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Assistant nurses and orientation to care robot use in three European countries

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ABSTRACT

This study investigates assistant nurses' views on and needs for orientation to care robot use in three European countries. The use of care robots is gradually being incorporated into welfare services. Orientation to care robot use (in short, introduction to the use of the care robot technology) has thus become a key issue for care services. A survey was sent to assistant nurses in Finland, Germany, and Sweden, to which 302 participants responded (Finland $n = 117$; Germany $n = 73$; Sweden $n = 112$). Only 11.3% of assistant nurses had experience of giving orientation to care robot use to older adults or colleagues, but over 50% were willing to do so. Those with experience of using care robots should take part in orientation. Orientation to care robot use should be seen as part of care management and an issue that may affect the whole organisation. Management should, firstly, allow assistant nurses to get to know care robots by offering information, and secondly, consider with the assistant nurses the ways care robots can change their work and the implications of this change. Emphasising the social factors and practical orientation to care robot use extends the previous theories and perspectives of technology acceptance, adoption and diffusion.

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Orientation to care robot use; assistant nurse; survey

1. Introduction

Care work has become increasingly digitally supported in recent years; there is also a rising societal interest towards using robots in care services (Pedersen and Wilkinson 2018; Pekkarinen et al. 2020), for instance, in residential care facilities (Khaksar et al. 2021; Melkas et al. 2020; Chu et al. 2017). The current situation related to care robots is dynamic in numerous Western societies in terms of expected benefits and fears, which are often competing (Pekkarinen et al. 2020). That is, despite the great interest and expectations towards care robots as part of solving staff shortage and facilitating prolonged independent life, many fears also exist, for example, related to a possible lack of humanity in care and a loss of jobs (Tuisku et al. 2019). These fears, in addition to technical restrictions, may hinder the larger implementation of care robots in care (Pekkarinen et al. 2020). Another point is that there are many research and pilot projects in the field, but the availability of commercial products and actual implementation of robots in care is still scarce (Bedaf, Gelderblom, and de Witte 2015; Pekkarinen et al. 2020). Potential users – assistant nurses – are thus quite inexperienced.

The small amount of experience in real life while there are also high expectations and considerable public debate relate to technology acceptance. Most care workers have to rely on second-hand information which might shape their expectations (see e.g. Johansson-Pajala et al. 2020; Pekkarinen et al. 2020). In our study, we analyse whether assistant nurses are aware of their insufficient knowledge base concerning care robots and whether they themselves would be able to find better ways of orientation to care robot use, referring here to introduction to technology use and its familiarisation. As a result, orientation to care robot use would be associated with a more realistic picture of robots and a more nuanced technology acceptance and adaptation in care settings.

Care robots are defined as partly or fully autonomous machines performing care-related activities for people with physical and/or mental disabilities related to age and/or health restrictions (Goeldner, Herstatt, and Tietze 2015). Care robots may assist older adults and/or people with disabilities in daily activities or improve their quality of life by enhancing their autonomy (Herstatt, Kohlbacher, and Bauer 2011) and providing protection (Goeldner, Herstatt, and Tietze 2015). Wu, Fassert, and Rigaud (2012) categorise care robots as monitoring robots (helping to observe health behaviours), assistive robots (offering support for the older

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adults and their caregivers in daily tasks), and socially assistive robots (providing companionship).

The use of care robots may enable older adults to stay independent in their own home, rather than moving to full-time residential care (Davey et al. 2004). Most people prefer to remain independent and connected with their social network, including friends and family (Rantz et al. 2005; Wiles et al. 2009). Care robots may also assist care workers, for example, assistant nurses, in their daily tasks (Melkas et al. 2020), by dispensing more time to perform the tasks where human touch is needed (Bush 2001). A more refined categorisation of care robots is provided by Niemelä et al. (2021), who classify robotic applications and services according to their use contexts and purposes, differentiating between robots created to (a) maintain independence and participation of the older adult, (b) improve efficiency and ergonomics of the care worker, (c) improve recreation and non-physical rehabilitation and therapy, (d) automate secondary tasks in care, (e) improve physical rehabilitation therapy and experience, (f) support manual work, e.g. in terms of precision or heavy lifting, and (g) support logistics and safety in hospitals.

Depending on the context or task, various types of robots can be used. For example, older adults who live in their own homes might benefit from a medicine-dispensing robot (Rantanen et al. 2017), fall prevention (Fischinger et al. 2016) or social robots (de Graaf and Allouch 2013; de Graaf, Allouch, and Klamer 2015), whereas those who live in care facilities may benefit from personal hygiene robots (Klein and Schlömer 2018) as well as social robots (Chu et al. 2017; Gustafsson, Svanberg, and Müllersdorf 2015; Melkas et al. 2020). In addition, care workers may benefit from, for example, transportation robots (Hennala et al. 2017) or robots assisting in physical (lifting) tasks (Turja et al. 2020). Nevertheless, besides positive impacts, care robots also are known to have negative (or neutral) impacts on both older adults and their care workers (Khaksar et al. 2021; Khosravi and Ghapanchi 2016; Melkas et al. 2020), as they may lead to more isolation and less personal touch. Additionally, the process of implementation at home may be complicated (de Graaf and Allouch 2013). There are also reciprocal perceptions toward human-robot interactions: robots can be seen either as caregivers responding to human needs, but humans can even adopt the role of a robot's caregiver – the robot being the one that needs care (Dautenhahn 2007; Kim, Park, and Sundar 2013). The reciprocal interaction makes a difference in how users perceive and evaluate robots (for details, see Kim, Park, and Sundar 2013).

Thus, despite the various technological possibilities, the implementation of robots in care is still underdeveloped, and best practices for how to start and manage the use of robots are lacking (Johansson-Pajala et al. 2020). According to the study of Johansson-Pajala et al. (2020), concerning various stakeholders (older adults, relatives, professional caregivers and care service managers), there is a lack of knowledge regarding general questions about what a care robot is, what it can do and what is available on the market. Detailed information was also requested by the stakeholders concerning benefits related to the individuals' specific needs (Johansson-Pajala et al. 2020). In this article, we suggest that focusing on *orientation to care robot use* is a central perspective when introducing care robots. We define the orientation to care robot use as the continuous co-creative process of introduction to technology use and its familiarisation, including learning of multi-faceted knowledge and skills for its effective use (Johansson-Pajala et al. 2020; Melkas et al. 2020). This definition can be regarded as complementing existing technology acceptance and diffusion models by focusing on the *process of how adoption and acceptance of robot technologies can be facilitated, and on understanding this process as inherently social action taking place among orientation givers and receivers, in addition to a more individual-level action.*

In care work, assistant nurses are an important part of the care personnel. In Nordic health and social care, they are the largest professional group (Ailasmaa 2015) and work at the grassroots level, closest to the older adults with care needs. However, they are an often-forgotten group in research when it comes to technology use (Hegney et al. 2007; Glomsås et al. 2020). Understanding their perspectives and needs for orientation to care robot use may be seen as key to the implementation of care robots. Assistant nurses support with basic care, such as checking vital signs, bed-making, and giving baths, and therefore interact with and care for older adults more frequently than registered nurses and physicians (MedicineNet n.d.). Assistant nurses are both receivers and providers of orientation to care robot use, and thus have a role of 'mediators' of knowledge related to the care robot use. In this sense, they are a critical group, as orientation to care robot use is essentially related to a mixture of practical and professional knowledge assistant nurses possess. With the increased use of care robots and other welfare technology, assistant nurses' tasks are likely to include introducing new technology to older adults and supporting them in its use (Roelands et al. 2006; Øyen et al. 2018). Skills for that, as well as for their own technology use, are needed, and orientation to care robot use has the potential to provide those. To understand the role of assistant nurses (also as part of their work communities) in relation to robot technology use, and to contribute to future strategies for orientation to care robot use, this study examines assistant nurses' views of and need for receiving and giving orientation to care robot use in three European countries. We focus especially on comparing the differences in Finland, Germany and Sweden.

In addition, the unique characteristics of care robots set a demand to focus also on social factors of technology adoption and acceptance which the previous theories (for example, technology acceptance models) partly fail to address. These previous theories have not fully described the role of human-technology interaction due to their focus on prior technologies such as information systems in the workplace, PCs and laptops, which are to facilitate the process of a service, an activity or a task – as an interface – with no or hardly any interaction with the human user. However, the recent technologies such as robots require more interactions (especially social or rehabilitation robots or robots for people with intellectual disabilities). The variation between different technologies in terms of social influence has been noted, for instance, by Yang and Choi (2001). In addition, prior theories focused more on the technical side of technology adoption. UTAUT and TAM have to some extent brought other variables, such as social influence, as well (see, e.g. Bozan, Davey, and Parker 2015, 2016; Yang and Choi 2001), but their main focus has been on the technical side of the -human-technology interaction. To provide a more multi-faceted view of this interaction, in addition to the technical side, the theoretical contribution of our study is to highlight the social side in technology implementation. Institutional characteristics influence technology use with two major aspects of behavioural intentions: the creation of formal structures and the incorporation of institutionalised practices (Bozan, Parker, and Davey 2016). Bozan, Davey, and Parker (2015, 2016) distinguish between three types of institutional forces which affect user behaviour: coercive pressure (formal and informal pressures by powerful actors), normative pressure (a large number of adopters), and mimetic pressure (conscious and voluntary act of copying behaviour of those with higher status and respect) (see also Sherer, Meyerhoefer, and Peng 2016; Krell, Matook, and Rohde 2016). Therefore, it is essential to study social factors when taking technology into use.

The research questions to be answered in our study are: (1) What are the needs for receiving orientation to care robot use in terms of sources and types of information, and means of providing it? (2) What are the needs for giving orientation to care robot use in terms of willingness and participants? (3) What theoretical and managerial implications do these needs lead to? While responding to these, we will present results regarding assistant nurses' views on orientation to care robot use, including similarities and differences between the three countries we focused on. The aim of the present study is thus to explore assistant nurses' needs for as well as views and knowledge of orientation to care robot use in three European countries.

2. Theoretical background

2.1. Models of technology adoption

A variety of theoretical technology adoption and acceptance models have been developed and further refined (Khakurel 2018). These models include, for instance, the technology acceptance model (TAM; Davis 1986, 1989), adapted from the theory of reasoned action (TRA; Fishbein and Ajzen 1975), diffusion of innovations theory (DIT; Rogers 2010), the unified theory of acceptance and use of technologies (UTAUT; Venkatesh et al. 2003), the model of media attendance (la Rose and Eastin 2004), and Triandis' framework (Triandis 1979), which focus on different stages of technology adoption: familiarity with technology, use intention, adoption and post-adoption (Khaksar et al. 2021). Among them, the TAM is one of the most extensively cited theoretical models for predicting end-user acceptance of information and communication technology (ICT) before end-users have experienced it. The TAM predicts that user acceptance of any technology is determined by two factors: perceived usefulness and perceived ease of use (Dillon and Morris 1996; Khakurel 2018). The TAM has been further developed by several scholars, by either integrating other theories or by adding variables (Khakurel 2018).

Out of these types of theories, the most comprehensive effort is the UTAUT model (Venkatesh et al. 2003), which is an integrated model combining several elements of eight existing models. Venkatesh et al. (2003) and Nandwani and Khan (2016) identified core determinants of intention and usage of technologies as well as moderators of key relationships (i.e. performance expectancy, effort expectancy, social influence, facilitating conditions, self-efficacy, computer anxiety and attitude toward using technology). With further analysis, Venkatesh et al. (2003) theorised that performance expectancy, effort expectancy and social inference as the key constructs that have direct influence on behaviour intention to use the technology, whereas facilitating conditions has a direct impact on usage behaviour. In addition, Venkatesh et al. (2003) theorised that self-efficacy, computer anxiety and attitude toward using technology are the three indirect determinants of intention to use (see also Khakurel 2018).

The UTAUT attempts to explain usage intention, as well as subsequent usage behaviour (Alaiad and Zhou 2014). The UTAUT model has further been extended in several empirical studies. For example, Alaiad and Zhou (2014) identified four new constructs, including trust, privacy concerns, ethical concerns, and legal concerns. According to Venkatesh et al. (2003), the UTAUT provides a useful tool when assessing the success likelihood of new technology introductions. It helps to understand the drivers of acceptance in order to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems.

In order to understand the acceptance of assistive social robots, Heerink et al. (2010) developed the Almere model. The model was developed from the UTAUT model and 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 (Turja 2019). In addition to the Almere model, several other studies related to adoption and acceptance of care robots (e.g. Alaiad and Zhou 2014; Louie, McColl, and Nejat 2014; de Graaf and Allouch 2013; de Graaf, Allouch, and Klamer 2015; de Graaf, Allouch, and van Dijk 2018; Turja 2019) have been conducted. These studies mainly explain the acceptance, but not the actual process, of adoption and familiarisation, especially as social action, which the concept of orientation to care robot use – the focus of this study – refers to.

2.2. Focus on the role of social factors and the concept of orientation to care robot use

While the theories and models presented above focus broadly on explaining the determinants of technology adoption and acceptance, none of them really addresses *how* we can facilitate adoption and acceptance of technologies or understands adoption and acceptance as inherently social and continuous action (like orientation, as defined), taking place among orientation givers and receivers (in addition to more individual-level action) within workplaces. While, for instance, Tsai et al. (2019) note that technology anxiety could be overcome through technology's perceived usefulness, this does not yet provide answers as to how this perceived usefulness can be achieved in order to promote the adoption of technology. The models also tend to focus on (individual) behaviour. Moreover, specifically in the case of assistant nurses, they may not have a chance to choose whether to accept and adopt; rather, new technology is 'imposed on' them at the workplace. Therefore, the above-mentioned institutional theory and social factors in them should also be considered. Just as the study by Sherer, Meyerhoefer, and Peng (2016), our study is related to the need to account for the contextual environment of health care in technology adoption. Health care is an industry that not only is highly institutionalised but also has traditionally had a strong professional logic (Sherer, Meyerhoefer, and Peng 2016). Orientation to care robot use, the topic of our study, when identifying the needs for and practices of orientation, contributes to this contextual approach to technology adoption.

Glomsås et al. (2020) recently noted that the processes of facilitating technology implementation and user involvement among health professionals have rarely been studied. In their study on the process of welfare technology implementation in home care services, they found that most of the health professionals emphasised that more competence, information and collaborative arenas were necessary for involvement in the implementation process. They called for further studies on the process of implementing welfare technology.

Relating to the earlier models, and the different stages on technology adoption, notably, familiarity with technology and use intention but also adoption and implementation, we have chosen to focus on the concept of *orientation to care robot use* in this study. Orientation is inherently a process consisting of strong social action related to the introduction and familiarisation of technologies (see also Melkas 2013). Orientation to care robot use is defined herein as the *continuous co-creative process of introduction to technology use and its familiarisation, including learning of multi-faceted knowledge and skills for its effective use* (Johansson-Pajala et al. 2020; Melkas et al. 2020). 'Co-creative process' refers to collective action with differing roles and participants, and the importance of identifying opportunities and co-creating practical possibilities through a process of sharing knowledge in dialogue (Bergdahl et al. 2019). 'Introduction to technology use and its familiarisation' is related to user involvement among professionals in the implementation of technology in care services (Glomsås et al. 2020). 'Learning of multi-faceted knowledge and skills for effective use' refers to health professionals' involvement, knowledge and ownership, which have been shown to be important success factors in innovation processes in the workplace (Framke et al. 2019).

Referring to Venkatesh et al. (2003), orientation is particularly related to the 'facilitating conditions' construct. It is the *action of orientating* (oneself or others), not as a one-time activity, but an on-going process, which is someway continuous – in this case of assistant nurses, on a workplace. It is more than (initial) training; it is a process that should be able to 'absorb' critical views and questioning attitudes, too. The word 'orientation' itself does not have a self-evident positive nuance, like acceptance or adoption, but may be considered more neutral. Many studies stop at seeking to understand *what* affects the adoption of technology among assistant nurses and other staff members in care services, to provide new knowledge for introducing and implementing various technologies in care in the future. However, the orientation-related 'doing part' is missing. In innovation literature, the experience-based mode of learning and innovation is called the 'Doing, Using and Interacting' (DUI) mode (Berg Jensen et al. 2016); our understanding of orientation resembles that kind of thinking.

Orientation to care robot use (care robot orientation, as they have formulated the concept) has previously been studied by Johansson-Pajala et al. (2020), who identified three aspects to consider regarding care robot orientation: (1) what care robot orientation is, (2) who needs it and who should give it, and (3) how it should be conducted. To design proper orientation, however, we need to understand the current situation – how things are being done and what the needs are – of assistant nurses, in this case. Based on Johansson-Pajala et al.'s (2020) findings, a research design based on the abovementioned aspects (2) and (3) was developed, exploring the question of who should give orientation to care robot use and how it should be conducted. Thus, as mentioned in the introduction, the aim of the present study is to explore assistant nurses' needs for as well as views and knowledge of orientation to care robot use in three European countries. It also characterises orientation to care robot use in relation to technology acceptance and adoption theories, such as their social factors.

3. Methods

The study has a quantitative approach responding to the questions above. An online survey questionnaire was developed by the authors based on previous findings from earlier research (Johansson-Pajala et al. 2020). We utilised the who and how aspects of orientation emerging in their research and created the survey questions based on those aspects.

3.1. Data collection

Data were collected from assistant nurses in three European countries – Finland, Germany and Sweden. Respondents answered the survey in their native languages, and their answers were then translated into English. Possible cultural differences were paid special attention to when designing the survey, for example, by mentioning culturally adopted examples of care robots. The researchers coming from different countries discussed the concepts together (researcher triangulation) to make sure that the terminology is understandable in every language but still not lose comparability of the data. Otherwise, the survey was similar in every country. The product examples of robots (for instance, what is meant with a telepresence robot) were however chosen so that they were familiar in the country in question. The study followed the principles outlined in the Declaration of Helsinki of 1975, as revised in 2000 and 2008.

Respondents from the three countries were recruited using local contacts by the researchers and national assistant nurses' associations using snowballing research strategy. In Finland, the survey was sent through three social and healthcare districts. In Germany, the survey was distributed by local trade unions to assistant nurses working in municipalities and sent directly to local elderly care institutions. In Sweden, the survey was distributed, through the management of the health and care administration, to all assistant nurses working in a medium-sized municipality in Sweden. Respondents were asked to participate via the online survey. The survey was sent out at the same time in each country. In Sweden and Finland, the survey was open for three weeks in November-December 2019, and for somewhat longer in Germany. The organisations that helped to distribute the survey for assistant nurses used e-mails, organisations' intranet channels, newspapers advertisements and other communication channels to reach the respondents.

3.2. Respondents

A total of 302 assistant nurses responded to the survey (Finland $n = 117$; Germany $n = 73$; Sweden $n = 112$). The background data of the participants are presented in Table 1.

3.3. Data analysis

The analysis focuses on two categories: (1) receiving orientation to care robot use and (2) giving orientation to care robot use. Receiving orientation to care robot use was studied via the following questions:

(1) From which source did you acquire information about care robots?

Table 1. Background data of the participants.

Background information		Country		
		Finland	Germany	Sweden
Gender	Female	113	54	96
	Male	4	19	15
	Other	–	–	1
Age	Mean (range)	41.8 (19–62)	47.4 (24–65)	48.1 (25–65)
Social and healthcare field	Hospital	0	12	0
	Primary healthcare	10	0	0
	Elderly care institutions	43	35	46
	Accommodation for disabled	1	2	19
	Home care	54	15	38
	Other	9	9	9
Years working in current field	Mean (range)	9.7 (0–38)	17.1 (0–39)	15.9 (0–46)
Level of knowledge on care robots	Very good	1	0	4
	Quite good	15	5	15
	Not good nor bad	34	32	47
	Quite poor	45	22	28
	Very poor	22	14	18
Experience with care robots[a]	Animal robot (e.g. Paro, Justocat)	1.02	1.11	1.09
	Humanoid robot (e.g. Zora/NAO, Pepper)	1.03	1.01	1.02
	Telepresence robot (e.g. Giraff)	1.0	1.01	1.07
	Transportation robot (e.g. TUG)	1.0	1.07	1.03
	Rehabilitation robot (e.g. Exoskeleton)	1.01	1.04	1.01
	Personal hygiene robot (e.g. shower robot)	1.01	1.0	1.04
	Medication distribution robot (e.g. Evondos)	1.35	1.0	1.02
	Meal assistance (e.g. Bestic)	1.04	1.01	1.03
	For physical assistance (e.g. Bioservo glove)	1.0	1.84	1.01
	Other	1.06	1.0	1.03

[a]Responses are average scores of 1 = *have not used*, 2 = *used once or twice*, and 3 = *use regularly*.

(2) How would you like the use of care robots to be introduced to you?
(3) What kind of information do you need to be interested in using care robots?

Question 1 was multiple-choice, from which respondents could choose as many as they wished. Questions 2 and 3 were also multiple-choice, but respondents could choose up to three answers.

Giving orientation to care robot use was studied via the following questions:

(4) Are you willing to pass along information about care robots to others?
(5) Have you given orientation on care robots to others, for example, colleagues or clients/older adults/relatives?
(6) When orientation on a care robot is given to clients/older adults, who should take part in the process?
(7) When orientation on a care robot is given to relatives of clients/older adults, who should take part in the process?
(8) When orientation on a care robot is given to colleagues, who should take part in the process?

Question 4 was a single-answer question; respondents had to choose only one of the four options: 1 = *Yes, but only once*; 2 = *Yes, whenever needed*; 3 = *Yes, I would like to be a 'super-user' and teach others regularly*; 4 = *No*. Question 5 was a yes-or-no question. Questions 6, 7 and 8 were multiple-choice, from which respondents could choose up to three options.

Data were analysed using 3 (country) × *number* (number of factors in each question) two-way repeated-measures analysis of variance (ANOVA; reported as the F statistics with df) to find out the differences in responses between the different countries. For multiple-choice questions, each option was treated as a single variable. When a statistically significant two-way interaction was found, one-way ANOVA was utilised. Bonferroni-corrected pairwise comparisons were used for post-hoc analysis. Only statistically significant results are reported. All statistical analyses were performed with IBM SPSS Statistics for Windows, version 26. In the figures, mean values ± standard error of the means (S.E.M.s) are presented.

Age was used as a control variable, and the results are reported separately.

4. Results

4.1. Receiving orientation to care robot use

4.1.1. From which source did you acquire information about care robots?

Figure 1 shows the breakdown of responses for each option. Two-way 3 (country) × 11 (source of information) ANOVA showed a statistically significant

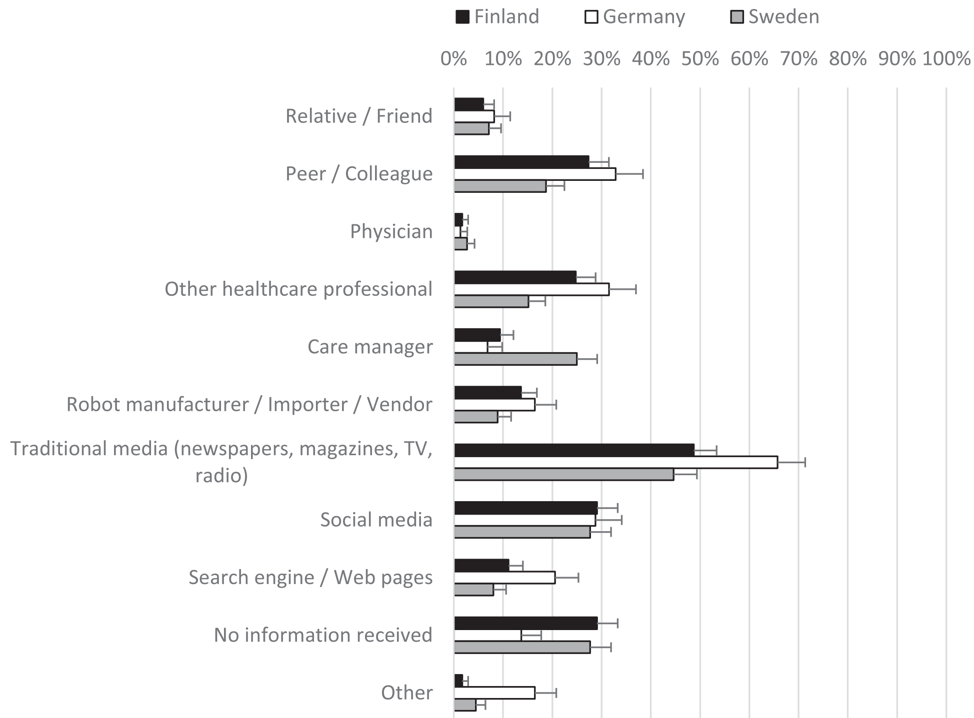

Figure 1. The breakdown of responses: source of information on care robots. The mean values (± S.E.M.s) are presented.

main effect on country $F(2,144) = 4.1$, $p < 0.05$, a statistically significant main effect on source of information $F(10,720) = 32.1$, $p < 0.001$, and significant interaction between country and source of information $F(20,1440) = 3.5$, $p < 0.001$.

Due to the statistically significant interaction, separate one-way ANOVAs for each of the information sources were performed with country as the dependent variable.

For *care manager*, one-way ANOVA showed a significant main effect of country $F(2,144) = 7.0$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *care manager* significantly more often than respondents from Germany (MD = 0.21, $p < 0.01$).

For *traditional media*, one-way ANOVA showed a significant main effect of country $F(2,144) = 5.4$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *traditional media* significantly more often than respondents from Sweden (MD = 0.27, $p < 0.05$).

For *search engine/web pages*, one-way ANOVA showed a significant main effect of country $F(2,144) = 4.5$, $p < 0.05$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *search engine/web pages* significantly more often than respondents from Sweden (MD = 0.14, $p < 0.05$).

For *no information received*, one-way ANOVA showed a significant main effect of country $F(2,144) = 3.6$, $p < 0.05$. Post-hoc pairwise comparisons were not statistically significant.

For *other* (information sources), one-way ANOVA showed a significant main effect of country $F(2,144) = 7.5$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *other* significantly more often than respondents from Finland (MD = 0.15, $p < 0.01$) and from Sweden (MD = 0.12, $p < 0.05$).

4.1.2. How would you like the use of care robots to be introduced to you?

Figure 2 shows the breakdown of responses. Two-way 3 (country) × 8 (introduction method) ANOVA showed a statistically significant main effect of introduction method $F(7,504) = 49.5$, $p < 0.001$, and statistically significant interaction between country and introduction method $F(14,1008) = 7.9$, $p < 0.001$.

Due to the statistically significant interaction, separate one-way ANOVAs for each introduction preference were performed with country as the dependent variable.

For *one individual introductory session (face-to-face)*, one-way ANOVA showed a significant main effect of country $F(2,144) = 4.4$, $p < 0.05$. Post-hoc pairwise comparisons showed that respondents from Germany (MD = 0.19, $p < 0.05$) and Sweden (MD = 0.19, $p < 0.05$) chose the option *one individual introductory session* significantly more often than respondents from Finland.

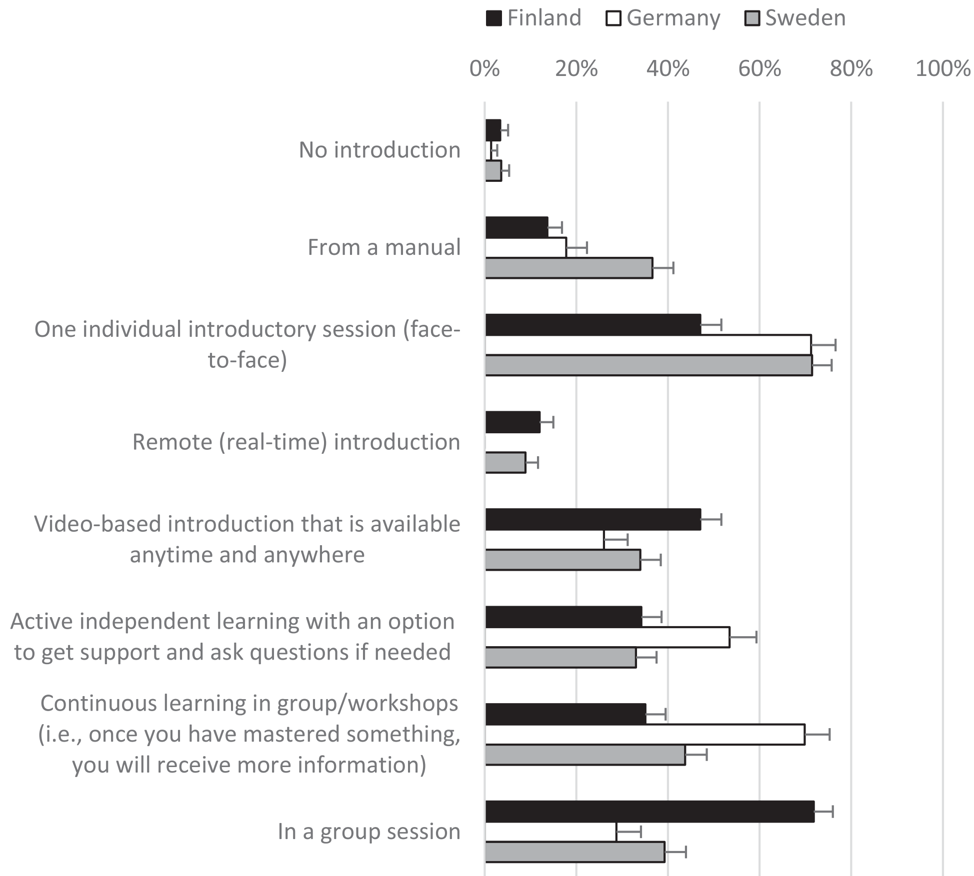

Figure 2. The breakdown of responses: introduction method preference. The mean values (± S.E.M.s) are presented.

For *one remote (real-time) introduction*, one-way ANOVA showed a significant main effect of country $F(2,144) = 3.6$, $p < 0.05$. Post-hoc pairwise comparisons showed that respondents from Finland (MD = 0.09, $p < 0.05$) and Sweden (MD = 0.09, $p < 0.05$) chose the option *remote introduction* significantly more often than respondents from Germany.

For *video-based introduction*, one-way ANOVA showed a significant main effect of country $F(2,144) = 3.3$, $p < 0.05$. Post-hoc pairwise comparisons were not statistically significant.

For *active independent learning*, one-way ANOVA showed a significant main effect of country $F(2,144) = 6.1$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *active independent learning* significantly more often than respondents from Sweden (MD = 0.26, $p < 0.01$).

For *continuous learning*, one-way ANOVA showed a significant main effect of country $F(2,144) = 17.2$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *continuous learning* significantly more often than respondents from Finland (MD = 0.36, $p < 0.001$) and from Sweden (MD = 0.43, $p < 0.001$).

For *group session*, one-way ANOVA showed a significant main effect of country $F(2,144) = 18.9$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Finland chose the option *group session* significantly more often than respondents from Germany (MD = 0.44, $p < 0.001$) and from Sweden (MD = 0.36, $p < 0.001$).

4.1.3. What kind of information do you need to be interested in using care robots?

The five response options and their country-proportions were:

Technical information: Finland 33.3%, Germany 28.7%, Sweden 40.2%

Benefits of care robots for the client: Finland 88.9%, Germany 80.8%, Sweden 86.6%

What are the tasks of a care robot: Finland 82.1%, Germany 64.4%, Sweden 75.0%

How the care robot could assist you in your work: Finland 81.2%, Germany 86.3%, Sweden 76.7%

How the care robot was paid for: Finland 7.7%, Germany 21.9%, Sweden 3.5%.

Two-way 3 (country) × 5 (type of information) ANOVA showed a statistically significant main effect of type of information $F(4,288) = 115.62$, $p < 0.001$, and a statistically significant interaction between country and type of information $F(8,576) = 2.34$, $p < 0.05$.

Due to the statistically significant interaction, separate one-way ANOVAs for each type of information were performed with country as the dependent variable.

On the option of *how the care robot was paid for*, one-way ANOVA showed a significant main effect of country $F(2,144) = 6.49$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Germany chose the option *how the care robot was paid for* significantly more often than respondents from Sweden (MD = 0.18, $p < 0.01$).

4.2. Giving orientation to care robot use

4.2.1. Would you be willing to pass along information about care robots to others?

Overall, in Finland 66.7% responded *yes* (one of the three options), in Germany 75.4% and in Sweden 42.4%. *Yes, but only once* was given in Finland by 3.4%, Germany 2.7%, and Sweden 4.4%. *Yes, whenever needed* was given in Finland by 53.8%, Germany 41.1%, and Sweden 25.0%, *Yes, I would like to be a 'super-user' and teach others regularly* was given in Finland by 9.4%, Germany 31.5%, and Sweden 12.5%. No response was given by 33.3% in Finland, 24.6% in Germany, and 58.0% in Sweden.

One-way ANOVA using country as the dependent variable showed a statistically significant main effect of country $F(2,144) = 5.87$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Finland (MD = 0.47, $p < 0.05$) and Germany (MD = 0.45, $p < 0.05$) were more willing to pass along information about robots than respondents from Sweden.

4.2.2. Have you given orientation on care robots to others, for example, colleagues or clients/older adults/relatives?

Only 11.3% of respondents chose *Yes* (Finland 8.5%; Germany 20.5%; and Sweden 8.1%) and 88.7% answered *No* (Finland 91.5%; Germany 79.5%; Sweden 91.9%).

4.2.3. When orientation on a care robot is given to clients/older adults, who should take part in the process?

The breakdown of responses are shown in Figure 3. Two-way 3 (country) × 8 (orientation attendee) ANOVA showed a statistically significant main effect of orientation attendee $F(7,504) = 84.45$, $p < 0.001$, and a statistically significant interaction between country and orientation attendee $F(14,1008) = 6.7$, $p < 0.05$.

Due to the statistically significant interaction, separate one-way ANOVAs for each orientation attendee were performed with country as the dependent variable. Only the statistically significant one-way ANOVAs are presented below.

For *peer/colleague*, one-way ANOVA showed a significant main effect of country $F(2,144) = 8.2$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Finland chose the option *peer/colleague* significantly more often than respondents from Germany (MD = 0.28, $p < 0.01$) or from Sweden (MD = 0.26, $p < 0.01$).

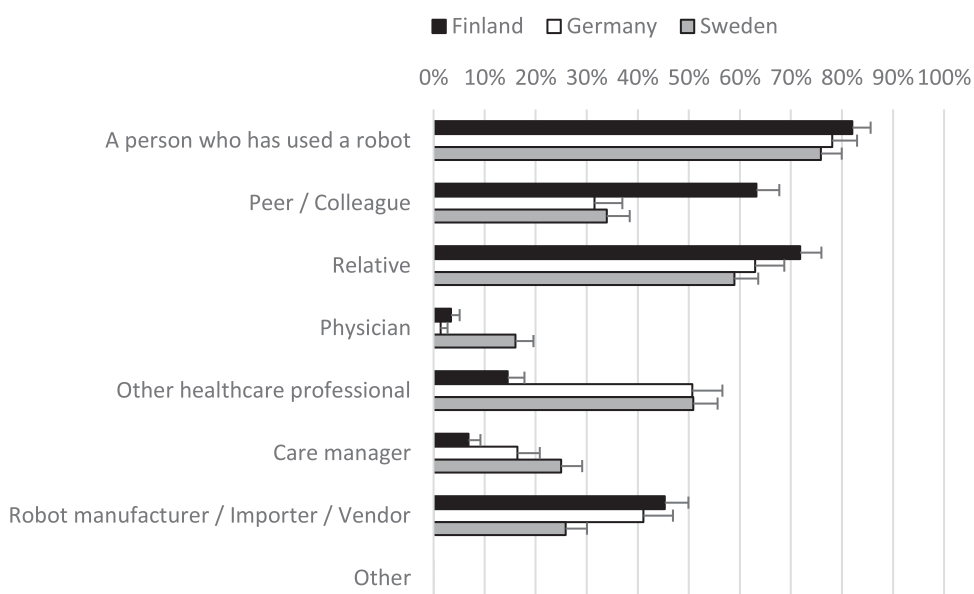

Figure 3. The breakdown of responses: who should take part in the process of giving orientation to care robot use to clients/older adults. The mean values (± S.E.M.s) are presented.

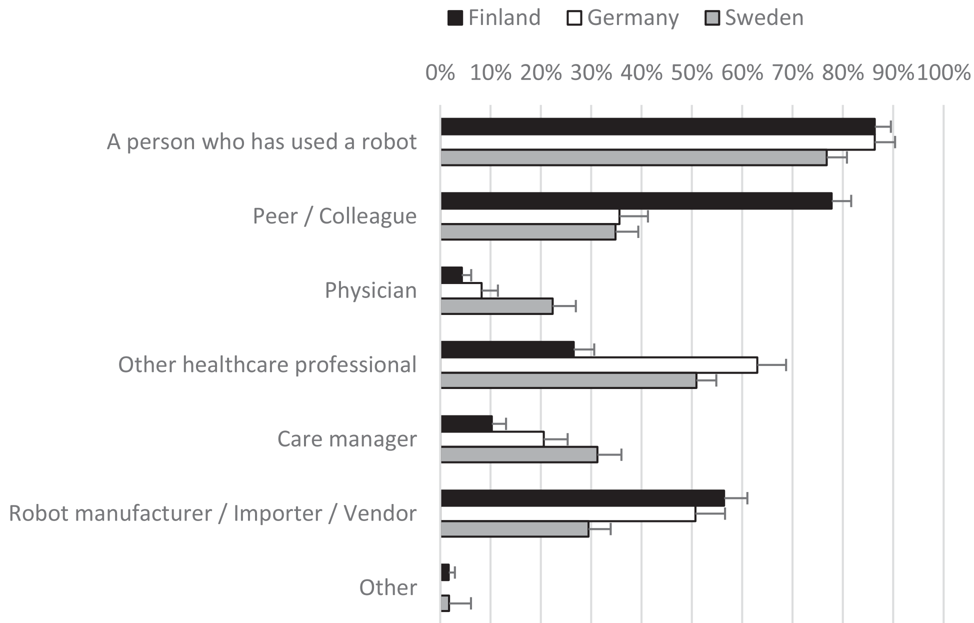

Figure 4. The breakdown of responses: who should take part in the process when giving orientation to care robot use to relatives of clients/older adults. The mean values (± S.E.M.s) are presented.

For (medical) *physician*, one-way ANOVA showed a significant main effect of country $F(2,144) = 7.5$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *physician* significantly more often than respondents from Finland (MD = 0.15, $p < 0.01$) or from Germany (MD = 0.26, $p < 0.01$).

For *other healthcare professional*, one-way ANOVA showed a significant main effect of country $F(2,144) = 16.8$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Germany (MD = 0.36, $p < 0.001$) and Sweden (MD = 0.43, $p < 0.001$) chose the option *other healthcare professional* significantly more often than respondents from Finland.

For *care manager*, one-way ANOVA showed a significant main effect of country $F(2,144) = 6.3$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *care manager* significantly more often than respondents from Finland (MD = 0.21, $p < 0.001$).

For *robot manufacturer/importer/vendor*, one-way ANOVA showed a significant main effect of country $F(2,144) = 4.2$, $p < 0.05$. Post-hoc pairwise comparisons showed that respondents from Finland chose the option *robot manufacturer/importer/vendor* significantly more often than respondents from Sweden (MD = 0.22, $p < 0.05$).

4.2.4. When orientation on a care robot is given to relatives of clients/older adults, who should take part in the process?

Figure 4 shows the breakdown of the responses. Two-way 3 (country) × 7 (orientation attendee) ANOVA showed a statistically significant main effect of orientation attendee $F(6,432) = 100.54$, $p < 0.001$, and a statistically significant interaction between country and orientation attendee $F(12,864) = 10.08$, $p < 0.001$.

Due to the statistically significant interaction, separate one-way ANOVAs for each orientation attendee were performed with country as the dependent variable. Only the statistically significant one-way ANOVAs are presented below.

For *peer/colleague*, one-way ANOVA showed a significant main effect of country $F(2,144) = 21.96$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Finland chose the option *peer/colleague* significantly more often than respondents from Germany (MD = 0.44, $p < 0.001$) or from Sweden (MD = 0.44, $p < 0.001$).

For *physician*, one-way ANOVA showed a significant main effect of country $F(2,144) = 3.65$, $p < 0.05$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *physician* significantly more often than respondents from Finland (MD = 0.13, $p < 0.05$).

For *other healthcare professional*, one-way ANOVA showed a significant main effect of country $F(2,144) = 10.27$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Germany (MD = 0.36, $p < 0.001$) and Sweden (MD = 0.27, $p < 0.01$) chose the option *healthcare professional* significantly more often than respondents from Finland.

For *care manager*, one-way ANOVA showed a significant main effect of country $F(2,144) = 8.07$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *care manager* significantly more often than respondents from Finland (MD = 0.25, $p < 0.01$).

For *robot manufacturer/importer/vendor*, one-way ANOVA showed a significant main effect of country $F(2,144) = 5.96$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Finland (MD = 0.25, $p < 0.01$) and Germany (MD = 0.23, $p < 0.05$) chose the option *robot manufacturer/importer/vendor* significantly more often than respondents from Sweden.

4.2.5. When orientation on a care robot is given to colleagues, who should take part in the process?

The breakdown of responses is shown in Figure 5. Two-way 3 (country) × 7 (orientation attendee) ANOVA showed a statistically significant main effect of orientation attendee $F(6,432) = 112.22$, $p < 0.001$, and a statistically significant interaction between country and orientation attendee $F(12,864) = 7.29$, $p < 0.001$.

Due to the statistically significant interaction, separate one-way ANOVAs for each orientation attendee were performed with country as the dependent variable.

For *physician*, one-way ANOVA showed a significant main effect of country $F(2,144) = 6.48$, $p < 0.01$. Post-hoc pairwise comparisons showed that respondents from Sweden chose the option *physician significantly* more often than respondents from Germany (MD = 0.14, $p < 0.05$).

For *other healthcare professional*, one-way ANOVA showed a significant main effect of country $F(2,144) = 10.78$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Germany (MD = 0.36, $p < 0.001$) and Sweden (MD = 0.23, $p < 0.01$) chose the option *other healthcare professional* significantly more often than respondents from Finland.

For *robot manufacturer/importer/vendor*, one-way ANOVA showed a significant main effect of country $F(2,144) = 16.85$, $p < 0.001$. Post-hoc pairwise comparisons showed that respondents from Finland chose the option *robot manufacturer/importer/vendor* significantly more often than respondents from Germany (MD = 0.32, $p < 0.001$) and Sweden (MD = 0.44, $p < 0.001$).

4.3. Control variable

As a control variable we used age. We performed a multivariate test for each question separately where we used the factors of each question as the dependent variable and the age as a control variable. Because we already reported the results for each of the questions, we report here only the questions where the control variable (age) had a statistically significant effect on the results.

For the question ‘from which source did you acquire information about care robots’, the age had a statistically significant effect for the option *media* $F = 5{,}07$, df = 1, $p < 0.05$. This shows that the *older* the respondent, the more this option was chosen.

For the question ‘how would you like the use of care robots to be introduced to you’, the age had a statistically significant effect on the option *from a manual* $F = 4.83$, df = 1, $p < 0.05$. This shows that the *younger* the respondent, the more this option was chosen.

For the question ‘when orientation on a care robot is given to clients or older adults, who should take part in

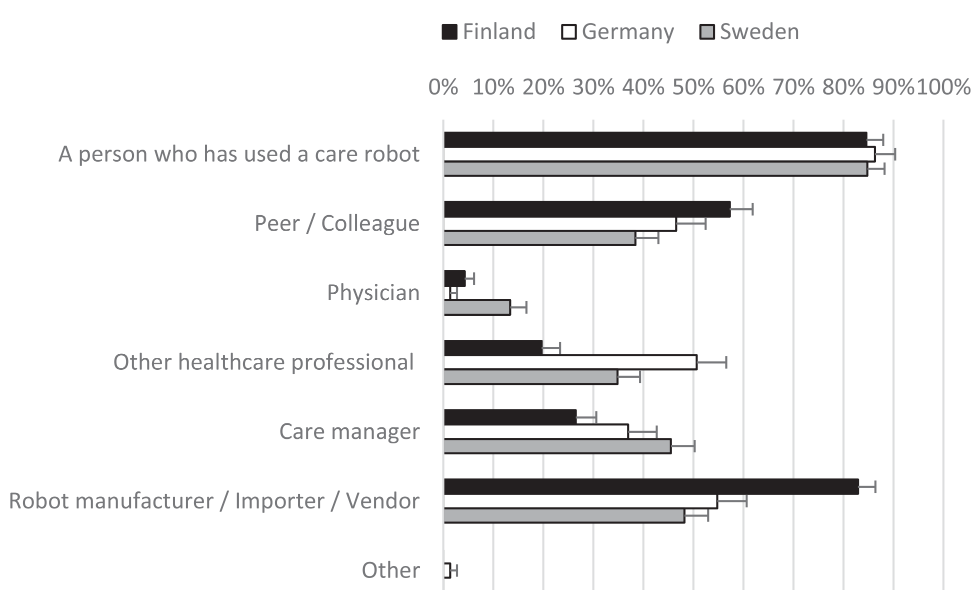

Figure 5. The breakdown of responses: who should take part in the process when giving orientation to care robot use to (respondent's) colleagues. The mean values (± S.E.M.s) are presented.

the process', the age had a statistically significant effect on the option *physician* $F = 4.91$, $df = 1$, $p < 0.05$. This shows that the *younger* the respondent, the more this option was chosen.

For the question 'when orientation on a care robot is given to relatives of clients or older adults, who should take part in the process', the age had a statistically significant effect on the option *other health care professional* $F = 4.76$, $df = 1$, $p < 0.05$. This shows that the *older* the respondent, the more this option was chosen.

5. Discussion

The aim of the present study was to explore assistant nurses' needs and views of orientation to care robot use in three European countries. We differentiated between receiving and giving orientation to care robot use from the standpoint of assistant nurses.

Regarding receiving orientation to care robot use, and more precisely, receiving information about care robots, the most selected source of information in all three countries was traditional media, which was selected by over 50% of respondents, suggesting that the issue is not being adequately discussed or highlighted in care settings, despite the demographic changes of an ageing population and shortage of care professionals, including assistant nurses (Peine et al. 2015). Further, respondents from different countries reported varying sources of information. Respondents from Germany reported having acquired more of their information from traditional media and search engines/web pages than did respondents from Sweden. Additionally, respondents from Germany indicated other information sources more often than did respondents from Finland. Quite interestingly, the neighbouring countries, Finland and Sweden, did not reflect statistically significant differences in sources of information. These results might be partly explained by the differences in attitudes toward care robots between these three countries, illustrated in a Eurobarometer survey (2012). Eurobarometer (2012) survey showed that 88% of Swedish and 80% of Finnish respondents had a positive view on robots while only 69% of German respondents indicated a positive view, which might explain the lack of difference in responses between the respondents from Finland and Sweden.

According to the analysis, the most important piece of information for the future user is the benefit of a robot, and second the knowledge on how the robot could assist caregivers in their work. This is in line with findings by Johansson-Pajala et al. (2020) suggesting that benefits of care robots need to be clearly communicated. Additionally, respondents from Germany showed more interest in the funding source of care robots than those from other countries. This was an interesting finding because the issue is often raised in public discussions in all countries, see, for example, Johansson-Pajala et al. (2020) and Tuisku et al. (2019).

In querying about receiving orientation to care robot use, varying methods emerged as the preference of respondents from different countries. For example, Finnish respondents preferred care robot introduction in a group session while German and Swedish respondents preferred individual introduction in a face-to-face meeting. Notably, all options preferred were face-to-face methods involving personal interaction, meaning that the participants did not wish to receive orientation without human contact, for example, by reading a manual. The least wanted option was the remote (real-time) introduction, regardless of its interactive features. This is contrary to recent trends in the education system, with the inverted classroom model moving away from pure face-to-face education (Handke and Sperl 2017). However, when considering the current situation with COVID-19 and more widespread remote work, it might be that these results would be different if the survey had been conducted after March 2020.

The education system can be used as an inspiration for how orientation to care robot use could be conducted. For example, the inverted classroom model has gained increased popularity in recent years within the education system. Rather than purely relying on face-to-face interactions, it additionally uses digital media allowing students to study on their own. As a result, it offers more diversity and flexibility to students (Handke and Sperl 2017). Considering this recent trend and its popularity, we expect assistant nurses on the receiving and giving end of orientation to care robot use to be open toward digital methods rather than just face-to-face interactions. Whatever the form, provision of sufficient time for learning is essential.

In assessing who should give orientation, the willingness of giving orientation is an important aspect. Our results imply a general willingness among respondents to give orientation in some capacity, with an average of 59.8% among the three countries. However, only 11.3% of all respondents had actually given orientation. The problem does not seem to be a lack of willingness; more likely, structured information dissemination channels for assistant nurses to obtain and pass along their knowledge are presently insufficient. This is in line with findings by Tuisku et al. (2019), who point out the lack of information dissemination and the lack of care robot related knowledge in society.

One limitation of this study is that respondents were asked to imagine how a care robot should be introduced to them and when they would be responsible for giving orientation to care robot use. As shown in Table 1, experience with care robots is still scarce, which makes it difficult to visualise actual orientation to care robot use. Moreover, results from different countries may be influenced by the structure of their welfare systems. In Finland and Sweden, older adults care services are tax funded and provided mainly by municipalities, while in Germany, welfare services are primarily funded by insurances.

Our findings on assistant nurses' views on orientation to care robot use imply that the introduction of technologies in care work require, for example, many levels of change management, knowledge management and personnel management. As Melkas (2013) noted, the starting point should be the recognition that orientation to technology use is a vital part of all care management. Thus, one of the practical implications of this study is that orientation to care robot use must be tailored to the specific country and especially to the local circumstances. This linking to the local circumstances is also a policy-making issue in terms of the necessary resource allocation which often requires policy framing. Care managers are able to utilise the results when they plan the adoption of care robots and orientation to care robot use in their organisation. This activity may, in turn, lead to further suggestions for policymakers. Additionally, it is known that when technology in any form is introduced to welfare services, it affects not only individuals receiving services but also those providing them (Lupton 2013; Øyen et al. 2018).

Additionally, our findings imply that expected benefits of care robots need to be communicated and personally experienced. However, there is a lacking information flow within care settings considering that the most common information source for assistant nurses remains traditional media and above all, to inform themselves independently. Interestingly, in the absence of structured information and in the presence of high levels of uncertainty concerning the technology, nurses in our sample prefer to be introduced to the new technology by colleagues and in face-to-face introductions. This is in line with the Almere model of robot introduction and may explain why social influence is such a powerful moderator. Our study would actively prefer social influence by peers and own experience over word of mouth and passive information reception.

Thus, the lack in orientation to care robot use also does not seem to stem from a lack of interest on behalf of the assistant nurses as they show in our sample willingness to spread information to others, but barely do so. Maybe because of lacking structured knowledge and uncertainty in giving their unstructured self-gained knowledge to others. Therefore, rather than simply spreading more information, our study's practical implication would be that the process to efficiently disseminate information needs to be more accessible and that also opportunities to gain practical experiences with care robots should be enhanced to enable the assistant nurses to provide profound first-hand knowledge to others. Engström et al. (2009) described the implementation of ICT (e.g. monitors/alarms, communication technology) as a process of changing the attitudes of the staff from fear of losing control to perceiving the increase in control and security. Similar issues are likely to be raised in orientation to care robot use, and thus, orientation to care robot use may become a key issue for care workers' skills (Dustin 2006; Melkas 2013). Hence, in planning orientation to care robot use, those who have used care robots should participate in the orientation; thus, the care management should identify those who are willing to give orientation to care robot use and arrange possibilities to get to know various other types of care robots in face-to-face sessions with robot manufacturers, importers and/or vendors.

To summarise, social factors connected to institutional characteristics play a remarkable role in orientation to care robot use and thus also care robot adoption and acceptance. The preferred way of introduction to technologies is, according to this study, based on a face-to-face introduction. Taking these kinds of preferences into account emphasises the social dimension of technology acceptance models.

5.1. Theoretical implications

Modern technology, including assistive robots, are becoming more familiar and popular within care services. The focus of this paper was to shed light on orientation to care robot use, which describes the continuous co-creative process of introduction to technology use and its familiarisation, including learning of multifaceted knowledge and skills for its effective use. Theoretical technology adoption and acceptance models mainly explain the acceptance from the technical side, not the actual process of adoption and familiarisation as a social process and as human-technology interaction. The models do not really address how we can facilitate adoption and acceptance of technologies or understand adoption and acceptance as inherently social and continuous action taking place among orientation givers and receivers within workplaces. The models tend to focus on individual behaviour. The institutional theory, in turn, takes the social pressure into account. This is noted for instance in the study of Sherer, Meyerhoefer, and Peng (2016), which suggests that institutional forces (mimetic, coercive and normative) can have a major impact on technology adoption decisions in health care. Our study suggests the importance of normative forces in orientation to care robot use, referring here to the importance of those people in orientation who have earlier experience of the robot use. This is somewhat in contrast with the study of Krell, Matook, and Rohde (2016), who found that normative pressure did not have a significant effect on team competence. However, it must be noted that the context of their study is somewhat different as they focused on competences, not the orientation process, and they studied project teams, not individuals. Discussing the institutional theory and technology acceptance theories in this empirical study on orientation to care robot use expands the institutional theory's applicability to this emerging field of care robot use.

Orientation, again, is inherently a process consisting of strong social action related to the introduction and familiarisation of technologies (Johansson-Pajala et al. 2020; Melkas et al. 2020; see also Melkas 2013). It is social action with differing roles and participants. Identifying opportunities and co-creating of practical possibilities through a process of sharing knowledge in dialogue (Bergdahl et al. 2019) is essential. Orientation as the action of orientating oneself or others should be a someway continuous process, in this case of assistant nurses on a workplace. Critical views and questioning attitudes need to be absorbed in this process. Orientation does not have a self-evident positive nuance as a single word but may be considered a neutral activity. Paying attention to these social factors and practical orientation to care robot use extends the previous theories by helping to understand care robot acceptance from the human-technology interaction side.

The experience-based mode of learning and innovation, the DUI mode (Berg Jensen et al. 2016) emphasises doing things together, hands-on experience and interaction; our results pointed at that kind of a direction – the importance of those activities during the process of orientation. The theoretical contribution of this study lies in the positioning of orientation, especially orientation to care robot use, within the context of the theories and perspectives of (care robot) acceptance, adoption and diffusion as well as the institutional theory, emphasising the practical introduction and the social dimension in it.

6. Conclusion

To conclude our survey results, the most common information source when it comes to receiving orientation to care robot use is traditional media. Meanwhile, the preferred way of introduction to orientation to care robot use is based on face-to-face interactions. In these introductions, the most important pieces of information are considered to be the benefits of a care robot and how care robots can assist caregivers. Concerning giving orientation to care robot use, 59.8% of respondents showed a willingness to pass the information on robots in some capacity, whereas only 11.3% of respondents had actually given orientation to care robot use.

The results varied depending on the country. While Finnish respondents preferred introductions in a group session, German and Swedish respondents preferred an individual face-to-face introduction. Concerning the most common information sources, respondents from Germany reported having acquired more of their information from traditional media and search engines/web pages than did respondents from Sweden. Additionally, respondents from Germany indicated other information sources more often than did respondents from Finland. Having said this, respondents from Sweden and Finland did not significantly differ from each other within their reported sources of information. A major difference between the countries can be seen in the willingness to give orientation to care robot use, as respondents from Finland and Germany were on average significantly more willing to pass along information than Swedish respondents. In conclusion, emphasising the social factors and practical orientation to care robot use extends the previous theories and perspectives of technology (care robot) acceptance, adoption, and diffusion, as well as the institutional theory, emphasising the practical introduction and the social dimension in it.

The practical implications of this study are that orientation to care robot use must be tailored to the specific country and its welfare system and especially to the local circumstances. This affects how orientation is conducted in practice, for example regarding preferable ways of receiving/providing knowledge. Furthermore, rather than simply spreading more information, the process to efficiently disseminate information needs to be more accessible and also practically oriented. Our study highlights that orientation to care robot use requires information from peers and experience with robots. We assume that passive information such as media coverage cannot improve acceptance and adaption due to the high associated uncertainties with respect to benefits and expected utility. Thus, orientation relying on peers and experiences is preferred over passive information retrieval.

In order to accept the use of care robots, assistant nurses need knowledge about the usability; how care robots can assist them in their work as well as how the care of the clients/older adults is affected. Thus, management should involve the assistant nurses in change management, for example regarding planning and implementing the changes in work processes that come with the introduction of new technological solutions in care. Opportunities to gain practical experiences with care robots should also be enhanced to enable assistant nurses to provide profound first-hand knowledge to others. Assistant nurses who are interested in giving orientation to care robot use should be encouraged to do so, for example by acting as super-users and as such facilitate acceptance and adoption of care robot use in elderly care settings, both in residential care facilities and home care.

Disclosure statement

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