance with Simons (1995), it comes down to what the purpose of nursing work is considered. The standards of today are written by experts, so they can surely be rewritten or updated by experts. Is it possible to reconsider the ethical norm of empathetic care and agree that the purpose of nursing work is realized if the patient is met with either empathy or simulated empathy? Goals and core purposes form a value system, such as occupational standards, but only when they are shared and accepted by the people involved (Simons, 1995).

Protecting a positive occupational identity and the shared values of care work are two of the most important concerns in care robotization. It is likely that care workers are not going to be replaced by robots anytime soon. The issue may then be more about changes in the job than losing the job. For many nurses, the most defining, identifying, and motivating aspect in their profession is achieving a successful and empathetic interaction with the patients (Beedholm et al., 2015; Bishop & Scudder, 1991; Bjellegaard et al., 2017; Hirvonen, 2015). Because this is a common understanding, it may be called a shared value. The patient work collectively defines the value of care work.

The correlation between personal moral values and social norms in robot acceptance may also be a sign of a shared social identity (Haslam et al., 2011). Cohesion among care workers may be structured partly on the occupational standards, but research has also found that nurses have especially strong identities as professionals (Collin-Jacques & Smith, 2005; O'Keeffe et al., 2015). Emotional labor, whereby workers express different emotions than they truly feel, is usually connected to occupational norms and the requirements coming from an upper hierarchy (Hochschild, 1983; McQueen, 2004). However, a reason for nurses to show effort in rendering kindness and empathy toward a customer can also originate from a strong occupational identity, which motivates nurses to make a self-conscious effort to behave how they feel they should as professionals (Lopez, 2006). Overall, from the combination of care workers' shared values, cohesiveness as a group of professionals, and strong occupational identity, it is not surprising that social norms in robot acceptance significantly influence the perceived compatibility between personal values and care work robotization.

Emotional labor can cause either emotional dissonance, particularly if the inner conflict challenges one's identity (Grandey, 2000), or cognitive dissonance, if it makes one question one's fitness for the job in the first place. Facing an emotional or cognitive contradiction between their behaviors and their feelings, values, or attitudes, people mentally seek a stable state with a minimal amount of cognitive dissonance (Festinger, 1957; McGrath, 2017). They do this by changing either their thoughts or actions. Our findings may support the theory of people's need to relieve cognitive dissonance by adjusting their attitudes to support the current situation and thus come to terms with it (Elliot & Devine, 2009). The majority of the respondents in the care worker data felt that using robots in their work would conflict with their principal ideas of care (Van Aerschot et al., 2017). However, the opposite distribution was found when examining those respondents who had firsthand experience with care robots (Study IV). The majority of care workers who had experience with robots reported that using care robots would be compatible with their personal values and view of the world.

Before additional studies, there is no way of knowing if this found difference is a case of having positive experiences with robots or of relieving dissonance in order to cope with a technological change. We know that any prior experiences generally correlate with more positive attitudes toward robots (Heerink, Kröse, Evers, & Wielinga, 2010; Katz & Halpern, 2014; Louie, McColl, & Nejat, 2014; Nomura, Kanda, & Suzuki, 2006), and the argument can be extended to the relation between experiences and personal values, since attitudes and personal values are parallel concepts in personality psychology as well as in the theory of cognitive dissonance (Festinger, 1957; McAdams, 2006). Nevertheless, it would be interesting to study how prior robot experience predicts robot acceptance, both separate from and together with the possible care robot paradox and its changes in time (e.g., the effect of relieving dissonance). In other words, investigate the role cognitive dissonance plays in the relation between cumulating experience and robot acceptance.

## 6.2 Ethical deliberation and limitations of the study

In this thesis, I have strived to maintain objectivity and a balanced understanding of robots and robotization. The ethical deliberation and limitations of the study concern mostly the care worker data I collected myself: the objective, the quality of the sample, and the development of the questionnaire.

As the utilitarian approach of studying robotization in care work sought to give healthcare professionals a voice in matters of technological change, my aim was to gain knowledge on whether care professionals would want to have robotic assistance and under what conditions. A utilitarian approach refers to the objective of maximizing positive outcomes for most people. If robots were to renew care work to be more pleasant and less burdensome, I would imagine mutual benefits among all stakeholders—employees, employers, care receivers, and product developers—and for different measures of well-being, namely, physical, psychological, social, and economic well-being.

Even if technological advances in society would be generally welcomed, it is sensible to accept that robots are not suited for assistance in every type of work in a wide range of care tasks (Vallor, 2011). I found it important to examine this by receiving input from healthcare professionals of different positions. Giving voice to a group of professionals can be perceived as a value-laden objective, so it was essential to draw both worker-level and manager-level trade union members into the sample. This brings us to the virtue ethics of research. However value-laden the objective, it was intuitively clear that the final research would retain its impartiality, with the researcher remaining unbiased and open to the results arising from the data. Impartiality is especially associated with quantitative research, which avoids bias and pursues objectivity (Barsky, 2010). I would not necessarily make such a division (qualitative/quantitative), but I can agree that impartiality is usually easier to maintain when dealing with interpretations based on statistics. However, designing a survey, one has also to acknowledge how bias can arise in inexpediently value-laden questions. In addition, quantitative researchers prefer not to be aligned with any group or community (Danaher, Danaher, & Moriarty, 2003), and to be clear, choosing to hear the care workers' views does not mean I have acted or will act as their spokesperson.

The possibility of politically biased data lies in the sample that is collected from members of trade unions. However, in this case, a high proportion (90%) of Finnish nurses are unionized (Kilpeläinen, 2010; Tehy, 2017), which speaks in favor of the data being balanced and representative. Taking away from the representativeness of the data is the 10% response rate and the fact that the results may have been affected by non-response bias. The trade unions' online surveys of their members usually reach a response rate of 30%. The robot theme was perhaps perceived as less approachable than a general union member survey would be. It is also possible that nurses who did not respond were busier or more reluctant to fill out an online questionnaire than those who did. The lower response rate affects validity because it brings up a question of whether the respondents represent the care worker population or whether, for example, technology enthusiasts are overrepresented in the data. The demographic distribution of the sample, however, was proportional to the population of Finnish care workers, and the large sample furthermore covered about 5% of this population (Ailasmaa, 2014).

In addition to virtue ethics of research, a more practical, principle-based ethical issue is the anonymity of the respondents in the care worker data. Following the ethical guidelines of Kuula (2006, p. 102), the invitation to the study included information about the study objectives, sample selection, data protection, and anonymity of the respondents. After reading the invitation received via email, the respondents decided whether to participate in the survey (i.e., click the link to the questionnaire). Personal information, such as the respondents' names or even places of work, was not gathered. In theory, the raw data could reveal an individual in the case of an extremely rare occupation or official title, but in a correlative study design, information from single respondents is not reported or published in any form.

The choice of terminology used in a study is an ethical issue, and in this case of care work robotization, the importance of using proper occupational lingo on the questionnaire became evident. The items on the questionnaire were developed along the way using feedback from researchers across different disciplines as well as from representatives of the trade unions with whom we organized the data collection. After this internal development work, we piloted the questionnaire first in a focus group discussion with five care professionals and later by an online version sent to 13 care workers. The main goal of the focus group discussion was to test the face validity of the questionnaire. Many wordings were changed into forms that were more appropriate or professional, but the examples are not translatable here. By conducting the test round for the online questionnaire, we tested the technical functionality of both the variables and the online platform.

New technology is being introduced to care gradually, and most care workers do not have any firsthand experience with care robots. To some of the respondents, the questionnaire may even have been the first source of information specifically about care robots. Thus, the questionnaire not only collected information but also distributed it, and this is where another ethical responsibility lies. In addition to defining robots in writing, I presented illustrations of four types of robots that have been developed to assist in care work—namely, telepresence, therapy animal, entertaining/activating humanoid, and patient-lifting robots. Thorough definitions with pictures on the questionnaire also served as a way of minimizing the variance in the mental representations of robots (Demers, 2014; Eurobarometer, 2014).

Operationalizing attitudinal robotization readiness somewhat covertly, by scenarios, was rationalized in Chapter 4.2. The evaluations of the scenarios undoubtedly reflect the mental representations of robots, their thought attributes, and their skill levels. For example, for the question about how comfortable the respondent would feel if a robot assisted him or her in moving a patient, we have to consider if the response hinges on accepting such robotic assistance or merely on the credibility of the given scenario. One of the reasons for using scenarios and not direct questions about the respondents' readiness for robotization was the desire to minimize the lure of answering strategically for or against robotization. In fact, this is a wider validity challenge shared by any self-report methods. In the MCM, the attitude is also viewed as depending on metacognitions (Petty et al., 2007). The developers of the MCM did not extend the model to the concept of response bias, but I consider it a valid way of evaluating this issue.

In the survey, we do not measure robotization readiness per se but rather what the respondents want to tell us about their robotization readiness. We have few tools to control the response bias, that is, responses that are given with a hidden agenda, such as "I generally think robots are useless in care, but I choose to give a response opposite to what I believe," or "All my past experiences with care robots has been positive, but in this situation, it is in my best interest to report not approving their implementation." Although difficult to control, there have been efforts to minimize some attitudinal strategies in this thesis; for example, we used the fear of technological unemployment or interest in technology as control variables in the adjusted models.

The survey data may also suffer from a common method bias (Cote & Buckley, 1987; Podsakoff, 2003), which manifests in overestimated reliability statistics and correlations between the dependent and independent variables. An example of common method bias is when a respondent has a habit of answering questionnaires in an optimistic manner, using only one end of the scale. This brings us to the possibility of mood-biased evaluation. In measuring robotization readiness, our aim was to gather information about the respondents' evaluative attitude on how comfortable they would feel if certain care tasks were robotized. Although we measured the "comfortability of an idea" instead of comfort as a situational, nonreflective feeling, we cannot rule out the possibility that part of the variance in robotization readiness stems from the mood of the respondent while completing the survey (see Heide & Gronhaug, 1991).

Regarding the aim of identifying social, psychological, sociodemographic, and contextual determinants of robot acceptance, values emerged as an important factor, quite unexpectedly. Thus, the findings leave much room for future research about the different categories and qualities of values behind robot acceptance, among them openness to change, occupational calling, and identity. The follow-up study will deepen the knowledge of the relations between different values. The focus will be on virtue ethics and instrumental values. Fear of technological unemployment weighs upon robot acceptance, yet it must be examined if the reasons for that relation include, not only instrumental values, but also other values tied to work. One specific regret is the decision to exclude religion from the background information questions. It would have been an interesting control variable, especially in our case of an unbalanced gender distribution in the population and sample of care workers (Marini et al., 1996). These shortages will be taken into account in the second wave of the care worker survey, which will be gathered and analyzed in a longitudinal study design in 2020. In this stage, follow-up studies are appealing because of the need to concentrate on details of one restricted research problem. The most fruitful research stems from a study design whereby a lot is said about a little instead of a little about a lot (David Silverman, 2008, p. 107). This principle had to be overlooked in the care worker data design because of our objectives of unfurling a novel field of research and finding premises for codesigning robotization already in a contemplative and uncertain stage of change.

To study values is to study motives, and the results in this thesis would benefit from qualitative research to gain more profound knowledge about the motive-based values in both robotization readiness and intention to use robots. De Oca and Nistor (2014) study technology acceptance by sociocognitive scripts. Our results imply that care robot acceptance includes an additional value-based, hence affective, script associated with the user's intention to use robots. If we view intention to use through the scripting lens of de Oca and Nistor (2014), the nurse is weighing the benefits and disadvantages of using care robots. In terms of the variables mentioned in the RAM-care (Study IV), the script could be "There are benefits to using the robot, and if it is compatible with personal and collective values, then I intend to use the robot." Following the study of de Oca and Nistor (2014), a semi-structured interview would help to categorize and deepen the information about the quality of the principles behind robot acceptance. Occupational norms have been emphasized in discussion of new technology implementations before (Ward, 2013), and in our case of Finnish care workers, I would hypothesize that the hesitation to deem personal values compatible with care robot use originates significantly from the ethical standards of care work.

Our two forthcoming studies of exoskeleton-mediated interaction in care work and pharmaceutical robotization will combine quantitative and qualitative methods. The exoskeleton study will experiment on the acceptance of a robotic, cyborg and human touch. The results will be examined against the ethics of human-centered nursing work. As for robotization in pharmacies, our preliminary statistical results imply that occupational identity plays an important part in robotization readiness. Qualitative data will further analyze and complement these results. Furthermore, we will examine the occupational identity and psychological basic needs in our research of service work robotization as it concerns the working population of Finland.

## 6.3 Conclusions

This thesis provided information about experiences and views related to service and care robots as assistants at work. It evidenced that robot acceptance includes several psychosocial factors, from the cultural and occupational context to individual differences—for example, self-efficacy and personal values. Based on the results, to promote robotization readiness among care workers, organizations could benefit from supporting the employees' self-efficacy and planning the change so that it is compatible with occupational and other social norms. Moreover, the staff should be involved in robotization and reorganizing work early on by giving opportunities to evaluate which tasks would be suited for robots and which should preferably remain in human hands. Robot trials in the workplace should cover employees at different levels and not be limited to, say, head nurses and other managers. Robot experience gained in one situation is strongly associated with robot acceptance in other situations. That said, perceived social norms relate to both robotization readiness and repeat intention to use robots regardless of prior robot experience. That makes social norms perhaps the most consistent explanatory factor related to robot acceptance.

Many aspects of acceptance support including care workers in planning and implementing technological change in the workplace. Care workers are confident in their ability to learn and use new technology, and in some part, they find that robots could renew care work in a positive direction. However, robotization also raises doubts and is not always perceived as compatible with personal moral values. Codesigning robotization with both change agents and change critics becomes an even more important starting point when personal values and social norms underlie robot acceptance. Evaluations of new technology should then involve not only assessments of usability but also a more principled point of view, addressing the core meaningfulness of the potential technology use. The codesign process should allow promotion or criticism of the technology use on personal, social, and value-based grounds. This means that involving the staff in the contemplative stage of robotization is not merely a way to ensure that everyone is on board with the change.

In this sense, the conclusion here does not restate an understanding of where technological change is most achievable by positive change readiness mutually shared among the staff (Rafferty et al., 2013; Weiner, 2009). Instead, in Figure 11 it is suggested how the issues of principle and practicality regarding emerging change should be brought to co-operation negotiations between employees and an employer already at the contemplative stage of robotization. By the measurement of personal and shared values in robot acceptance, the possible principles behind accepting robots in specific fields of work are taken into consideration—this being the first step in ensuring that technological changes are not perceived as too abrupt or even inappropriate.

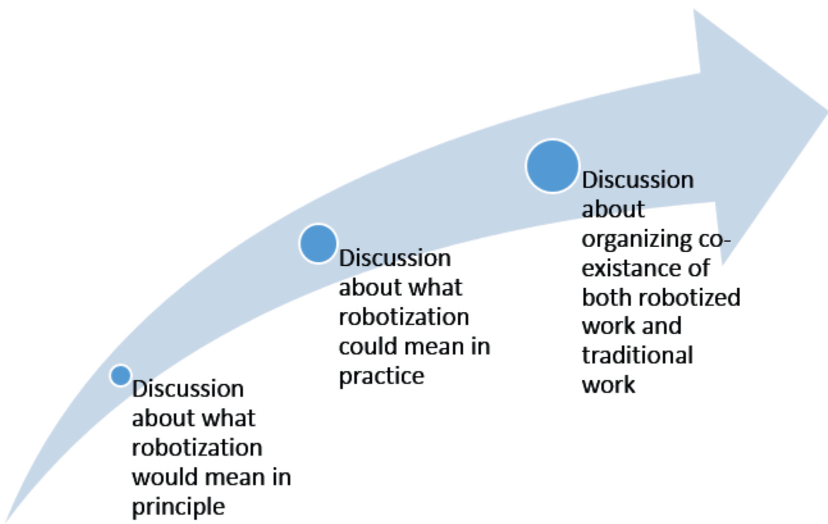


Figure 11. Suggested cooperation negotiations during the contemplative stage of robotization

Care workers have excellent means to act as gatekeepers in care robotization and to educate developers and decision-makers on its risks and expectations, such as which tasks are suitable and unsuitable to be robotized. The views of care workers are especially relevant because they represent a group of professionals committed to ethical occupational norms and particularly to the well-being of patients and customers. Thus, their preferences are to be considered as heavily guided by universal values of understanding and protecting people, as well as values of benevolence, aiming to retain a pleasant and secure working environment. In addition, to exclude practical and registered nurses from organizational decision-making and decrease their autonomy in choosing their own working methods is a way of disregarding potential change agents that endangers the whole staff's commitment to robot adoption.

The ideal is that organizations would actually embrace the variance in robot acceptance. Could the robotization be built on pure volunteerism then, where all employees have an honest opportunity to choose the degrees to which they will work with new technology? Volunteerism would support the idea of job crafting and self-direction values by adding to employees' autonomy and allowing them to modify their jobs as they feel comfortable. We know that people vary in their motivations to use technology, and this discrepancy is partly due to different experiences with technology and different personalities. Organizations should acknowledge individual differences among their staff and identify the individuals with a special drive to use robots, letting them step forward as the change agents of robotization.

Diversity in working methods, robotized and non-robotized, should enrich a workplace similarly to the way in which organizations today benefit from variations in demographic and personality profiles among staff (Bamel, Paul, & Bamel, 2018). It would also open the opportunity for patients and customers to choose between robotized and more traditional care. In the context of care work, robots are still considered complementary, so nurses declining to use care robots are not standing in the way of medical developments, which would be the case if they refused to use a heart machine in a hospital or blood pressure monitor in home care. Under the ethos of volunteerism, some employees would decline to use care robots altogether, while others would volunteer to specialize in utilizing new technology. While we claim here that both of these groups of professionals would be important for the codesigning process of robotization, we must acknowledge the challenges that may come from differentiation of technology users and non-users (Hård, 1993; Taipale, 2016).

This doctoral dissertation in social psychology has produced insight into how people perceive assistive robots at the onset of service field robotization, as well as into how robot acceptance depends on social, personal, and principled factors. Personal and shared values emerged as an important frame among the variety of hypothesized explanatory factors. This frame was mostly found in the care work context, wherein it constitutes both a personal practice orientation, instrumental values and collective ethical norms for the work. In the contemplative stage of robotization, Finnish care workers are not as worried about their abilities to use new technology as about the core principles of using robots in varying tasks of care work. In unique ways, each of the four studies led to the conclusion that robot acceptance at work is associated with value-based considerations.

# REFERENCES


Acemoglu, D. (1999). Changes in unemployment and wage inequality: An alternative theory and some evidence. *American Economic Review*, *89*(5), 1259–1278.

Acemoglu, D. (2002). Technical change, inequality, and the labor market. *Journal of Economic Literature, 40*(1), 7–72.

Ailasmaa, R. (2014). *Health care and social welfare personnel 2013*. National Institute for Health and Welfare. Retrieved from https://www.thl.fi/fi/tilastot/tilastot-aiheittain/sosiaali-ja-terveydenhuollon-henkilosto

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*(4), 665–683.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.

Alaiad, A., & Zhou, L. N. (2014). The determinants of home healthcare robots adoption: An empirical investigation. *International Journal of Medical Informatics*, *83*(11), 825–840. doi:10.1016/j.ijmedinf.2014.07.003

Allport, G. W. (1935). Attitudes. In C. Murchison (Ed.), *Handbook of social psychology* (pp. 798–844). Worcester, MA: Clark University Press.

Allport, G. W. (1961). *Pattern and growth in personality*. New York, NY: Holt, Rinehart & Winston.

Anthony, C., & Tripsas, M. (2016). Organizational identity and innovation. B. Ashforth, M. Pratt, D. Ravasi, M. Schultz (Eds.), *The Oxford handbook of organizational identity* (pp. 417–435). Oxford: Oxford University Press.

Arieli, S., Sagiv, L., & Roccas, S. (2019). Values at work: The impact of personal values in organisations. *Applied Psychology*, doi:10.1111/apps.12181.

Armenakis, A. A., & Harris, S. G. (2002). Crafting a change message to create transformational readiness. *Journal of Organizational Change Management*, *15*, 169–183.

Armenakis, A. A., Harris, S. G., & Mossholder, K. W. (1993). Creating readiness for organizational change. *Human Relations*, *46*(6), 681–703.

Arntz, M., Gregory, T., & Zierahn, U. (2016). *The risk of automation for jobs in OECD countries: A comparative analysis*. OECD Social, Employment and Migration Working Paper No. 189. Paris, France: OECD.

Ausserhofer, D., Zander, B., Busse, R., Schubert, M., De Geest, S., Rafferty, A. M., . . . Sjetne, I. S. (2014). Prevalence, patterns and predictors of nursing care left undone in European hospitals: Results from the multicountry cross-sectional RN4CAST study. *BMJ Quality and Safety*, *23*(2), 126–135. doi:10.1136/bmjqs-2013-002318

Autor, D. H. (2014, September). Polanyi's paradox and the shape of employment growth (NBER Working Paper No. 20485). Retrieved from http://www.nber.org/papers/w20485

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics*, *118*(4), 1279–1333.

Avey, J. B., Wernsing, T. S., & Luthans, F. (2008). Can positive employees help positive organizational change? Impact of psychological capital and emotions on relevant attitudes and behaviors. *Journal of Applied Behavioral Science*, *44*(1), 48–70.

Azimova, A., Abdraimova, A., Orozalieva, G., Muratlieva, E., Heller, O., Loutan, L., & Beran, D. (2016). Professional medical associations in low-income and middle-income countries. *Lancet Global Health*, *4*(9), e606–e607.

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems, 4*(3), 244–254.

Bakibinga, P., Vinje, H. F., & Mittelmark, M. (2012). Factors contributing to job engagement in Ugandan nurses and midwives. *ISRN Public Health*, article 372573. doi:10.5402/2012/372573

Bakker, A. B. (2015). A job demands-resources approach to public service motivation. *Public Administration Review*, *75*, 723–732.

Ball, J., Murrells, T., Rafferty, A. M., Morrow, E., & Griffiths P. (2014). "Care left undone" during nursing shifts: Associations with workload and perceived quality of care. *BMJ Quality & Safety*, *23*, 116–125. doi:10.1136/bmjqs-2012-001767

Ballermann, M. A., Shaw, N. T., Mayers, D. C., Gibney, N., & Westbrook, J. (2011). Validation of the work observation method by activity timing (WOMBAT) method of conducting time-motion observations in critical care settings: An observational study. *BMC Medical Informatics & Decision Making*, *11*(32), 1–12. doi:10.1186/1472-6947-11-32

Bamel, U. K., Paul, H., & Bamel, N. (2018). Managing workplace diversity through organizational climate. In T. P. S. Singh & A. J. Kulkarni (Eds.), *Flexibility in Resource Management* (pp. 87–97). Singapore: Springer.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*, 191–215.

Bandura, A. (1984). Recycling misconceptions of perceived self-efficacy. *Cognitive Therapy and Research, 8,* 231–255.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. New Jersey: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bandura, A. (2006). Guide for creating self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307–337). Greenwich Connecticut: Information Age Publishing.

Bandura, A. (2009). Social cognitive theory of mass communication. In J. Bryant & M. B. Oliver (Eds.), *Media effects: Advances in theory and research* (pp. 94–124). New York, NY: Routledge.

Bandura, A., Caprara, G. V., Barbaranelli, C., Gerbino, M., & Pastorelli, C. (2003). Role of affective self-regulatory efficacy in diverse spheres of psychosocial functioning. *Child Development*, *74*(3), 769–782.

Banks, J., & Bowman, N. D. (2016). Avatars are (sometimes) people too: Linguistic indicators of parasocial and social ties in player–avatar relationships. *New Media & Society*, *18*(7), 1257–1276. doi:10.1177/1461444814554898

Bardi, A., & Schwartz, S. H. (2003). Values and behavior: Strength and structure of relations. *Personality and Social Psychology Bulletin*, *29*, 1207–1220.

Baron, R. A., & Ensley, M. D. (2006). Opportunity recognition as the detection of meaningful patterns: Evidence from comparisons of novice and experienced entrepreneurs. *Management Science*, *52*, 1331–1344.

Barry, A. (2001). *Political machines: Governing a technological society*. London, UK: Athlone Press.

Barsky, A. E. (2010). The virtuous social work researcher. *Journal of Social Work Values and Ethics*, *7*(1), 1–10.

Beedholm, K., Frederiksen, K., Frederiksen, A. M. S., & Lomborg, K. (2015). Attitudes to a robot bathtub in Danish elder care: A hermeneutic interview study. *Nursing & Health Sciences*, *17*(3), 280–286. doi:10.1111/nhs.12184

Benjamin, M., & Curtis, J. (1992). *Ethics in nursing* (3rd ed.). New York, NY: Oxford University Press.

Bensing, J. M., Tromp, F., van Dulmen, S., van den Brink-Muinen, A., Verheul, W., & Schellevis, F. G. (2006). Shifts in doctor-patient communication between 1986 and 2002: A study of videotaped general practice consultations with hypertension patients. *BMC Family Practice*, *7*(1), 62.

Berger, P. L., & Luckman, T. (1966). *The social construction of reality. A treatise in the sociology of knowledge*. New York, NY: Anchor Books.

Berner, A. (2015). Liikenne- ja viestintäministeri Anne Bernerin vastaus kirjalliseen kysymykseen robotti- ja automaatiostrategiasta eduskunnassa 2015 (KKV 332/2015 vp). Retrieved from https://www.eduskunta.fi/FI/vaski/Kysymys/Documents/KKV_332+2015.pdf

Bickmore, T. W., Caruso, L., & Clough-Gorr, K. (2005). Acceptance and usability of a relational agent interface by urban older adults. In W. Kellogg, S. Zhai, G. van der Veer, & C. Gale (Eds.), *Proceedings from ACM SIGCHI Conference on Human Factors in Computing Systems* (pp. 1212-1215). Portland, OR. New York, NY: ACM Publications.

Bijker, W. E. (1997). *Of bicycles, Bakelites, and bulbs: Toward a theory of sociotechnical change*. Cambridge, MA: MIT Press.

Bishop, A. H., & Scudder, J. R. (1991). *Nursing: The practice of caring*. New York, NY: National League for Nursing Press.

Bjellegaard, K., Haslam, S. A., Mewse, A., & Morton, T. (2017). The shared experience of caring: a study of care-workers' motivations and identifications at work. Ageing & Society, 37(1), 113-138. doi:10.1017/S0144686X15000860

Bordia, P., Hobman, E., Jones, E., Gallois, C., & Callan, V. J. (2004). Uncertainty during organizational change: Types, consequences, and management strategies. *Journal of Business and Psychology*, *18*(4), 507–532.

Bouckenooghe, D., Devos, G., & Van den Broeck, H. (2009). Organizational change questionnaire—Climate of change, processes, and readiness: Development of a new instrument. *Journal of Psychology*, *143*(6), 559–599.

Bouskill, K. E., Chonde, S., & Welser IV, W. (2018). Speed and Security. https://www.rand.org/content/dam/rand/pubs/perspectives/PE200/PE274/RAND_PE274.pdf.

Brey, P., Reijers, W., Rangi, S., Toljan, D., Romare, J., & Collste, G. (2015). International differences in ethical standards and in the interpretation of legal frameworks. Retrieved from http://satoriproject.eu/media/D3.2-Int-differences-in-ethical-standards.pdf

Broadbent, E., Kuo, I. H., Lee, Y. I., Rabindran, J., Kerse, N., Stafford, R., & MacDonald, B. A. (2010). Attitudes and reactions to a healthcare robot. *Telemedicine and e-Health*, *16*(5), 608–613.

Broekens, J., Heerink, M., & Rosendal, H. (2009). Assistive social robots in elderly care: A review. Gerontechnology , 8, 94–103. doi:10.4017/gt.2009.08.02.002.00.

Brown, S. A., & Venkatesh, V. (2005). Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle. *Management Information Systems Quarterly*, *29*, 399–426.

Bruckenberger, U., Weiss, A., Mirnig, N., Strasser, E., Stadler, S., & Tscheligi, M. (2013, October). The good, the bad, the weird: Audience evaluation of a "real" robot in relation to science fiction and mass media. In *International Conference on Social Robotics* (pp. 301-310). Cham, Switzerland: Springer.

Brynjolfsson, E., & McAfee, A. (2011). *Race against the machines: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy*. Lexington, MA: Digital Frontier Press.

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York, NY: Norton.

Burkhardt, M. E., & Brass, D. J. (1990). Changing patterns or patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, *35*, 104–127.

Čaić, M., Mahr, D., & Odekerken-Schröder, G.(2019). Value of social robots in services: Social cognition perspective, *Journal of Services Marketing*, *33*(2).

Carson, K. D., & Bedeian, A. G. (1994). Career commitment: Construction of a measure and examination of its psychometric properties. *Journal of Vocational Behavior*, *44*(3), 237–262.

Cavallaro, F. I., Facal, D., Pigini, L., Mast, M., & Blasi, L. (2011). Deliverable D1. 1 Detailed user requirements, environment definition, general guidelines on ethical concerns and SRS scenario report. Retrieved from http://srs-project.eu/sites/default/files/SRS%20247772%20DELIVERABLE%20 1.1.pdf

Cesta C., Cortellessa, G., Orlandini, A., & Tiberio, L. (2016). Long-term evaluation of a telepresence robot for the elderly: Methodology and ecological case study. *International Journal of Social Robotics*, *8*(3), 421–441.

Chau, P. Y., & Hu, P. J. H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: An empirical test of competing theories. *Information & Management*, *39*(4), 297–311. doi:10.1016/S0378-7206(01)00098-2

Chen, C. C., Wu, J., & Crandall, R. E. (2007). Obstacles to the adoption of radio frequency identification technology in the emergency rooms of hospitals. *International Journal of Electronic Healthcare*, *3*, 193–207

Chen, N. H., & Huang, C. T. (2016). Domestic technology adoption: Comparison of innovation adoption models and moderators. *Human Factors and Ergonomics in Manufacturing*, *26*, 177–190.

Christensen, C. (2000). *The innovator's dilemma*. Cambridge, MA: Harvard Business School Press.

Clark, M., & Dudrick, D. (2007). Nietzsche and moral objectivity: the development of Nietzsche's metaethics. In B. Leiter & N. Sinhababu (Eds.), *Nietzsche and Morality* (pp. 192—226). Oxford University Press.

Collin-Jacques, C., & Smith, C. (2005). Nursing on the line: Experiences from England and Quebec (Canada). *Human Relations*, *58*(1), 5–32.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *Management Information Systems Quarterly*, *19*(2), 189–211.

Coradeschi, S., Kristoffersson, A., Loutfi, A., Von Rump, S., Cesta, A., Cortellessa, G., & Gonzalez, J. (2011). Towards a methodology for longitudinal evaluation of social robotic telepresence for elderly. In *Proceedings of the HRI 2011 Workshop on Social Robotic Telepresence* (pp. 1–7).

Cote, J. A., & Buckley, M. R. (1987). Estimating trait, method and error variance: Generalizing across 70 construct validation studies. *Journal of Marketing Research*, *26*, 315–318.

Coutinho, S. A., & Neuman, G. (2008). A model of metacognition, achievement goal orientation, learning style and self-efficacy. *Learning Environments Research*, *11*(2), 131–151.

Crocker, J., Niiya, Y., & Mischkowski, D. (2008). Why does writing about important values reduce defensiveness? Self-affirmation and the role of positive other-directed feelings. *Psychological Science*, *19*, 740–747.

Cunningham, C. E., Woodward, C. A., Shannon, H. S., MacIntosh, J., Lendrum, B., Rosenbloom, D., & Brown, J. (2002). Readiness for organizational change: A longitudinal study of workplace, psychological and behavioural correlates. *Journal of Occupational and Organizational Psychology*, *75*, 377–392.

Curtis, E., & White, P. (2002). Resistance to change: Causes and solutions. *Nursing Management*, *8*(10), 15.

Damiano, L., Dumouchel, P., & Lehmann, H. (2014). Towards human–robot affective co-evolution overcoming oppositions in constructing emotions and empathy. *International Journal of Social Robotics*, *7*, 7–18. doi:10.1007/s12369-014-0258-7

Danaher, P. A., Danaher, G., & Moriarty, B. (2003). Risks and dilemmas, virtues and vices: Engaging with stakeholders and gatekeepers in Australian traveller education research. In *Proceedings of the Association for Active Educational Researchers Conference (NZARE/AARE 2003)* (pp. 1–8). Australian Association for Research in Education.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly 13*, 319–340.

Davis, F., Bagozzi, R., & Warshaw, P. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, *22*(14), 1111–1132.

Dean, M., & Spoehr, J. (2018). The fourth industrial revolution and the future of manufacturing work in Australia: challenges and opportunities. *Labour & Industry: a journal of the social and economic relations of work, 28*(3), 166–181.

De Bruin, G. P., & De Bruin, K. (2009). Career counselling assessment. In C. Foxcroft & G. Roodt (Eds.), *Introduction to psychological assessment in the South African context* (pp. 175–184). Cape Town, South Africa: Oxford University Press.

Deery, R., Hughes, D., & Kirkham, M. (2010). *Tensions and barriers to improving maternity care: The story of a struggling birth centre.* Abingdon: Radcliffe Publishing.

de Graaf, M. M., & Ben Allouch, S. (2013). Exploring influencing variables for the acceptance of social robots. *Robotics and Autonomous Systems 61*, 1476–1486.

de Graaf, M. M., Ben Allouch, S., & van Dijk, J. A. (2019). Why would i use this in my home? a model of domestic social robot acceptance. *Human–Computer Interaction, 34*(2), 115-173.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self determination in human behavior*. New York, NY: Plenum. doi:10.1007/978-1-4899-2271-7.

Demerouti, E., & Bakker, A. B. (2014). Job crafting. In M. C. W. Peeters, J. de Jonge, & T. W.

Taris (Eds.), *An introduction to contemporary work psychology* (pp. 414-433). Chichester, UK: Wiley-Blackwell.

Demers, L. P. (2014). Machine performers: Agents in a multiple ontological state. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.829.7112&rep=rep1&-type=pdf

de Oca, A. M. M., & Nistor, N. (2014). Non-significant intention–behavior effects in educational technology acceptance: A case of competing cognitive scripts? *Computers in Human Behavior*, *34*, 333–338.

Detert, J. R., & Burris, E. R. (2016). Can your employees really speak freely? Despite their best intentions, managers tend to shut people down. *Harvard Business Review*, *94*(1–2), 80.

Djellal, F., & Gallouj, F. (2013). The productivity challenge in services: Measurement and strategic perspectives. *Service Industries Journal*, *33*(3–4), 282–299.

Dobson, L. K., Gardner, M. K., Metz, A. J., & Gore, P. A., Jr. (2014). The relationship between interests and values in career decision making: The need for an alternative method of measuring values. *Journal of Career Assessment*, *22*(1), 113–122.

Dotson, T. (2015). Technological determinism and permissionless innovation as technocratic governing mentalities: Psychocultural barriers to the democratization of technology. *Engaging Science, Technology, and Society*, *1*, 98–120.

Dovidio, J., Kawakami, K., Johnson, C., Johnson, B., & Howard, A. (1997). The nature of prejudice: Automatic and controlled processes. *Journal of Experimental Social Psychology*, *33*, 510–540.

Drummond, J. S., & Standish, P. (2007). Introduction: Philosophical enquiry into education. In J. S. Drummond & P. Standish (Eds.), *The philosophy of nurse education* (pp. 1–33). Basingstoke, UK: Palgrave Macmillan.

Dunjko, V., & Briegel, H. J. (2018). Machine learning and artificial intelligence in the quantum domain: A review of recent progress. *Reports on Progress in Physics*, *81*(7), 074001.

Duodecim. (2018). Current care guidelines. Retrieved from https://www.duodecim.fi/english/products/current-care-guidelines/.

Durkheim, E. (1947). *The division of labor* (G. Simpson, Trans.). New York, NY: Free Press.

Edwards, K. (1990). The interplay of affect and cognition in attitude formation and change. *Journal of Personality and Social Psychology*, *59*(2), 202.

Elliot, A. J., & Devine, P. G. (2009). On the motivational nature of cognitive dissonance: Dissonance as psychological discomfort. *Journal of Personality and Social Psychology*, *67*, 382–394.

Engelbrekt, K., & Nygren, B. (2014). *Russia and Europe: Building bridges, digging trenches*. New York, NY: Routledge.

Entman, R. M. (2007). Framing bias: Media in the distribution of power. *Journal of Communication*, *57*(1), 163–173.

Erickson, R. J. (1995). The importance of authenticity for self and society. *Symbolic Interaction*, *18*(2), 121–144.

Erkkilä, S., Simberg, S., & Hyvärinen, M. (2016). *Jos minä nyt kuitenkin jaksan: Selvitys lähi- ja perushoitajien kokemasta työkuormasta* [Maybe I can manage: Perceived workload reported by practical nurses]. Finnish Union of Practical Nurses.

Eurobarometer. (2014). Public attitudes towards robots [WWW data archive, Gesis]. doi:10.4232/1.12265

Eurobarometer. (2017). Dataset. Retrieved from https://dbk.gesis.org/dbksearch/sdesc2.asp?no=6861&db=e&doi=10.4232/1.12915

Evetts, J. (2013). Professionalism: Value and ideology. *Current Sociology Review 61*, 778-796.Fabrigar, L. R., & Wegener, D. T. (2010). Attitude structure. In R. F. Baumeister & E. J. Finkel (Eds.), *Advanced social psychology: The state of the science* (pp. 177–216). New York, NY: Oxford University Press.

Falk, A., & Fischbacher, U. (2006). A theory of reciprocity. *Games and Economic Behavior*, *54*(2), 293–315. doi:10.1016/j.geb.2005.03.001

Fernández-Macías, E. (2012). Job polarization in Europe? Changes in the employment structure and job quality, 1995–2007. *Work and Occupations*, *39*(2), 157–182. doi:10.1177/0730888411427078

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Finland's Ministry of Economic Affairs and Employment (2019). Occupational barometer: The number of occupations suffering from labour shortage has decreased. Retrieved from https://tem.fi/en/article/-/asset_publisher/ammattibarometri-tyovoimapulasta-karsivien-ammattien-maara-kaantynyt-laskuun. Accessed 15th October 2019.

Finland's Ministry of Social Affairs and Health (2017). *Laatusuositus ikääntymisen turvaamiseksi ja palvelujen parantamiseksi 2017. Sosiaali- ja terveysministeriön julkaisuja 2017:6*. Helsinki, Finland: Ministry of Social Affairs and Health.

Finnish Nurses Association. (2019). What is APN. Retrieved from https://www.nurses.fi/8th-icn-international-nurse-prac/what-is-apn/

Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations*, *16*(3), 233–239.

Flandorfer, P. (2012). Population ageing and socially assistive robots for elderly persons: The importance of sociodemographic factors for user acceptance. *International Journal of Population Research*. doi:10.1155/2012/829835.

Fogg, B., & Nass, C. (1997). How users reciprocate to computers: An experiment that demonstrates behavior change. In: CHI '97 extended abstracts on human factors in computing systems, CHI EA '97. ACM, New York, NY, pp 331–332. doi: 10.1145/1120212.1120419.

Ford, J. K., Smith, E. M., Weissbein, D. A., Gully, S. M., & Salas, E. (1998). Relationships of goal orientation, metacognitive activity, and practice strategies with learning outcomes and transfer. *Journal of Applied Psychology*, *83*, 218–233.

Frey, C. B., & Osborne, M. A. (2015, February). Technology at work: The future of innovation and employment. *Citi GPS: Global Perspectives & Solutions*.

Friedman, B., & Kahn, P. H., Jr. (2007). Human values, ethics, and design. In A. Sears & J. A. Jacko (Eds.), *The human-computer interaction handbook* (pp. 1223–1248). New York, NY: Lawrence Erlbaum Associates.

Fugate, M., Kinicki, A. J., & Ashforth, B. E. (2004). Employability: A psycho-social construct, its dimensions, and applications. *Journal of Vocational Behavior*, *65*(1), 14–38.

Gaynor, M., Wyner, G., & Gupta, A. (2014). Dr. Watson? Balancing automation and human expertise in healthcare delivery. In T. Margaria & B. Steffen (Eds.), Leveraging application and validation. Specialized techniques and applications (pp. 561–569). Berlin, Germany: Springer-Verlag Berlin Heidelberg.

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, *36*, 399–417.

Gherardi, S., & Rodeschini, G. (2016). Caring as a collective knowledgeable doing: About concern and being concerned. *Management Learning, 47*(3), 266–284.

Glende, S., Conrad, I., Krezdorn, L., Klemcke, S., & Krätzel, C. (2015). Increasing the acceptance of assistive robots for older people through marketing strategies based on stakeholder needs. *International Journal of Social Robotics*, *8*(3), 355–369.

Goeldner, M., Herstatt, C., & Tietze, F. (2015). The emergence of care robotics—A patent and publication analysis. *Technology Forecasting and Social Change*, *92*, 115–131.

Goffman, E. (1959). *Asylums*. New York, NY: Doubleday.

Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, *37*, 504–528.

Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review*, *25*(2), 161–178. doi:10.2307/2092623

Grandey, A.A. (2000) Emotion regulation in the workplace: A new way to conceptualise emotional labour. *Journal of Occupational Health Psychology* *5*(1): 95–100.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510.

Grant, A. M. (2008). The significance of task significance: Job performance effects, relational mechanisms, and boundary conditions. *Journal of Applied Psychology*, *93*, 108–124. doi:10.1037/0021-9010.93.1.108

Green, L. (2001). *Technoculture*. Crows Nest, Australia: Allen and Unwin.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*, 4–27.

Haddock, G., & Maio, G. R. (2008). Attitudes: Content, structure and functions. In M. Hewstone, W. Stroebe, & K. Jonas (Eds.), *Introduction to social psychology: A European perspective* (pp. 112–133). Oxford, UK: Blackwell.

Hagele, M. (2016). Robots conquer the world [turning point]. *IEEE Robotics and Automation Magazine*, *23*, 118–120.

Haidt, J., and Joseph, C. (2004). Intuitive ethics: How innately prepared intuitions generate culturally variable virtues. *Daedalus, Fall*: 55–66.

Hale, J. L., Householder, B. J., & Greene, K. L. (2003). The Theory of Reasoned Action. In J. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 259-286). Thousand Oaks, CA: SAGE.

Halme, J., Lanz, M., Kämäräinen, J., Pieters, R., Latokartano, J., & Hietanen, A. (2018). Review of vision-based safety systems for human-robot collaboration. *Procedia Manufacturing*, *72*, 111–116. doi:10.1016/j.procir.2018.03.043

Hebesberger, D., Körtner, T., Pripfl, J., Gisinger, C., & Hanheide, M. (2015). What do staff in eldercare want a robot for? An assessment of potential tasks and user requirements for a long-term deployment. In: IROS Workshop on "Bridging user needs to deployed applications of service robots", 28 September 2015, Hamburg, Germany.

Helander, M.G., & Khalid, H.M. (2006). Affective and pleasurable design. In: Salvendy, G. (Ed.), *Handbook on human factors and ergonomics* (pp. 543–572). New York, NY: Wiley and Sons.

Hänninen, V. (1999). *Sisäinen tarina, elämä ja muutos*. Tampere, Finland: Tampere University Press.

Hartwick, J., & Barki, H. (1994). Explaining the role of user participation in information systems use. *Management Science*, *40*, 440–465.

Haslam, S. A. (2003). *Social identity at work: Developing theory for organizational practice*. New York, NY: Psychology Press.

Haslam, S. A., Reicher, S. D., & Platow, M. J. (2011). *The new psychology of leadership: Identity, influence and power*. London, UK: Psychology Press.

Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing acceptance of assistive social agent technology by older adults: The Almere model. *International Journal of Social Robotics*, *2*, 361–375. doi:10.1007/s12369-010-0068-5

Heide, M., & Gronhaug, K. (1991). Respondents' moods as a biasing factor in surveys: An experimental study. *Advances in Consumer Research, 18*, 566–575.

Henriksson, L. (2011). Lähihoitaja – joustavaa työvoimaa sosiaali- ja terveysalalle. In A. Laiho & T. Ruoholinna (Eds.), *Terveysalan ammatit ja koulutus*. Helsinki, Finland: Gaudeamus.

Hepler, J., & Albarracin, D. (2013). Attitudes without objects: Evidence for a dispositional attitude, its measurement, and its consequences. *Journal of Personality and Social Psychology*, *104*(6), 1060–1076.

Hirvonen, H. (2014). Doing gendered and (dis) embodied work. Care work in the context of medico-managerial welfare state. *Nordic Social Work Research*, *4*(2), 113–128.

Hirvonen, H. (2015). Reconstructing care professionalism in Finland. In T. Carvalho & R. Santiago (Eds.), *Professionalism, managerialism and reform in higher education and the health services: The European welfare state and the rise of the knowledge society* (pp. 81–101). London, UK: Palgrave Macmillan.

Hochschild, A. R. (1983). *The managed heart: Commercialization of human feeling*. Berkeley: University of California Press.

Hård, M. (1993). Beyond harmony and consensus: A social conflict approach to technology. *Science, Technology, & Human Values, 18*(4), 408–432.

Höflich, J. R., & El Bayed, A. (2015). Perception, acceptance, and the social construction of robots—Exploratory studies. In J. Vincent, S. Taipale, B. Sapio, G. Lugano, & L. Fortunati (Eds.), *Social robots from a human perspective* (pp. 39–51). London, UK: Springer.

Hofmann, B. (2013). Ethical challenges with welfare technology: A review of the literature. *Science and Engineering Ethics*, *19*(2), 389–406.

Holden, R. J., & Karsh, B.T. (2010). The technology acceptance model: Its past and its future in health care. *Journal of Biomedical Informatics*, *43*, 159–172.

Holmes, D., Murray, S. J., Perron, A., & McCabe, J. (2008). Nursing Best Practice Guidelines: reflecting on the obscene rise of the void. *Journal of Nursing Management, 16*(4), 394–403.

Hong, A., Igharoro, O., Liu, Y., Niroui, F., Nejat, G., & Benhabib, B. (2019). Investigating human-robot teams for learning-based semi-autonomous control in urban search and rescue environments. Journal of Intelligent & Robotic Systems, 94(3), 669-686. doi:10.1007/s10846-018-0899-0.

Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research*, *21*(2), 155–172.

Huet, E. (2016, October 20). Pushing the boundaries of AI to talk to the dead. Bloomberg. Retrieved from https://www.bloomberg.com/news/articles/20161020/pushingtheboundariesofaitotalktothedead

Huhtala, M., Feldt, T., Lämsä, A.-M., Mauno, S., & Kinnunen, U. (2011). Does the ethical culture of organisations promote managers' occupational well-being? Investigating indirect links via ethical strain. *Journal of Business Ethics*, *101*, 231–247.

Inglehart, R., & Welzel, C. (2014). The WVS cultural map of the world. World Value Surveys. Retrieved from http://www.worldvaluessurvey.org/WVSNewsShow.jsp?ID=192

International Federation of Robotics (2018). Executive summary world robotics 2017 service robots. Author. Retrieved from https://ifr.org/downloads/press/Executive_Summary_WR_Service_Robots_2017_1.pdf

Iwamura, Y., Shiomi, M., Kanda, T., Ishiguro, H., & Hagita, N. (2011). Do elderly people prefer a conversational humanoid as a shopping assistant partner in supermarkets? In *Proceedings of the 6th International Conference on Human–Robot Interaction* (pp. 449–456). New York, NY: ACM.

Jasanoff, S. & Kim, S.-H. (2015). *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*. London, UK: University of Chicago Press.

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. doi:10.1007/s12369-015-0322-y.

Johnson, D. O., Cuijpers, R. H., Pollmann, K., & van de Ven, A. A. J. (2016). Exploring the entertainment value of playing games with a humanoid robot. *International Journal of Social Robotics*, *8*(2), 247–269.

Jokinen, K., & Wilcock, G. (2017, October). Expectations and first experience with a social robot. In *Proceedings of the 5th International Conference on Human Agent Interaction* (pp. 511–515). New York, NY: ACM.

Jonge, E. D. (2014). Profession or craft? A reflection on the moral identity of social work. *Journal of Social Intervention: Theory and Practice*, *23*(1), 91–106.

Kachouie, R., Sedighadeli, S., Khosla, R., & Chu, M. T. (2014). Socially assistive robots in elderly care: A mixed-method systematic literature review. *International Journal of Human Computer Interaction*, *30*(5):369–393. doi:10.1080/10447318.2013.873278.

Kaplan, B. (2012). U.S. Patent No. 8,271,411. Washington, DC: U.S. Patent and Trademark Office.

Karahanna, E. (1999) Symbolic adoption of information technology. Proceedings from the International Decision Sciences Institute Conference, Athens, Greece. July, 121–144.

Karahanna, E., Agarwal, R., & Angst C. M. (2006). Reconceptualizing compatibility beliefs in technology acceptance research. *Management Information Systems Quarterly*, *30*, 781–804.

Karunarathne, D., Morales, Y., Nomura, T., Kanda, T., & Ishiguro, H. (2019). Will Older Adults Accept a Humanoid Robot as a Walking Partner?. *International Journal of Social Robotics, 11*(2), 343-358.

Katz, D. (1960). The functional approach to the study of attitudes. *Public Opinion Quarterly*, *24*(2), 163–204.

Katz, J. E., & Halpern, D. (2014). Attitudes towards robots suitability for various jobs as affected robot appearance. *Behaviour & Information Technology*, *33*(9), 941–953.

Kelman, H. C. (1961). Process of opinion change. *Public Opinion Quarterly, 25*, 57–78.

Kenworthy, J., Fay, C., Frame, M., & Petree, R. (2014). A meta-analytic review of the relationship between emotional dissonance and emotional exhaustion. *Journal of Applied Social Psychology; 44*: 94–105.

Kenworthy, J. B., Miller, N., Collins, B. E., Read, S. J., & Earleywine, M. (2011). A trans-paradigm theoretical synthesis of cognitive dissonance theory: Illuminating the nature of discomfort. *European Review of Social Psychology, 22*, 36–113.

Kielhofner, G. (2008). Dimensions of doing. In G. Kielhofner (Ed.), *Model of human occupation: Theory and application* (4th ed., pp. 101–109). Baltimore, MD: Lippincott Williams & Wilkins.

Kilpeläinen, T. (2010). *Foreign nurses' guide to Finnish working life*. European Social Fund.

Klein, K.J. , & Kozlowski, S.W.J. (2000). From micro to meso: Critical steps in conceptualizing and conducting multilevel research. *Organizational Research Methods, 3*, 211–236.

Koceski, S., & Koceska, N. (2016). Evaluation of an assistive telepresence robot for elderly healthcare. *Journal of Medical Systems*, *40*(5), 121.

Kodama, Y., & Fukahori, H. (2017). Nurse managers' attributes to promote change in their wards: A qualitative study. *Nursing Open*, *4*, 209–217. doi:10.1002/nop2.87

Koistinen, P., & Lilja, K. (1988). Consensual adaptation to new technology. In R. Hyman & W. Streeck (Eds.), *New technology and industrial relations* (pp. 265–272). New York, NY: Basil Blackwell.

Komarraju, M., & Nadler, D. (2013). Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter?. *Learning and Individual Differences, 25*, 67–72.

Kumar, R. S. (2018). Robotic nursing in health care delivery. *International Journal of Nursing Education, 10*(3), 148–151.

Kumar, A. (2019). Scheffler, tradition and value. *Journal of Value Inquiry*, *53*(1), 1–17.

Kuokkanen, L., & Katajisto, J. (2003). Promoting or impeding empowerment? Nurses' assessments of their work environment *Journal of Nursing Administration*, *33*, 209–215.

Kuokkanen, L., & Leino-Kilpi, H. (2001). The qualities of an empowered nurse and the factors involved *Journal of Nursing Management*, *9*, 273–280.

Kuokkanen, L., Suominen, T., Rankinen, S. Kukkurainen, M. L., Savikko, N., & Doran, D. (2007). Organizational change and work-related empowerment. *Journal of Nursing Management*, *15*(5), 500–507. doi:10.1111/j.1365-2834.2007.00733.x

Kuula, A. (2006). *Tutkimusetiikka. Aineistojen hankinta, käyttö ja säilytys*. Tampere, Finland: Vastapaino.

Laitinen, A. (2018). What principles for moral machines? Envisioning robots in society–power, politics, and public space. In M. Coeckelbergh et al. (Eds.), *Proceedings of Robophilosophy* (pp. 311–319). Amsterdam, Netherlands: IOS.

Lam, S. S. K., & Schaubroeck, J. (2000). A field experiment testing frontline opinion leaders as change agents. *Journal of Applied Psychology*, *85*, 987–995.

Lane, G. W., Noronha, D., Rivera, A., Craig, K., Yee, C., Mills, B., & Villanueva, E. (2016). Effectiveness of a social robot, "Paro," in a VA long-term care setting. *Psychological Services, 13*, 292–299. doi:10.1037/ser0000080.

LaPointe, K. (2010). Narrating career, positioning identity: Career identity as a narrative practice. *Journal of Vocational Behavior*, *77*(1), 1–9.

Latikka, R., Turja, T., & Oksanen, A. (2019). Self-efficacy and acceptance of robots. *Computers in Human Behavior*, *93*, 157–163.

Leamer, E. (2008, September). *Inequality and globalization*. Session Handouts, Global Economic Symposium 2008 (GES), Schleswig-Holstein, Germany.

Lee, N., Shin, H., & Sundar, S. S. (2011, March). Utilitarian vs. hedonic robots: role of parasocial tendency and anthropomorphism in shaping user attitudes. In Proceedings of the 6th international conference on Human-robot interaction (pp. 183-184). New York, NY: ACM. doi:10.1145/1957656.1957722.

Leiter, M. P., & Maslach, C. (2009). Nurse turnover: The mediating role of burnout. *Journal of Nursing Management*, *17*(3), 331–339. doi:10.1111/j.1365-2834.2009.01004.x

Lewis, L. K., & Seibold, D. R. (1998). Reconceptualizing organizational change implementation as a communication problem: A review of literature and research agenda. *Annals of the International Communication Association*, *21*(1), 93–152.

Li, D., Rau, O., & Li, Y. (2010). A cross-cultural study. *International Journal of Social Robotics*, *2*, 175–86.

Lin, C. H., Shih, H. Y., & Sher, P. J. (2007). Integrating technology readiness into technology acceptance: The TRAM model. *Psychology and Marketing*, *24*(7), 641–657.

Lipińska-Grobelny, A., & Papieska, E. (2012). Readiness for change and job satisfaction in a case of Lean management application—A comparative study. *International Journal of Occupational Medicine and Environmental Health*, *25*, 418–425. doi:10.2478/S13382-012-0044-4

Liveng, A. (2008). A crisis of recognition in care work for elderly people? Looking at professional, bodily and gendered hierarchies for explanations. In S. Wrede, L. Henriksson, H. Høst, S. Johansson, & B. Dybbroe (Eds.), *Care work in crisis. Reclaiming the Nordic ethos of care* (pp. 95–111). Lund, Sweden: Studentlitteratur.

Lopes, M., Peters, J., Piater, J., Toussaint, M., Baisero, A., Busch, B., Erkent, O., Kroemer, O., Lioutikov, R., Maeda, G., Mollard, Y., Munzer, T., Shukla, D. (2015). Semi-Autonomous 3rd-Hand Robot. *Robotics in future manufacturing scenarios, 3*.

Lopez, S. H. (2006). Emotional labor and organized emotional care: Conceptualizing nursing home care work. *Work and Occupations*, *33*(2), 133–160.

Loughnan, S., Bastian, B., & Haslam, N. (2014). The psychology of eating animals. *Current Directions in Psychological Science, 23*, 104–108.

Louie, W-Y. G., McColl, D., & Nejat, G. (2014). Acceptance and attitudes toward a human-like socially assistive robot by older adults. *Assistive Technology*, *26*, 140–150.

MacIntyre, A. C., & (1988). *Whose justice? Which rationality?* (Vol. 239). London, UK: Duckworth.

Madsen, J. B., & Farhadi, M. (2018). International technology spillovers and growth over the past 142 years: The role of genetic proximity. *Economica*, *85*(338), 329–359.

Madsen, S. R., Miller, D., & John, C. R. (2005). Readiness for organizational change: Do organizational commitment and social relationships in the workplace make a difference? *Human Resource Development Quarterly*, *16*(2), 213–234. doi:10.1002/hrdq.1134

Maillet, É., Mathieu, L., & Sicotte, C. (2015). Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT. *International Journal of Medical Informatics*, *84*, 36–47.

Maio, G. R. (2010). Mental representations of social values. In *Advances in experimental social psychology* (Vol. 42, pp. 1–43). Academic Press.

Maio, G. R., & Olson, J. M. (1995). Relations between values, attitudes, and behavioral intentions: The moderating role of attitude function. *Journal of Experimental Social Psychology*, *31*, 266–285.

Maio, G. R., & Olson, J. M. (2000). What is a “value-expressive” attitude? In G. R. Maio & J. M. Olson (Eds.), *Why we evaluate: Functions of attitudes* (pp. 249–269). Mahwah, NJ: Erlbaum.

Mäkikangas, A., Aunola, K., Seppälä, P., & Hakanen, J. (2016). Work engagement–team performance relationship: Shared job crafting as a moderator. *Journal of Occupational and Organizational Psychology*, *89*(4), 772–790. doi:10.1111/joop.12154

Marini, M. M., Fan, P. L., Finley, E., & Beutel, A. M. (1996). Gender and job values. *Sociology of Education*, 69, 49–65.

Marshak, R. J. (2006). *Covert processes at work: Managing the five hidden dimensions of organizational change*. San Francisco, CA: Berrett-Koehler.

Marti, P., Bacigalupo, M., Giusti, L., Mennecozzi, C., & Shibata, T. (2006, Feburary). Socially assistive robotics in the treatment of behavioural and psychological symptoms of dementia. Paper presented at the The First IEEE/RAS-EMBS International Conference on Biomedical Robotics and Biomechatronics, 2006, Pisa, Italy.

Matheson, L. K., & Bobay, K. (2007). Validation of oppressed group behaviors in nursing. *Journal of Professional Nursing*, *23*(4), 226–234. doi:10.1016/j.profnurs.2007.01.007

McAdams, D. P. (1985). *Power, intimacy, and the life story*. Homewood, IL: Dorsey.

McAdams, D. P. (2006). The role of narrative in personality psychology today. *Narrative Inquiry*, *16*, 11–18.

McAdams, D. P., & McLean, K. C. (2013). Narrative identity. *Current Directions in Psychological Science*, *22*(3), 233–238.

McDonald, T., & Siegall, M. (1996). Enhancing worker self-efficacy: An approach for reducing negative reactions to technological change. *Journal of Managerial Psychology*, *11*, 41–44. doi:10.1108/02683949610110550

McFadden, D. (1979). Quantitative methods for analyzing travel behaviour of individuals: Some recent developments. In D. Hensher & P. Shopher (Eds.), *Behavioral travel modelling* (pp. 279-318). Andover, UK: Croom Helm.

McGlynn, S. A., Kemple, S. C., Mitzner, T. L., King, C. H., & Rogers, W. A. (2014, September). Understanding older adults' perceptions of usefulness for the Paro robot. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 58, No. 1, pp. 1914–1918). Los Angeles, CA: SAGE Publications.

McGrath, A. (2017). Dealing with dissonance: A review of cognitive dissonance reduction. *Social and Personality Psychology Compass, 11*(12), e12362-n/a. doi:10.1111/spc3.12362.

McMillan, K., & Perron, A. (2013). Nurses amidst change: The concept of change fatigue offers an alternative perspective on organizational change. *Policy, Politics, & Nursing Practice*, *14*, 26–32.

McQueen, A. C. H. (2004). Emotional intelligence in nursing work. *Journal of Advanced Nursing*, *47*(1), 101–108.

Melkas, H., Hennala, L., Pekkarinen, S., & Kyrki, V. (2016, September). Human impact assessment of robot implementation in Finnish elderly care. In *Proceedings of International Conference on Serviceology* (pp. 202-206).

Mendell, J. S., Palkon, D. S., & Popejoy, M. W. (1991). Health managers' attitudes toward robotics & artificial computer intelligence: an empirical investigation. *Journal of Medical Systems*, *15*(3), 197–204.

Menon, S. P. (2015). Maximizing time with the patient: The creative concept of a physician scribe. *Current Oncology Reports*, *17*(12), 59. doi:10.1007/s11912-015-0484-7.

Miailhe, N., & Hodes, C. (2017). The third age of artificial intelligence. *Field Actions Science Reports*, Special Issue 17, 6–11.

Miles, A. (2015). The (re)genesis of values: Examining the importance of values for action. *American Sociological Review*, *80*(4), 680–704. doi:10.1177/0003122415591800

Mindell, D. (2019). *Lecture on the course "Shaping the Future of Work*." MIT. Task Force on Work of the Future.

Ministry of Economic Affairs and Employment. (2018). Työelämä 2020: Luottamuskysely. [Working life 2020: Trust survey]. Retrieved from https://tem.fi/documents/1410877/2132296/suomalaisen_tyoelaman_luottamuskysely_tulokset_1.pdf/5df964b6-e846-46d1-897e-c39f12494ce4/suomalaisen_tyoelaman_luottamuskysely_tulokset_1.pdf.pdf. Accessed 12.7.2018

Mischel, W., & Shoda, Y. (1995). A cognitive–affective system theory of personality: Reconceptualizing situations, dispositions, and invariance in personality structure. *Psychological Review*, *102*, 246–268.

Mulligan, K. (1998). From appropriate emotions to values. *Monist*, *81*(1), 161–188.

Nagórka, P. (2017). Conceptual maps of European values. *International Journal on Language, Literature and Culture in Education*, *4*(1), 3–33.

Napoletano, A., Tacchella, A., & Pietronero, L. (2018). A context similarity-based analysis of countries' technological performance. *Entropy*, *20*, 833.

Nass, C., & Reeves, B. (1996). *The media equation: How people treat computers, televisions, and new media like real people and places*. Stanford, CA: CSLI.

National Institute of Health and Welfare. (2018). Statistical yearbook on social welfare and health care 2017. Helsinki, Finland: Juvenes Print—Suomen Yliopistopaino Oy. Retrieved from http://www.julkari.fi/bitstream/handle/10024/135959/URN_ISBN_978-952-302-970-5.pdf?sequence=1&isAllowed=y

Nelson, A. J., & Irwin, J. (2014). Defining what we do—All over again: Occupational identity, technological change, and the librarian/Internet-search relationship. *Academy of Management Journal*, *57*(3), 892–928.

Nickelsen, N. C. M. (2018). Socio-technical imaginaries and human-robotics proximity—The case of Bestic. In M. Coeckelbergh, J. Loh, M. Funk, J. Seibt, & M. Nørskov (Eds.), *Envisioning robots in society and public space, power, and politics* (pp. 212–221). Amsterdam, Netherlands: IOS.

Niemelä, M., Määttä, H., & Ylikauppila, M. (2016, September). *Expectations and experiences of adopting care robots in Finland: Perspectives of caregivers and decision-makers*. A paper presented at the ICServ2016 Special Session: Meaningful Technology for Seniors, Tokyo, Japan.

Niemelä, M., Ylikauppila, M., & Talja, H. (2016). Long-term use of Paro the therapy robot seal: the caregiver perspective. In 10th world conference of gerontechnology.

Nieminen, M., & Hyytinen, K. (2015). Future-oriented impact assessment: Supporting strategic decision-making in complex socio-technical environments. *Evaluation*, *21*(4), 448–461.

NMC. (2015). The code. Professional standards of practice and behaviour for nurses and midwives. Nursing and Midwifery Council. Retrieved from https://www.nmc.org.uk/globalassets/sitedocuments/nmc-publications/nmc-code.pdf.

Nomura, T., Kanda, T., & Suzuki, T. (2006). Experimental investigation in to influence of negative attitudes toward robots on human–robot interaction. *AI & Society*, *20*, 138–150.

Nourbakhsh, I. R. (2006). Robots and society. Retrieved from http://www.oxfordreference.com/view/10.1093/acref/9780195141931.001.0001/acref-9780195141931-e-96?rskey=EkRUR8&result=1

Nye, D. E. (1997). Shaping communication networks: Telegraph, telephone, computer. *Social Research*, *64*, 1067–1091.

O'Connor, G. C., & Rice, M. P. (2001). Opportunity recognition and breakthrough innovation in large established firms. *California Management Review*, *43*, 95–116.

O'Keeffe, V. J., Thompson, K. R., Tuckey, M. R., & Blewett, V. L. (2015). Putting Safety in the Frame: Nurses' Sensemaking at Work. *Global Qualitative Nursing Research*. doi:10.1177/2333393615592390.

Orlikowski, W. J., & Gash, D. C. (1994). Technological frames: Making sense of information technology in organizations. *ACM Transactions on Information Systems*, *12*, 174–207.

Ornston, D. (2012). Old ideas and new investments: Divergent pathways to a knowledge economy in Denmark and Finland. *Governance*, *25*, 687–710.

Page, J., Bain, M., & Mukhlish, F. (2018, August). The Risks of Low Level Narrow Artificial Intelligence. In 2018 IEEE International Conference on Intelligence and Safety for Robotics (ISR) (pp. 1-6). IEEE. doi:10.1109/IISR.2018.8535903.

Pajarinen, M., & Rouvinen, P. (2014). Computerization threatens one third of Finnish employment. ETLA Brief No. 22.

Parks-Leduc, L., Feldman, G., & Bardi, A. (2015). Personality traits and personal values: A meta-analysis. *Personality and Social Psychology Review*, *19*(1), 3–29. doi:10.1177/1088868314538548

Parviainen, J. (2019). Hoivarobotiikka ja faktantarkistus. [Care robotics and checking the facts]. Yhteiskuntapolitiikka 2/2019.

Parviainen, J., van Aerschot, L., Särkikoski, T., Pekkarinen, S., Melkas, H., & Hennala, L. (2016). Motions with Emotions?. In Robophilosophy/TRANSOR (pp. 210–219).

Parviainen, J., Turja, T. & Van Aerschot, L. (in press). Social robots and human touch in care: The perceived usefulness of robot assistance among healthcare professionals. In *Social robots. An interdisciplinary compendium on technological, societal and ethical aspects*. Springer.

Pask, E. J. (2003). Moral agency in nursing: Seeing value in the work and believing that I make a difference. *Nursing Ethics*, *10*(2), 165–74. doi:10.1191/0969733003ne591oa

Pekkarinen, S. (2011). Innovations of ageing and societal transition. Dynamics of change of the socio-technical regime of ageing. Lappeenranta University of Technology, Lahti School of Innovation.

Pekkarinen, S. Tuisku, O, Hennala, L., Melkas, H. (forthcoming) Robotics in Finnish welfare services: Dynamics in an emerging innovation ecosystem. A manuscript accepted in *European Planning Studies*.

Peltomaa, K., Viinikainen, S., Rantanen, A., Sieloff, C., Asikainen, P, & Suominen, T. (2013). Nursing power as viewed by nursing professionals. *Scandinavian journal of caring sciences, 27*(3), 580-588.

Pervin, L. A. (2003). *The science of personality*. New York, NY: Oxford.

Petersén, M. (2019). *The Swedish Microchipping Phenomenon*. UK: Emerald Group Publishing.

Petrou, P., Demerouti, E., & Xanthopoulou, D. (2017). Regular versus cutback-related change: the role of employee job crafting in organizational change context of different nature. *International Journal of Stress Management*, *24*(1), 62–85.

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The meta-cognitive model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition*, *25*(5), 657–686.

Phelan, S., & Kinsella, E. A. (2009). Occupational identity: Engaging socio-cultural perspectives. *Journal of Occupational Science*, *16*(2), 85–91.

Piasek, J., & Wieczorowska-Tobis, K. (2018, July). Acceptance and long-term use of a social robot by elderly users in a domestic environment. In *2018 11th International Conference on Human System Interaction (HSI)* (pp. 478–482). IEEE.

Piçarra, N., & Giger, J. C. (2018). Predicting intention to work with social robots at anticipation stage: Assessing the role of behavioral desire and anticipated emotions. *Computers in Human Behavior, 86*, 129–146.

Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*, 879–903.

Prakash, A., & Rogers, W. A. (2015). Why some humanoid faces are perceived more positively than others: Effects of human-likeness and task. *International Journal of Social Robotics*, *7*, 309–331. doi:10.1007/s12369-014-0269-4

Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Behavior*, *12*, 38–48.

Prochaska, J. O., Velicer, W. E., Rossi, J. S., Goldstein, M. G., Marcus, B. H., RaJiowski, W., . . . Rossi, S. R. (1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychology*, *13*, 39–46.

Pu, L., Moyle, W., Jones, C., & Todorovic, M. (2019). The effectiveness of social robots for older adults: A systematic review and meta-analysis of randomized controlled studies. *The Gerontologist, 59*(1).

Rafferty, A. E., Jimmieson, N. L., & Armenakis, A. A. (2013). Change readiness: A multilevel review. *Journal of Management*, *39*(1), 110–135.

Rahman, M. S., Ko, M., Warren, J., & Carpenter, D. (2016). Healthcare technology self-efficacy (HTSE) and its influence on individual attitude: An empirical study. *Computers in Human Behavior*, *58,* 12–24.

Rantanen, T., Lehto, P., Vuorinen, P., & Coco, K. (2018). Attitudes towards care robots among Finnish home care personnel–a comparison of two approaches. *Scandinavian Journal of Caring Sciences, 32*(2), 772–782.

Rautava-Nurmi, H., Westergård, A., Henttonen, T., Ojala, M., & Vuorinen, S. (2013). *Hoitotyön taidot ja toiminnot*. Helsinki, Finland: Sanoma Pro Oy.

Reicher, S., Haslam, S. A., & Hopkins, N. (2005). Social identity and the dynamics of leadership: Leaders and followers as collaborative agents in the transformation of social reality. *Leadership Quarterly*, *16*(4), 547–568.

Reineck, C. (2007). Models of change. *Journal of Nursing Administration*, *37*, 388–391.

Rhodes, R. E., & Courneya, K. S. (2004). Differentiating motivation and control in the theory of planned behavior. *Psychology, Health & Medicine*, *9*(2), 205–215.

Robert, G., Cornwell, J., Locock, L., Purushotham, A., Sturmey, G., & Gager, M. (2015). Patients and staff as codesigners of healthcare services. *Bmj, 350*. Doi: 10.1136/bmj.g7714.

Roberts, B. W., & Mroczek, D. (2008). Personality trait change in adulthood. *Current Directions in Psychological Science*, *17*(1), 31–35.

Roccas, S., Sagiv, L., Oppenheim, S., Elster, A., & Gal, A. (2014). Integrating content and structure aspects of the self: Traits, values, and self-improvement. *Journal of personality, 82*(2), 144-157.

Rogers, E. (2000). The extensions of men: the correspondence of Marshall McLuhan and Edward T Hall. *Mass Communication and Society*, *3*(1), 117–135.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed.). New York, NY: Free Press.

Rogers, E.M., and Shoemaker, F.F. (1971). *Communication of Innovation: A Cross-Cultural Approach*. New York, NY: Free Press.

Romppel, M., Herrmann-Lingen, C., Wachter, R., Edelmann, F., Düngen, H.-D., Pieske, B., Grande, G. (2013). A short form of the General Self-Efficacy Scale (GSE-6): Development, psychometric properties and validity in an intercultural non-clinical sample and a sample of patients at risk for heart failure. *Psycho-social Medicine*, *10*, 1–7.

Ronen, S., & Shenkar, O. (1985). Clustering countries on attitudinal dimensions: A review and synthesis. *Academy of Management Review*, *10*, 435–454

Ros, M., Schwartz, S. H., & Surkiss, S. (1999). Basic individual values, work values, and the meaning of work. *Applied Psychology*, *48*(1), 49–71.

ROSE Consortium (2017). Robotics in Care Services: A Finnish Roadmap. Retrieved from http://roseproject.aalto.fi/images/publications/Roadmap-final02062017.pdf. Accessed 18th June 2018.

Rosenberg, M. J., & Hovland, C. I. (1960). Cognitive, affective and behavioral components of attitudes. In M. J. Rosenberg & C. I. Hovland (Eds.), *Attitude organization and change: An analysis of consistency among attitude components* (pp. 1–14). New Haven, CT: Yale University Press.

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology*, *78*, 122–135

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, *110*(1), 145–172.

Russell, R. F. (2001). The role of values in servant leadership. *Leadership and Organisation Development Journal*, *22*(2), 76–83.

Rutten, R., & Boekema, F. (2007). Regional social capital: Embeddedness, innovation networks and regional economic development. *Technological Forecasting and Social Change*, *74*(9), 1834–1846.

Šabanović, S., & Wang-Lin, C. (2016). Socializing robots: Constructing robotic sociality in the design and use of the assistive robot PARO. *AI & Society*, *31*, 537–551. doi:10.1007/s00146-015-0636-1.

Šabanović, S. (2010). Robots in society, society in robots—Mutual shaping of society and technology as a framework for social robot design. *International Journal of Social Robotics*, *2*(4), 439–450. doi:10.1007/s12369-010-0066-7.

Sætra, H. S. (2018). The ghost in the machine: Being human in the age of AI and machine learning. *Human Arenas, 2*, 60–78.

Sandfort, J. R. (2010). Human service organizational technology: Improving understanding and advancing research. In Y. Hasenfeld (Ed.), *Human services as complex organizations* (pp. 269–287). Los Angeles, CA: SAGE.

Sandoval, E. B., Brandstetter, J., Obaid, M., & Bartneck, C. (2016). Reciprocity in human–robot interaction: A quantitative approach through the prisoner's dilemma and the ultimatum game. *International Journal of Social Robotics*, *8*(2), 303–317.

Saner, M., & Wallach, W. (2015). Technology unemployment, AI, and workplace standardization: The convergence argument. *Journal of Evolution & Technology*, *25*(1), 74–80.

Santoni de Sio, F., & van Wynsberghe, A. (2016). When should we use care robots? The nature-of activities approach. *Science and Engineering Ethics*, *22*(6), 1745–1760. doi:10.1007/s11948-015-9715-4

Sarrica, M., Brondi, S., & Fortunati, L. (2019). How many facets does a "social robot" have? A review of scientific and popular definitions online. *Information Technology & People*. doi:10.1108/ITP-04-2018-0203

Savela, N., Turja, T., & Oksanen, A. (2018). Social acceptance of robots in different occupational fields: A systematic literature review. *International Journal of Social Robotics, 10*(4), 493–502. doi:10.1007/s12369-017-0452-5

Savickas, M. L., & Porfeli, E. J. (2012). Career Adapt-Abilities Scale: Construction, reliability, and measurement equivalence across 13 countries. *Journal of Vocational Behavior*, *80*, 661–673.

Scammell, J., Tait, D., White, S., & Tait, M. (2017). Challenging nurse student selection policy: Using a lifeworld approach to explore the link between care experience and student values. *Nursing Open*, *4*, 218–229. doi:10.1002/nop2.88

Schäfer, M. (2018). The fourth industrial revolution: How the EU can lead it. *European View*, *17*(1), 5–12.

Schot, J., & Rip, A. (1997). The past and future of constructive technology assessment. *Technological Forecasting and Social Change*, *54*(2–3), 251–268.

Schwab, K. (2016). *The fourth industrial revolution*. New York, NY: Crown Business.

Schwartz, S. H. (1992). Universals in the content and structure of values. In M. Hewstone & R. J. Brown (Eds.), *Advances in experimental social psychology* (pp 1-65). San Diego, CA: Academic Press.

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture*, *2*(1), 11. doi:10.9707/2307-0919.1116.

Schwarz, N., & Strack, F. (1991). Context effects in attitude surveys: Applying cognitive theory to social research. In W. Stroebe & M. Hewstone (Eds.), *European Review of Social Psychology* (Vol. 2, pp. 31–50. Chichester, UK: Wiley.

Schyns, B. (2004). The Influence of occupational self-efficacy on the relationship of leadership behavior and preparedness for occupational change. *Journal of Career Development*, *30*, 247–261.

Seibt, J. (2017). Towards an ontology of simulated social interaction: Varieties of the "as if" for robots and humans. In J. Seibt & R. Hakli (Eds.), *Sociality and normativity for robots* (pp. 11–39). Cham, Switzerland: Springer.

Sellman, D. (2010). Professional values and nursing. *Medicine, Health Care and Philosophy*, *14*(2), 203–208. doi:10.1007/s11019-010-9295-7

Sennett, R. (1998). *The corrosion of character: The personal consequences of work in the new capitalism*. New York, NY: Norton.

Senousy, M. B., & Mazen, T. S. (2014). Discrete probability distributions–based methodology for measuring software usability. *International Journal of Scientific & Engineering Research*, *5*(6), 1167.

Seppälä, P., Hakanen, J. J., Tolvanen, A., & Demerouti, E. (2018). A job resources-based intervention to boost work engagement and team innovativeness during organizational restructuring: For whom does it work? *Journal of Organizational Change Management*, *31*(7), 1419–1437. doi:10.1108/JOCM-11-2017-0448

Sharkey, A., & Sharkey, N. (2012). Granny and the robots: ethical issues in robot care for the elderly. *Ethics and Information Technology 14*, 27–40.

Sharp, H., Rogers, Y., & Preece, J. (2007). Interaction design: Beyond human computer interaction. New York, NY: Wiley.

Shavitt, S. & Nelson, M. R. (2002). The role of attitude functions in persuasion and social judgment. In J.P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Development in theory and practice* (pp. 137–154). Thousands Oaks, CA: Sage.

Shoda, Y. (1999). A unified framework for the study of behavioral consistency: Bridging person × situation interaction and the consistency paradox. *European Journal of Personality*, *13*, 361–387.

Siciliano, B., & Khatib, O. (2008). Introduction. In B. Siciliano & O. Khatib (Eds.), *Handbook of robotics* (pp. 1–8). Berlin, Germany: Springer.

Siegall, M., & McDonald, T. (2004). Person-organization value congruence, burnout, and diversion of resources. *Personnel Review*, *33*, 291–301.

Silverman, D., & Marvasti, A. (2008). Doing qualitative research: A comprehensive guide. Sage.

Silverstein, M., & Heap, J. (2015). Sense of coherence changes with aging over the second half of life. *Advances in Life Course Research*, *23*, 98–107.

Simons, R. (1995), Levers of Control, Harvard Business School Press, Boston, MA.

Sire, J. W. (2004). *Naming the elephant: Worldview as a concept*. Downers Grove, IL: InterVarsity Press.

Skitka, L. J. (2002). Do the means always justify the ends, or do the ends sometimes justify the means? A value protection model of justice reasoning. *Personality and Social Psychology Bulletin*, *28*, 588–597.

Sleebos, E., Ellemers, N., & De Gilder, D. (2006) The carrot and the stick: Affective commitment and acceptance anxiety as motives for discretionary group efforts by respected and disrespected group members. *Personality and Social Psychology Bulletin*, *32*, 244–255.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, *177*(3), 1333–1352.

Sorell, T., & Draper, H. (2014). Robot carers, ethics and older people. *Ethics and Information Technology*, *16*(3), 183–195.

Sparrow, R. (2007). Killer robots. *Journal of Applied Philosophy*, *24*(1), 62–77.

Stahl, B. C., McBride, N., Wakunuma, K., & Flick, C. (2014). The empathic care robot: A prototype of responsible research and innovation. *Technological Forecasting & Social Change*, *84*, 74–85.

Stamper, R., Liu, K., Hafkamp, M., & Ades, Y. (2000). Understanding the roles of signs and norms in organizations-a semiotic approach to information systems design. *Behaviour & Information Technology*, *19*(1), 15–27.

Statistics Finland (2015). Yliopistokoulutus [University education]. Helsinki, Finland: Tilastokeskus. http://www.stat.fi/til/yop/2015/yop_2015_2016-05-10_tie_001_fi.html

Statistics Finland (2019). Number of young people in danger of diminishing considerably due to the decrease in birth rate. Retrieved from www.tilastokeskus.fi/til/vaenn/2018/vaenn_2018_2018-11-16_tie_001_en.html. Accessed 15th October 2019.

Stuart, S. (2017, January). How do you feel? Affectiva's AI can tell. *PC Magazine*. Retrieved from https://www.pcmag.com/news/349956/how-do-you-feel-affectivas-ai-can-tell

Suhonen, R. (2012). Ikääntynyt ihminen, osaaminen ja palvelujärjestelmä -keskustelua konsensuslausumasta. *Gerontologia*, *26*(1), 63–65.

Svensson, S. (2011). Flexible working conditions and decreasing levels of trust. *Employee Relations*, *34*(2), 126–137.

Tajfel, H. (1978). Social categorization, social identity and social comparison. In H. Tajfel (Ed.), *Differentiation between social groups. Studies in the social psychology of intergroup relations* (pp. 61–76). London, UK: Academic Press.

Taipale, S. (2016). Synchronicity matters: defining the characteristics of digital generations. *Information, Communication & Society, 19*(1), 80–94.

Taipale, S, de Luca, F., Sarrica, M., & Fortunati, L. (2015). Robot shift from industrial production to social reproduction. In J. Vincent, S. Taipale, B. Sapio, L. Fortunati, & G. Lugano (Eds.), *Social robots from a human perspective* (pp. 11–24). London, UK: Springer.

Takayama L., Ju, W., & Nass, C. (2008). Beyond dirty, dangerous and dull: What everyday people think robots should do. In *Proceedings of the Human–Robot Interaction 2008* (pp. 25–32).

Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivity. *Journal of Management Information Systems*, *24*(1), 301–328.

Tehy (2017). Tehy tilastoina. [Statistics of the Union of Health and Social Care Professionals in Finland]. Retrieved from https://www.tehy.fi/fi/system/files/mfiles/julkaisu/2017/2017_d2_tehy_tilastoina_id_9565.pdf

Thatcher, A., & Ndabeni, M. (2013). A psychological model to understand e-adoption in the context of the digital divide. In J. Steyn & G. Johanson (Eds.), *Digital literacy: Concepts, methodologies, tools, and applications* (pp. 1402–1424). IGI Global.

Thompson, R., Higgins, C., & Howell, J. (1991). Personal computing: Toward a conceptual model of utilization. *Management Information Systems Quarterly*, *15*(1), 124–143.

Toode, K., Routasalo, P., Helminen, M., & Suominen, T. (2015). Hospital nurses' work motivation. *Scandinavian Journal of Caring Sciences*, *29*, 248–257. doi:10.1111/scs.12155

Tripsas, M. (2009). Technology, identity, and inertia through the lens of "The Digital Photography Company." *Organization Science*, *20*, 441–460.

Trist, E. (1981). *The sociotechnical perspective: The evolution of sociotechnical systems as a conceptual framework and as an action research paradigm*. New York, NY: Wiley & Sons.

Trydegård, G.-B. (2012). Care work in changing welfare states: Nordic care workers' experiences. *European Journal of Ageing*, *9*, 119–129. doi:10.1007/s10433-012-0219-7

Tung, F.-C., Chang, S.-C., & Chou, C.-M. (2008). An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS in the medical industry. *International Journal of Medical Informatics*, *77*, 324–335.

Turja, T., & Niemelä, M. (2018). Robotin ja hoitajan yhteistyöllä tehokkuutta ja mielekkyyttä hoitotyöhön. [Efficiency and wellbeing in care work by robots and nurses collaborating]. *Sosiaalipsykologi*, *2*, 12–17.

Turja, T., Rantanen, T., & Oksanen, A. (2017). Robot use self-efficacy in healthcare work (RUSH): Development and validation of a new measure. *AI & Society, 34*(1), 137–143. doi:10.1007/s00146-017-0751-2.

Turja, T., & Särkikoski, T. (2018). Varastavatko robotit hoivatyöt? Työpoliittinen aikakauskirja 1/2018. Retrieved from http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160692/TEM%20tyopoliittinen%20aikakauskirja%201_2018.pdf

Turner, J. C., Hogg, M. A., Oakes, P. J., & Wetherell, M. S. (1987). *Re-discovering the social group: A self-categorization theory*. Oxford, UK: Basil Blackwell.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. *Advances in Experimental Social Psychology*, *29*, 271–360.

Vallor, S. (2011). Carebots and caregivers: Sustaining the ethical ideal of care in the twenty-first century. *Philosophy & Technology*, *24*, 251–268.

Van Aerschot, L. (2014). Vanhusten hoiva ja eriarvoisuus, sosiaalisen ja taloudellisen taustan yhteys avun saamiseen ja palvelujen käyttöön. Doctoral dissertation. University of Tampere.

Van Aerschot, L., Turja, T., & Särkikoski, T. (2017). Roboteista tehokkuutta ja helpotusta hoitotyöhön? Työntekijät empivät, mutta teknologia ei pelota. *Yhteiskuntapolitiikka*, *82*(6), 630–640.

van der Kooij, J. C., de Ruyter, D. J., & Miedema, S. (2013). “Worldview”: The meaning of the concept and the impact on religious education. *Religious Education*, *108*(2), 210–228.

van Wynsberghe, A. (2013). Designing robots for care: Care centered value-sensitive design. *Science and Engineering Ethics*, *19*, 407–433.

Varcoe, C., Doane, G., Pauly, B., Rodney, P., Storch, J. L., Mahoney, K., . . . Starzomski, R. (2004). Ethical practice in nursing: Working the in-betweens. *Journal of Advanced Nursing*, *45*(3), 316–325. doi:10.1046/j.1365-2648.2003.02892.x

Vauclair, C.-M. (2009). Measuring cultural values at the individual-level: Considering morality in cross-cultural value research. *RAM: Revista de Administração Mackenzie*, *10*(3), 60–83. doi:10.1590/S1678-69712009000300005

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating perceived behavioral control, computer anxiety and enjoyment into the technology acceptance model. *Information Systems Research*, *11*(4), 342–365.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273–315.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *INFORMS*, *46*(2), 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *Management Information Systems Quarterly*, *27*(3), 425–478.

Ventä, O., Honkatukia, J., Häkkinen, K., Kettunen, O., Niemelä, M., Airaksinen, M., & Vainio, T. (2018). Robotisaation ja automatisaation vaikutukset Suomen kansantalouteen 2030. Retrieved from https://tietokayttoon.fi/julkaisut/raportti?pubid=URN:ISBN:978-952-287-484-9

Veruggio, G., & Operto, F. (2008). Roboethics: Social and ethical implications of robotics. In T. B. Siciliano & O. Khatib (Eds.), *Springer handbook of robotics* (pp. 1499–1524). Berlin, Germany: Springer.

Vinje, H. F., & Mittelmark, M. B. (2007). Job engagement's paradoxical role in nurse burnout. *Nursing & Health Sciences*, *9*, 107–111. doi:10.1111/j.1442-2018.2007.00310.x

Waerness, K. (1984). The rationality of caring. *Economic and Industrial Democracy*, *5*, 185–211.

Walczuch, R., Lemmink, J., & Streukens, S. (2007). The effect of service employees' technology readiness on technology acceptance. *Information & Management*, *44*(2), 206–215.

Wallach, W., Allen, C., & Smit, I. (2008). Machine morality: Bottom-up and top-down approaches for modelling human moral faculties. *AI & Society*, *22*, 565–582.

Wanberg, C. R., & Banas, J. T. (2000). Predictors and outcomes of openness to changes in a reorganizing workplace. *Journal of Applied Psychology*, *85*, 132–142.

Wang, X., & Krumhuber, E. G. (2018). Mind perception of robots varies with their economic versus social function. *Frontiers in Psychology, 9*, 1230-1230. doi:10.3389/fpsyg.2018.01230.

Wanous, J. P., Reichers, A. E., & Austin, J. T. (2000). Cynicism about organizational change: Measurement, antecedents, and correlates. *Group & Organization Management*, *25*(2), 132–153.

Ward, R. (2013). The application of technology acceptance and diffusion of innovation models in healthcare informatics. *Health Policy and Technology*, *2*(4), 222–228. doi:10.1016/j.hlpt.2013.07.002

Watanabe, K., Hyytinen, K., & Koivula, H. (2018), Challenges in integrating assistive technologies into elderly-care services: Comparative study between Japan and Finland. *European Review of Service Economics and Management, 6*(2), 97–122.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organization Science, 16*(4), 409–421.

Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science*, *4*(1), 67. doi:10.1186/1748-5908-4-67.

Whelan, S., Murphy, K., Barrett, E., Krusche, C., Santorelli, A., & Casey, D. (2018). Factors affecting the acceptability of social robots by older adults including people with dementia or cognitive impairment: A literature review. *International Journal of Social Robotics*, *10*(5), 643–668.

Willard, C. A. (1976). On the utility of descriptive diagrams for the analysis and criticism of arguments. *Communications Monographs*, *43*(4), 239–258.

Williams, D. M., & Rhodes, R. E. (2016). The confounded self-efficacy construct: conceptual analysis and recommendations for future research. *Health psychology review, 10*(2), 113–128.

Winslow, S., DeGuzman, P., Kulbok, P., & Jackson, S. (2014). Nurses' self-efficacy and academic degree advancement. *Journal for nurses in professional development, 30*(3), 110–116.

Wrzesniewski, A., & Dutton, J. E. ( 2001). Crafting a job: Revisioning employees as active crafters of their work. *Academy of Management Review*, *26*, 179–201. doi:10.5465/AMR.2001.4378011

Wrzesniewski, A., McCauley, C. R., Rozin, P., & Schwartz, B. (1997). Jobs, careers, and callings: People's relations to their work. *Journal of Research in Personality*, *31*, 21–33.Zsiga, K., Edelmayer, G., Rumeau, P., Orsolya, P., Tóth, A., & Fazekas, G. (2013). Home care robot for socially supporting the elderly: Focus group studies in three European countries to screen user attitudes and requirements. *International Journal of Rehabilitation Research*, *36*(4), 375–378.

# APPENDIX A

Linear regression validating the construct of robotization readiness

**PERCEIVED USEFULNESS OF CARE ROBOTS**[a]

| | *Beta* | *t* | *p* |
|---|---|---|---|
| (Constant) | | 2.163 | <0.005 |
| ROBOTIZATION READINESS | 0.140 | 3.593 | <0.001 |
| PERCEIVED EASE OF USE | 0.136 | 3.379 | <0.005 |
| PERCEIVED ADAPTIVITY | 0.571 | 14.262 | <0.001 |
| USE-RELATED ANXIETY | -0.090 | -2.270 | <0.005 |
| *Adjusted R2* | | 0.440 | |

a. Composite variable of perceived usefulness of four care robot types