Informal Caregivers' Acceptance Towards In-Home Monitoring Technology for Home-Based Dementia care and Its Determinants

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Abstract

Background: Dementia cases are globally increasing in number while the residential care possibilities of elderly are limited and the workload of formal caregivers remains high. This, together with the preference of elderly for extended independent living, leads to most of dementia care being provided in-home by informal caregivers like spouses and children. However, providing informal care can result in much strain on the informal caregivers, in extreme cases making them the invisible second patient due to resulting stress-related illnesses. A possible solution to this issue is the employment of in-home monitoring technology for home-based dementia care, which enables informal caregivers to remotely monitor their care recipient and enables the care recipient to live at home for longer. More specifically, in-home monitoring technologies remotely provide informal caregivers with information regarding the safety, lifestyle and daily functioning of their loved one at any time. This intervention has the potential to relieve informal caregivers of people with dementia from the high burden they experience as a result of providing care. However, this potential and a successful implementation can only be realised if in-home monitoring technology is fully accepted by the end-users.

Objective: The objective of this study was to explore the general acceptance towards in-home monitoring technology among informal caregivers of people with dementia. In addition, their acceptance towards different monitoring technologies and towards different care scenarios in which in-home monitoring technology can be utilized was explored. Moreover, in search of possible determinants of user acceptance of in-home monitoring technology among informal caregivers of people with dementia, it was explored to what extent digital literacy, personal innovativeness and the size of care network an informal caregiver is part of are associated with their general acceptance towards in-home monitoring technology.

Methods: A cross-sectional quantitative study was conducted by means of an online survey. 110 participants took part which were acquired through a combination of non-probability convenience sampling and snowball sampling. Participants were informal caregivers of whom the digital literacy, personal innovativeness, size of care network, general acceptance towards in-home monitoring technology, acceptance towards different care scenarios in which in-home monitoring technology could be utilized and the acceptance towards different monitoring technologies was explored in the survey. To examine the levels of digital literacy, personal innovativeness and acceptance in the sample, descriptive statistics were used. Next to that, to examine differences in acceptance towards different care scenarios and towards different devices, Friedman's tests in combination with post-hoc Wilcoxon signed-rank tests were conducted. Furthermore, non-parametric Spearman correlation analyses were employed to

assess the relevant associations of digital literacy and personal innovativeness with the general acceptance towards in-home monitoring technology. Lastly, a non-parametric Kruskal-Wallis test was employed to assess the association of size of care network with informal caregivers' general acceptance towards in-home monitoring technology for home-based dementia care.

Results: Informal caregivers of people with dementia in the sample showed slightly positive levels of acceptance in general, towards different care scenarios and towards different monitoring technologies. Namely, for the general acceptance a median acceptance rating of 3.6 ($IQR = 0.89$) out of 5 was obtained. For the acceptance towards in-home monitoring technology for different care scenarios, median acceptance ratings ranged from 3.5 to 3.7 across the different scenarios. For the acceptance towards different types of monitoring technologies, the median acceptance rating for each different technology was 4.0, with interquartile ranges ranging from 1.0 to 2.0. Moreover, Friedman's tests indicated that informal caregivers' acceptance towards different scenarios ($F_r = 13.00$, $p = .011$) and towards different types of monitoring technologies ($F_r = 14.18$, $p = .007$) significantly differed. Namely, post-hoc Wilcoxon signed-rank tests indicated significant differences in acceptance between the scenario 'acute situations' and all other care scenarios, with 'acute situations' being the most accepted scenario. Also, significant differences in acceptance were found between visual devices and radiofrequency devices ($Z = -2.8$, $p = .004$), between visual devices and object-attached devices ($Z = -3.4$, $p = .001$) and between auditory devices and object-attached devices ($Z = -2.1$, $p = .037$), with visual and auditory devices being the least accepted respectively. For the explored associations, Spearman's rho indicated both digital literacy ($r_s = .22$, $p = .02$) and personal innovativeness ($r_s = .35$, $p = .00$) to be significantly correlated with the general acceptance towards in-home monitoring technology. Lastly, a Kruskal-Wallis test indicated no significant association ($p = .78$) between the size of care network an informal caregiver is part of and their general acceptance towards in-home monitoring technology for home-based dementia care.

Conclusions: In order to realise the potential of in-home monitoring technology for home-based dementia care, such a technology and its subsequent implementation must be fully accepted among end-users. This study found positive levels of acceptance in the sample as well as two significant predictors of user acceptance of in-home monitoring technology for home-based dementia care. Namely, the digital literacy and personal innovativeness of end-users must be adequately met in the pre- and post-implementation of in-home monitoring technology for dementia care. However, limitations in this study exist, and further research must be conducted into the acceptance of in-home monitoring technology for home-based dementia care and its determinants as well as into other factors that influence a successful implementation.

Introduction

Over the last years, rapid population ageing is taking place as a result of an increasing life expectancy and decreased fertility rate among people (Bai, 2014; Nichols & Vos, 2021). Namely, according to Lutz et al. (2008), the average age of the world's population is strongly rising with an average age of 29.7 in the year 2000 and a projected average age of 37.1 in the year 2040. More specifically, in Europe, the share of people aged 80 years and over is projected to have a two-and-a-half-fold increase by the year 2050, rising from 137 million to 425 million people being aged 80 or over (Eurostat, 2022). This trend of ageing in Europe as well as the entire world is accompanied by a range of societal issues. These issues pertain to multiple domains as ageing presents us with ethical, financial, political, social and environmental problems (Dixon, 2021). However, most importantly and central to this article is the drastic issue of the increased prevalence of age-dependent (chronic) health(care) problems. This trend following an ageing society puts increasing pressure on social care and health care systems and will result in reduced availability of caregivers in affected areas of health systems (Siegel & Dorner, 2017). An important division of these age-related (chronic) health(care) problems that accompany the ageing population involves the onset of dementia in elderly and its increased prevalence due to that same ageing of the population. As defined by the World Health Organization (WHO, 2021), ''dementia is a syndrome in which there is deterioration in cognitive function beyond what might be expected from the usual consequences of biological ageing''. At the time of writing of this report, 55 million people suffer from dementia globally and this number of sufferers is expected to be 139 million in 2050, with a projected dementia incidence of 10 million new cases per year, making it one of the major causes of disability and dependency among older people to which an effective cure has not yet been found ("Alzheimer's Disease Facts and Figures," 2020; WHO, 2021).

Dementia manifests itself in many different forms, often depending on the physiological cause, with Alzheimer's disease being the most prevalent by covering around 60-70% of all dementia cases (Dening & Sandilyan, 2015). This form of dementia is caused by genetical mutations in genes, making this type of dementia heritable (Alzheimer's society, 2020). Another type of dementia, namely vascular dementia, which is caused by damage to vessels that supply blood to the brain, accounts for up to 20% of all dementia cases. Furthermore, another type of dementia worth mentioning by accounting for 10-15% of all dementia cases is dementia with Lewy bodies, which are clumps in the brain that cause progressive dementia (Alzheimer's society, 2020). Due to the many different types of dementia, clear identifiable

boundaries of a number of types of dementia have not yet been established, often leading to a diagnosed co-occurrence of multiple types within an individual (Echávarri et al., 2012). Regardless of the type, however, dementia in general imposes great consequences on the sufferer, the care provider and on society. For the person with dementia, the illness imposes cognitive, psychological, physical and behavioural consequences that manifest differently depending on the type and the stage of development of their dementia, as dementia progresses through stages (WHO, 2021; Arvanitakis et al., 2019). In general, cognitively, the person with dementia will experience short-term memory loss and word-finding difficulties in early stages and additional memory loss in working memory and more expressive communication difficulties and language loss in later stages. Psychologically, the person with dementia will show signs of depression and apathy in earlier stages and additional delusions in later stages. Physically, the person dealing with dementia will experience gait impairment in early stages and frequent purposeless movement, seizures and parkinsonism in later stages. Lastly, behaviourally, the person with dementia will withdraw from social engagement and will experience disinhibition of behaviour in early stages and will show signs of aggression and hallucinations and episodes of wandering in later stages (Arvanitakis et al., 2019).

Due to the cognitive, psychological, physical and behavioural consequences of dementia along the previously described stages, people with dementia (PwD) become increasingly dependent on others for their own self-care (Gitlin et al., 2005). Moreover, Lord et al. (2016) have shown that there is a growing preference for PwD to live in their own homes as long as possible. This trend, in combination with an increasing shortage of professional in-home care providers and limited residential care possibilities, results in a big share of dementia care being provided in-home by informal caregivers like spouses, offspring and even acquaintances on a voluntary basis (Zwaanswijk et al., 2013). This brings consequences for both PwD and the informal caregiver. Namely, from the PwD's perspective, they might develop a sense of guilt towards their informal caregiver as a result of the burden they create for them by requiring their care (Urwyler et al., 2017). On the other hand, from the informal caregiver's perspective, Collins and Kishita (2019) state that such informal caregivers might be heavily burdened by their caregiving tasks. Burdened, in this context, entails the negative impact of providing informal dementia care on one's social and financial status as well as one's physical and emotional health. In extreme cases, informal caregivers might even develop a depression or other stress-related illnesses as a result of the intense burden of providing in-home dementia care (Collins & Kishita, 2019). Although informal caregivers somewhat relieve the professional care providers of their increased workload following the trend of an increasing prevalence of

dementia in combination with the preference of elderly for extended independent living in their own homes, the burden it puts upon themselves might cause them to be the 'invisible second patient', as stated by Wrede et al. (2021). Therefore, a solution to the remaining high workload of formal caregivers and the burden on informal caregivers is required.

The need for such a solution to both the needs of people with dementia and the needs of the (in)formal caregiver creates a broader societal issue. Namely, it concerns the organisation of care and its cost-effectiveness. One solution for ensuring the extended independent living of PwD in their own homes and simultaneously reducing the workload of formal caregivers even further - however without negatively impacting informal caregivers - is by implementing assistive eHealth technologies (Bastoni et al., 2021). According to Singhal and Cowie (2020), eHealth can be defined as ''the use of information and communication technology in support of health and health-related fields''. Furthermore, Bastoni et al. (2021) divide assistive eHealth technology in the field of informal dementia care into three different types; Namely, technology to be used 'by informal caregivers', technology to be used 'by PwD' and technology to be used 'with PwD'. Herein, technology to be used 'by informal caregivers' does not involve the active involvement of the PwD, whereas technologies to be used by and with PwD do. Therefore, a new potential assistive eHealth technology to be used by informal caregivers of PwD is in-home monitoring technology, which beneficially does not require much involvement of the PwD. For dementia care, in-home monitoring technology could be implemented to relieve informal caregivers of the burden of providing dementia care by allowing them to do more from a distance, which is especially important during the contemporary COVID-19 pandemic, herewith lessening the impact on their social and financial status as well as their physical and emotional health (Bastoni et al., 2021). More specifically, in-home monitoring technology remotely provides informal caregivers with information regarding the safety, lifestyle and daily functioning of their loved one at any time (Wrede et al., 2021). In this light, in-home monitoring technology is able to e.g. communicate about emergencies, potential risks for emergencies and (self-care) behaviour of PwD to the informal caregivers. Additionally, by facilitating informal dementia care by implementing such an assistive eHealth technology, formal caregivers are relieved of their high workload in this ageing society even further.

Although it seems promising, the implementation of in-home monitoring technology remains a complex mission as dementia care is mainly home-based, meaning that the issue of privacy and therefore the obtrusiveness of eHealth technologies play an important role (van Gemert-Pijnen et al., 2018). Subsequently, there is an increased need for innovative unobtrusive assistive eHealth technologies, meaning that in-home monitoring technologies like cameras and

microphones are less accepted and difficult to be implemented as they violate privacy to a great extent (Wrede et al., 2021). Following the trend of an increased need for innovative unobtrusive technologies, a shift in type of monitoring technology has been visible in the development of in-home monitoring technologies, moving from cameras and microphones to more recent and innovative forms of passive in-home monitoring technologies like motion-activated sensors and systems that analyse the body's reflection of radio waves by means of artificial intelligence (AI) (Wrede et al., 2021). Moreover, multiple types of monitoring technologies can nowadays be thought of, including wearable devices, visual devices, auditory devices, radiofrequency devices and object-attached devices. Therefore, in light of the obtrusiveness of different types of in-home monitoring technologies, it is an important direction for research to examine the acceptance towards different types of monitoring technologies that each differ in their obtrusiveness, as this also is an important factor for the pre- and post-implementation of in-home monitoring technologies (Townsend et al., 2011).

What's more, besides the importance of the functionality and obtrusiveness for a successful implementation of assistive eHealth technologies, is the actual continued utilization of such technologies after implementation. To ensure that in-home monitoring technology is actually used continually by end-users, there must be a fit between the technology, the context and the end-user(s) (van Gemert-Pijnen et al., 2018). In other words, for a successful implementation of in-home monitoring technology for dementia care, it is essential that their exists sustained acceptance of that same technology among end-users, namely the (in)formal caregivers in particular. Therefore, to establish such sustained acceptance, the end-user's perspectives must be frequently involved in the development process (pre- and post-implementation) of technology so that their needs of the technology can be warranted adequately (van Gemert-Pijnen et al., 2018). What's more unclear still today, however, are the determinants of technology acceptance among informal caregivers of PwD that should be identified in the development process (pre- and post-implementation) of technologies. This knowledge gap is an important direction for research in the field of dementia care and a focus point of this research article, as the aforementioned indicates how important the acceptance of a technology among end-users is for its implementation success (Greenhalgh et al., 2017).

Over the years, many theories and models of technology acceptance have been developed to assess the determinants of people's acceptance towards technology. In general, technology acceptance regards individuals' psychological properties that determine their voluntary adoption and utilization of newly introduced technologies (Alabdulkarim et al., 2021). One well-known and widely adopted model of technology acceptance is the Technology

Acceptance Model (TAM) by Davis (1989). In this model, technology acceptance is determined by two external influences, namely 'perceived usefulness' and 'perceived ease of use' of a technology. These two external factors in turn influence one's attitude and intention towards actual use of the technology (Alomary & Woollard, 2015). In addition to the TAM, another well-known theory of technology acceptance is the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT builds upon the TAM, mainly by including two additional variables, namely 'social influence' and 'facilitating conditions'. Although the TAM and UTAUT are the most widely used model and theory of technology acceptance, much criticism and limitations on these still exist (Malatji et al., 2020). Peek et al. (2014) and Malatji et al. (2020) state that although the TAM and UTAUT comprise variables that indeed seem to influence people's acceptance and adoption of technology, the model fails to include and specify other important and essential determinants of technology acceptance and adoption, especially among elderly. In addition, Peek et al. (2014) state that determinants of technology acceptance for aging in place might even fluctuate over time and differ for various types of assistive technology. These shortcomings might be explained by the fact that the TAM and UTAUT might not be applicable to all health contexts, e.g. the various contexts of home-based dementia care, where more factors besides just the technology are at stake (Scott et al., 2019).

Because of the inadequacy of the technology acceptance models and theories like the TAM and UTAUT, further research has to be conducted into possible determinants of technology acceptance among people and, more specifically to this research article, among end-users of in-home monitoring technologies for dementia care, in particular the informal caregivers as they provide the biggest share of the care. In this light, recent research has attempted to investigate antecedents of the TAM and UTAUT constructs of 'perceived usefulness', 'perceived ease of use', 'social support' and 'facilitating conditions', leading to the discovery of new and more concrete determinants of technology acceptance (Rosen, 2005). One of these determinants is the subjective digital literacy of technology consumers, which might be an antecedent of 'facilitating conditions' from the UTAUT. Namely, Lim (2009) has shown that the acceptance and adoption of ICT products by elderly and middle-aged people depend heavily on the degree to which the ICT products match their subjective level of digital literacy. This finding might be indicative of informal caregivers' subjective digital literacy having an association with technology acceptance in the scarcely researched domain of in-home monitoring technology for home-based dementia care. Moreover, more specific facets of general digital literacy have been shown by research to be more precise determinants of technology acceptance in the information technology domain (Rosen, 2005). One of these facets

in the general domain of digital literacy is the personal innovativeness of technology consumers, defined by Hurt et al. (1977) as 'willingness to change' (Jaschinski, 2018). Personal innovativeness traces back to the innovation diffusion theory by Rogers (1995), in which people react differently to an idea, object or practice because of individual differences in the trait of personal innovativeness. The concept of personal innovativeness has been shown predictive of technology acceptance in several domains, like the information technology domain (Agarwal & Prasad, 1998). This finding might be indicative of personal innovativeness having an association with technology acceptance in an even more specific domain of information technology which is yet scarcely researched, namely in-home monitoring technology for home-based dementia care.

Another area of investigation into the acceptance of in-home monitoring technology for dementia care among (in)formal caregivers of people with dementia (PwD) pertains to whether or not there exists a supportive network to provide the primary caregiver help in caregiving. Namely, it has been shown by research that the presence of a secondary caregiver for dementia care can significantly reduce the experienced burden of providing care for the primary caregiver (Gaugler et al., 2003). This reduced burden in turn might result in a lessened acceptance of the use of assistive technologies like in-home monitoring technology for dementia care because there is less of a need for assistance in providing care among informal caregivers. This further coincides with and can be substantiated by the association between willingness to pay for dementia care by informal caregivers and their caregiver burden. Herein, more caregiver burden is indicative of a higher willingness to spend money on caregiving assistance, as shown by Gustavsson et al. (2009). Since such in-home monitoring technologies for dementia care do not come without a price, the aforementioned further illustrates how the number of caregivers and the subsequent division of labour/burden in caregiving influences the need for (more) assistance and subsequently influences the acceptance of in-home monitoring technology for dementia care. Namely, by division of labour/burden through the inclusion of multiple caregivers, the need for more (costly) assistance by technology lessens, potentially reducing its acceptance. Furthermore, as large scale quantitative studies focussing on user acceptance of innovative (unobtrusive) in-home monitoring technologies are still scarce, all of these potential predictors allow room for further research into their association with technology acceptance and adoption with regards to home-based dementia care.

Therefore, following the aforementioned criticism and overreliance on the TAM, UTAUT and other technology acceptance models and following indications of new determinants of technology acceptance by previous research, it will be examined in this article

to what extent informal caregivers' digital literacy and personal innovativeness as well as the number of accompanying caregivers for a single person with dementia (PwD) are associated with informal caregivers' acceptance of in-home monitoring technology for home-based dementia care. Also, informal caregivers' general acceptance towards in-home monitoring technology for dementia care will be investigated as well as the acceptance towards different care scenarios and different technologies that can be used for in-home monitoring. Concludingly, the following research questions will be addressed:

1. What is the general acceptance towards in-home monitoring technology for people with dementia among informal caregivers of people with dementia?
2. Are there differences in the acceptance towards in-home monitoring technology for community dwelling PwD from the perspective of informal caregivers for different care scenarios?
3. Are there differences in the acceptance towards different types of in-home monitoring technologies for community dwelling PwD from the perspective of informal caregivers?
4. To what extent are the digital literacy and personal innovativeness of informal caregivers of people with dementia associated with their general acceptance of in-home monitoring technology for PwD?
5. To what extent is the number of active (in)formal caregivers for a single person with dementia associated with the general acceptance of in-home monitoring technology among informal caregivers for dementia?

Methods

Design

A cross-sectional quantitative study design by means of an online survey was employed in order to examine the general acceptance towards in-home monitoring technology for home-based dementia care among informal caregivers of people with dementia. Additionally, it was more specifically examined to what extent in-home monitoring technology was accepted by informal caregivers in different care scenarios and towards different types of monitoring technologies. Next to that, the potential associations between the digital literacy, personal innovativeness and size of care network of informal caregivers of persons with dementia and their general acceptance towards in-home monitoring technology for home-based dementia care were examined.

Participants

In order to assure that all recruited participants were legally allowed to take part in the study, individuals under the age of 18 were excluded. Furthermore, besides being 18 years or older, other inclusion criteria for this study entailed that participants had to be an informal caregiver, implicating they provide unpaid/voluntary care to a person with either dementia/mild cognitive impairment or general anility. Next to that, participants were excluded from participation if their care recipient resided in a care institution, as in-home monitoring technology would not be applicable in such environments. Lastly, participants were only able to take part in the study if they had sufficient proficiency in either Dutch or German, as these were the only survey translations available.

Participants were acquired through non-probability sampling, more specifically purposive sampling. Namely, Facebook self-help groups for informal caregivers for dementia were targeted to address potential participants. In consultation with the group moderators, members of these groups were invited to participate in the survey by means of a link that was posted on the message timeline of these groups. Furthermore, specific institutions in The Netherlands and Germany for informal caregivers and their care recipients that are dealing with dementia/general memory deterioration were contacted to fill in the survey through the survey link that was sent by email and distributed further to the informal caregivers by the institution's designated person. Moreover, it was requested alongside the invitation to share the link among their informal care networks in order to increase the response rate through snowball sampling.

Materials

For this study a quantitative survey (see Appendices A & B) was conducted. The survey first starts by collecting informed consent (see Appendix C) and both background and demographic characteristics. Collected background/demographic characteristics consisted of age, gender, education, country of residence, informal caregiver status, reason of care, relationship with care recipient, size of care network, geographical distance to care recipient, age of care recipient, type of dementia, time since appearance of dementia symptoms, living and housing situation of care recipient and whether or not the care recipient receives professional assistance. All background/demographic variables were measured using single-item scales, differing in measurement level, which will be described in next sections.

Of all relevant constructs to this study, namely the general acceptance of in-home monitoring technology for dementia care, acceptance towards different use scenarios of in-home monitoring technology, acceptance towards different monitoring technologies, digital

literacy, personal innovativeness and the number of accompanying caregivers, the first five were measured using multi-item scales and the number of accompanying caregivers was measured using a single-item scale as a background variable (size of care network). Since targeted participants mainly lived in The Netherlands and Germany, a German and Dutch translation (see Appendices A & B) of the survey was available. Participants were able to change the language of the questionnaire themselves using a setting in the online survey.

Background/Demographic variables

Firstly, the age of the respondent was asked in years, indicating a ratio measurement level. As for gender, treated as a nominal variable, three options were provided; 'male', 'female' or 'other'. For their nationality, respondents could indicate to be Dutch, German or other, meaning a nominal measurement level. For their education, measured with an ordinal scale, respondents were asked to indicate their highest completed education, dependent on the education system of the country and thus the language version of the survey. As for the country of residence, measured on a nominal scale, respondents had to indicate in which country they predominantly reside, with the answer options being 'The Netherlands', 'Germany' or 'other'. Next, using a nominal scale, participants had to report their informal caregiver status, either being one or not. Furthermore, reason of care was asked to the respondent by means of a nominal scale with 6 answer options; 'Dementia/mild cognitive impairment', 'Anility', 'Cardiovascular disease', 'Diabetes', 'COPD' or 'other'. Only if participants indicated to be an informal caregiver of a person with dementia, they were asked the question whether the dementia was formally diagnosed or not and if so, which type of dementia their care recipient was dealing with, both answered on a nominal scale. Subsequently, their relationship with the care recipient was asked using a nominal scale, with the answer options being 'spouse', 'daughter/son', 'stepdaughter/stepson', 'grandchild', 'neighbour' or 'other'. Next, in terms of the size of the care network, they were asked on an ordinal scale alongside how many (in)formal caregivers they provide care, with the answer options being 'I'm the only one', 'one other', 'two others', 'three others' and 'four or more others'. As for the geographical distance, participants were asked on an ordinal scale how far they were removed from their care recipient, expressed in time. Next, the age of the care recipient was asked in years, indicating a ratio measurement level. Finally, the living and housing situation of the care recipient and whether or not the care recipient receives professional assistance were both examined using a nominal scale.

Digital Literacy and Personal Innovativeness

To examine people's digital literacy in the healthcare domain, also called eHealth literacy, a subscale of the eHLQ was utilized, created by Kayser et al. (2018). In this subscale called 'ability to actively engage with digital services in the healthcare domain' of the eHLQ, participants were asked to what extent they agreed or disagreed with five shown statements based on an ordinal 4-point Likert scale ranging from 1 (= Strongly disagree) to 4 (= Strongly agree). However, digital literacy was treated as an interval variable, with a final digital literacy score being obtained by computing the mean of the 5 items of the scale, resulting in a final score between 1 to 4. An example of such an item is the following; ''I can enter data into health technology systems''. The psychometric qualities of the original subscale and its official translations are very satisfactory and robust with the composite scale reliability (CSR) of the utilized subscale being .86. Additionally, Cronbach's alpha was shown to be .86 for this subscale as well. Furthermore, supportive validity evidence was found for the eHLQ based on relationships with other variables, as stated by Cheng et al. (2021).

Personal innovativeness was examined using the scale "Personal innovativeness towards technology (PIIT)", developed by Agarwal and Prasad (1998). The scale contains four items and each item is measured on an ordinal 7-point Likert scale ranging from 1 (= Totally disagree) to 7 (= Totally agree). However, personal innovativeness was treated as an interval variable, with a final personal innovativeness score being obtained by computing the mean of the 4 items of the scale, resulting in a final score between 1 to 7. An example of such an item is the following; ''Among my peers, I am usually the first to try out new information technologies''. In addition, to counter potential acquiescence bias, one of the 4 items was worded negatively; ''In general, I am hesitant to try out new information technologies''. This item was recoded before computing participants' final personal innovativeness score. Furthermore, the psychometric qualities of the original scale are satisfactory. Namely, Cronbach's alpha indicates high reliability with a value of .84, implicating a good internal consistency of the scale. As for the Dutch and German translations, a Cronbach's alpha of .86 was obtained, implicating good internal consistency of the translations of the scale.

Acceptance of In-Home Monitoring Technology For Different Care Scenarios

A total of 5 scenarios/events for in-home monitoring technology were presented to the respondents; 'Acute situations', 'Risk prediction', 'Selfcare behaviour', 'Well-being during nights' and 'Long-term patterns'. These scenarios are derived from the study of Wrede et al. (2021), who identified important care related aspects in which in-home monitoring technology

could be utilized. Herein, 'acute situations' refers to informing the informal caregiver about emergencies that happened like episodes of falling, whereas 'risk prediction' refers to informing the informal caregiver about emergencies which might occur by monitoring e.g. the walking speed/pattern of the PwD. 'Selfcare behaviour' pertains to informing the informal caregiver about the selfcare, e.g. feeding and personal hygiene, of the PwD. 'Well-being during nights' refers to informing the informal caregiver about deviations from normal night patterns to assure PwD's nightly well-being. Lastly, 'long-term patterns' pertains to informing the informal caregiver about cognitive or physical changes/deterioration of PwD which develop over time. For each scenario a description, including example situations, was provided in the survey (see Appendix A & B). Respondents had to indicate their perceived acceptability (2 items), usefulness (7 items) and willingness to use (1 item) regarding in-home monitoring technology for each specific scenario by means of the same items per scenario. The 10 items in total would represent respondents' acceptance towards the different care scenarios. An example of such an item of 'perceived usefulness' is the following; '' Such a monitoring system would help my loved one to live at home for longer''. An example of such an item for 'acceptability' is the following; ''I consider it acceptable to collect this type of information, using the system''. An example of such an item for 'willingness to use' is the following; ''I am willing to use such a monitoring system in the (near) future''. All these items were measured on an ordinal 5-point Likert scale, ranging from 1 (= Totally disagree) to 5 (= Totally agree). However, the items were treated as being on an interval level, with participants' final acceptance score for each scenario being obtained by computing the mean of the 10 items of the scale per scenario. Furthermore, Cronbach's alpha for this scale (and its translations) ranged from .93 to .97 across the five care scenarios, indicating good reliability and internal consistency.

Acceptance Towards Different Monitoring Technologies

Next, respondents' acceptance towards different devices/technologies that could be used for monitoring their loved one that requires care was examined. Based on an ordinal 5-point Likert scale, respondents had to indicate to what extent they considered a range of five different monitoring devices/technologies acceptable, ranging from 1 (= Totally unacceptable) to 5 (= Totally acceptable). This variable was examined after the other acceptance variables so that participants had a clear image of in-home monitoring technology and its possibilities. The devices/technologies to which respondents had to indicate their perceived acceptability are the following; 'wearable technology (smartwatches, mobile phones, wearable alarm buttons)', 'vision-based technology (cameras)', 'Audio-based technology (smart speakers or

microphones)', 'Radiofrequency-based technology (centrally localized sensors that use radars to collect motion data)' and 'object-tagged technology (sensors that are attached to objects of daily use)'. Respondents' agreement in terms of acceptability towards each monitoring device provides an indication of the acceptance towards different in-home monitoring devices that are to be used in home-based (dementia-)care. Moreover, the items of this variable were treated as being on an interval level, with participants' final acceptance score for each device/technology ranging from 1 to 5. Furthermore, a Cronbach's alpha of .72 was obtained for this scale and its translations, indicating good reliability and internal consistency.

General Acceptance Towards In-Home Monitoring Technology

General acceptance towards in-home monitoring technology was examined by asking respondents to indicate to what extent they perceive in-home monitoring technology in general to be useful (2 item) and to what extent they were willing to use in-home monitoring technology (2 items). The two items for measuring perceived usefulness are 'I think in-home monitoring technology is useful for me at this point in my life' and 'I think in-home monitoring technology is useful for me when the physical/cognitive health of my loved one declines'. The two items for measuring willingness to use are 'I would use in-home monitoring technology in the care for my loved one at this point in my life' and 'I would use in-home monitoring technology in the care for my loved one when his/her physical/cognitive health declines'. Moreover, 5 additional items were included to examine the general acceptance towards in-home monitoring technology. An example of such an item is the following; 'My family and friends would react positively when I would use in-home monitoring technology in the care of my loved one'. All 9 items were measured on an ordinal 5-point Likert scale, ranging from 1 (= Totally disagree) to 5 (= Totally agree). However, general acceptance towards in-home monitoring technology was treated as an interval variable, with a participant's final score of general acceptance towards in-home monitoring technology being obtained by computing the mean of the 9 items of the scale in total. Furthermore, a Cronbach's alpha of .88 was obtained for this scale and its translations, indicating good reliability and internal consistency.

Procedure

The questionnaire was initially created in English and later on translated to both Dutch (see Appendix A) and German (see Appendix B) by the researchers using the method of forward-backward translation to match the targeted respondents, with the exception of some scales that had an official translation. The questionnaire was provided online via Qualtrics in

the two languages and participants were able to choose the language themselves via a setting in the online survey. Two middle-aged Dutch and two middle-aged German people voluntarily pre-tested the questionnaire for readability and clarity, which was subsequently proven adequate. Prior to data collection, ethical approval was granted from the ethical committee of the BMS faculty of the University of Twente with request number 220421.

The questionnaire was distributed with a short link by posting it on Facebook self-help groups for informal caregivers, especially those groups with a focus on informal care for dementia, and by emailing designated persons of dementia institutions to further distribute the link to informal caregivers within their institution. The link was accompanied by a very short textual explanation of the study in order to let people know where the link would redirect them to and who were targeted by the study. In addition to this, it was included in the textual explanation that there existed a possibility to win a price as an incentive for people to participate. Once they pressed on the link and were redirected to the survey, they were first presented with an informed consent form (see appendix C), which included a short briefing describing the study's purpose, practicalities and the targeted audience. After this, the participants were informed that taking part is voluntary and that they could withdraw from it at any point in time. Confidentiality in the handling of data was guaranteed and in case of questions or remarks, the researchers contact data were provided. Filling out the survey was only possible if the participants agreed to this informed consent.

After respondents provided informed consent to continue with the survey, they were presented with the questionnaire, in which the background/demographic, digital literacy, personal innovativeness and acceptance items were all presented. In filling out the survey, participants who either indicated to be below the age of 18 or indicated that they were not an informal caregiver or that their care recipient resided in a care institution were immediately directed to the end of the survey. Next to that, if respondents indicated their reason of care to be other than dementia/mild cognitive impairment or general anility, they were also excluded from further participation. Furthermore, the type of dementia and the time since symptoms of dementia was only asked to participants who indicated that their care recipient was formally diagnosed with dementia.

As a last step, participants were thanked for their participation and were reminded of their ability to contact the researchers for any clarification and of their chance of winning a price, as well as how the price giveaway would take place. In total, the survey took the participants about 15-20 minutes to complete.

Data Analysis

The data was analysed by usage of the statistical program SPSS (version 27), created by the International Business Machines Corporation (IBM).

First of all, the data was prepared in SPSS. Initially, data was sorted out pairwise, meaning that all remaining data from participants that were forced to end the questionnaire prematurely along the aforementioned inclusion and exclusion criteria was deleted. In addition, all incomplete responses to variables relevant to the research question were filtered out of the data set as well. This means that any incomplete responses to each of the variables 'the general acceptance of in-home monitoring technology for dementia care', 'acceptance towards different care scenarios of in-home monitoring technology', 'acceptance towards different monitoring technologies', 'digital literacy', 'personal innovativeness' and 'size of care network' were filtered out of the data file.

Next, descriptive statistics were computed to summarize the social demographic characteristics of the sample. Additionally, these descriptive statistics were used to examine the general acceptance towards in-home monitoring technology as well as the acceptance towards different care scenarios and towards different devices. This was done by computing the median final acceptance scores in general, for different devices and for different care scenarios. Subsequently, the variables that were included in the descriptive statistics were 'age', 'gender', 'education', 'country of residence', 'relationship with care recipient', 'size of (in)formal care network', 'digital literacy', ''personal innovativeness', 'geographical distance from care recipient', 'the general acceptance of in-home monitoring technology for dementia care', 'acceptance towards different care scenarios of in-home monitoring technology' and 'acceptance towards different monitoring technologies'. Furthermore, a Shapiro-Wilk test was conducted in order to test whether the assumption of normality is met for the obtained data regarding the variables 'the general acceptance of in-home monitoring technology for dementia care', 'acceptance towards different care scenarios of in-home monitoring technology', 'acceptance towards different monitoring technologies', 'digital literacy', 'personal innovativeness' and 'size of care network'. If the assumption of normality is met regarding the aforementioned variables, parametric tests and statistics would be used to answer the research questions. If the assumption of normality is not met, however, non-parametric tests and statistics would be used to answer the research questions. Except for the variable of personal innovativeness, the latter held true for the data obtained in this study.

In order to answer the second and third research questions, which aim to examine whether or not there exists a difference in the acceptance of in-home monitoring technology

between different care scenarios and between different monitoring devices, a Friedman's test was conducted using participants' final acceptance scores per scenario and participants' final acceptance scores per device. In addition, a post-hoc Wilcoxon's signed-rank test was conducted to further investigate where differences in acceptance precisely exist for each of these two variables. Both the Friedman's test and Wilcoxon signed-rank test make use of ranks of the data instead of the original data values themselves.

In order to answer the fourth research question '' To what extent are the digital literacy and the personal innovativeness of informal caregivers of people with dementia associated with their acceptance of in-home monitoring technology for PwD?'', non-parametric Spearman's correlation analyses were conducted between respondents' final 'digital literacy' and final 'general acceptance towards in-home monitoring technology' scores and between respondents' final 'personal innovativeness' and final 'general acceptance towards in-home monitoring technology' scores. By doing this, it was investigated whether or not there existed either a positive or negative association between people's final digital literacy and personal innovativeness scores and people's final general acceptance scores, which were not normally distributed in the sample.

To answer the fifth research question ''To what extent is the number of active (in)formal caregivers for a single person with dementia associated with the general acceptance of in-home monitoring technology among informal caregivers for dementia?'', a non-parametric Kruskal-Wallis test, as we deal with a categorical variable, was conducted to see whether the different sizes of a care network that an informal caregiver might be part of significantly differed in terms of their general acceptance towards in-home monitoring technology. The Kruskal-Wallis test, in this case, assesses the null-hypothesis that there is no difference in 'general acceptance towards in-home monitoring technology' between the different care network sizes.

Results

A total 247 people took part in the survey, of which 110 completed the relevant items of the survey and met the inclusion criteria. The mean (SD) age of those 110 participants from our sample was 53.2 (13.1) years and the majority was female ($N= 85$, 77%) and German ($N= 82$, 75%). Furthermore, relationship with care recipient was mostly daughter/son ($N= 72$, 66%) and majority of the sample was accompanied by just one other caregiver ($N= 43$, 39%) or was caring for their loved one alone ($N= 29$, 26.4%). Lastly, most of the sample lived either in the same house as their care recipient ($N= 32$, 29%) or lived between 6-15 minutes from their care recipient ($N= 29$, 26%). Detailed demographics of the sample are shown in table 1 below.

Table 1

Social Demographic Characteristics of the Sample of Informal Caregivers

	n	Percent (%)	Mean	SD**	Median	IQR***
Age (in years)	110		53.2	13.1	56	11
Gender						
Female	85	77.3				
Male	25	22.7				
Education						
Secondary education	16	14.5				
Secondary vocational education	20	18.2				
Professional degree	14	12.7				
Bachelor/Master degree	54	49.1				
Doctoral degree	5	4.5				
Other*	1	0.9				
Nationality						
Dutch	21	19.1				
German	82	74.5				
Other*	7	6.4				
Relationship care recipient						
Spouse/partner	13	11.8				
Daughter/Son	72	65.5				
Other*	25	22.7				
Size of care network						
Only caregiver	29	26.4				
One other caregiver	43	39.1				
Two other caregivers	19	17.3				
Other*	19	17.3				
Distance to care recipient						
Same house as care recipient	32	29.1				
1-5 minutes removed	7	6.4				
6-15 minutes removed	29	26.4				
16-30 minutes removed	17	15.5				
Other*	27	22.7				

Based on other answer categories of the variable in the questionnaire (see Appendix A & B)
*** Standard deviation*
****Interquartile range*

Next, with regards to the digital literacy, personal innovativeness, general acceptance and the acceptance towards different care scenarios and towards different devices, positive levels have been found in the sample. To examine how the sample scored on these variables, descriptive statistics were computed. These descriptive statistics can be seen in table 2 below.

Table 2

Levels of Digital Literacy, Personal Innovativeness and Acceptance in the Sample

	Mean	SD*	Median	IQR**
Digital literacy			3.0	0.7
Personal Innovativeness	4.2	1.4		
General acceptance towards in-home monitoring technology			3.6	0.89
Acceptance to different care scenarios				
Scenario 1 (acute situations)			3.7	0.93
Scenario 2 (Risk prediction)			3.5	1.00
Scenario 3 (Selfcare behaviour)			3.6	0.90
Scenario 4 (Nightly Well-being)			3.6	0.90
Scenario 5 (Long-term patterns)			3.5	0.92
Acceptance to different monitoring devices				
Wearable devices			4.0	2.00
Visual devices			4.0	2.00
Auditory devices			4.0	1.00
Radiofrequency devices			4.0	1.00
Object-attached devices			4.0	1.00

Standard deviation

Interquartile range

As can be seen from table 2 above, the general acceptance towards in-home monitoring technology was slightly positive in the sample with a median score of 3.6 ($IQR = 0.89$). Furthermore, for the acceptance of in-home monitoring technology towards different care

scenarios, the median scores for each scenario ranged from 3.5 to 3.7, indicating that acceptance towards all care scenarios was slightly positive in the sample, with 'acute situations' being the most acceptable care scenario. Moreover, interquartile ranges for the median acceptance scores for the different care scenarios ranged from 0.90 to 1.00, meaning some variation in respondents' scores existed. Next, for the acceptance towards different monitoring devices/technologies, the median scores for each of the different technologies were all 4.0, indicating that all different devices were generally accepted in the sample. Furthermore, the interquartile ranges for the median scores on each of the different technologies ranged from 1.00 to 2.00, meaning that there existed a notable variation in respondents' scores on this variable. Lastly, high levels of digital literacy and average levels of personal innovativeness were found in the sample, with a median score of 3.0 ($IQR = 0.7$) for digital literacy and a mean score of 4.2 ($SD = 1.4$) for personal innovativeness.

Next, more specifically in the context of the second and third research question, a Friedman's test yielded a significant difference between the different care scenarios in terms of participants' acceptance scores ($F_r = 13.00$, $p = .011$) and a significant difference between different monitoring devices in terms of participants' acceptance scores ($F_r = 14.18$, $p = .007$). A post-hoc Wilcoxon signed-rank test indicated where the differences precisely exist in terms of participants' acceptance towards different care scenarios and towards different monitoring devices/technologies. The results of the Wilcoxon signed-rank tests can be seen in tables 3 and 4 below.

Table 3

Differences in Acceptance of In-Home Monitoring Technology for Different Care Scenarios

		Acute situations	Risk prediction	Selfcare behaviour	Nightly well-being	Long-term patterns
Acute situations	Z-value	-	-	-	-	-
	p-value					
Risk prediction	Z-value	-3.6**	-	-	-	-
	p-value	.000				
Selfcare behaviour	Z-value	-3.1**	-0.4	-	-	-
	p-value	.002	.698			

Nightly	Z-value	-2.2*	-0.9	-0.9	-	-
well-being	p-value	.027	.346	.350		
Long-term	Z-value	-3.3**	-0.0	-0.0	-1.1	-
patterns	p-value	.001	.964	.969	.260	

Difference is significant at the 0.05 level (2-tailed)

**Difference is significant at the 0.01 level (2-tailed)

Table 4

Difference in Acceptance Towards Different In-Home Monitoring Devices

		Wearable devices	Visual devices	Auditory devices	Radiofrequency devices	Object-attached devices
Wearable devices	Z-value	-	-	-	-	-
	p-value					
Visual devices	Z-value	-0.8	-	-	-	-
	p-value	.421				
Auditory devices	Z-value	-0.2	-1.3	-	-	-
	p-value	.889	.218			
Radiofrequency	Z-value	-0.9	-2.8**	-1.5	-	-
devices	p-value	.371	.004	.150		
Object-attached	Z-value	-1.3	-3.4**	-2.1*	-0.7	-
devices	p-value	.186	.001	.037	.532	

Difference is significant at the 0.05 level (2-tailed)

**Difference is significant at the 0.01 level (2-tailed)

From table 3 above, it can be seen that a significant difference in (ranked) final acceptance scores existed between the different care scenarios. Namely, a significant difference was found between the scenario 'acute situations' and all other scenarios ($Z > 1.96$, $p < .05$). This indicates that in-home monitoring technology for the scenario 'acute situations' obtained

a significantly higher acceptance rating in the sample compared to all the other care scenarios, as the Friedman's test indicated the mean rank score of the 'acute situations' scenario to be the highest. Furthermore, from table 4 above, it can be seen that a significant difference in (ranked) final acceptance scores existed in the sample between different monitoring devices. Namely, a significant difference in acceptance ratings between visual devices and radiofrequency devices ($Z = -2.8$, $p = .004$), between visual devices and object-attached devices ($Z = -3.4$, $p = .001$) and between auditory devices and object-attached devices ($Z = -2.1$, $p = .037$) was found. This indicates that for these three differences, the acceptance ratings for visual devices and auditory devices were significantly lower, as the Friedman's test indicated the mean rank score of 'visual devices' and 'auditory devices' to be the lowest respectively.

Next, in the context of the remaining fourth and fifth research questions, it was explored to what extent 'digital literacy', 'personal innovativeness' and 'size of care network' are associated with 'general acceptance towards in-home monitoring technology'. For the first two potential associations, a Spearman's correlation analysis was conducted using participants final scores on 'digital literacy', 'personal innovativeness' and 'general acceptance towards in-home monitoring technology'. The results of these Spearman's correlation analyses can be seen in table 5 below.

Table 5

The Association of Digital Literacy and Personal Innovativeness and General Acceptance

	General acceptance towards in-home monitoring technology	*p-value (2-tailed)*
Digital literacy	.22*	.02
Personal innovativeness	.35**	.00

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

From table 5, it can be seen that both digital literacy and personal innovativeness were significantly correlated with the general acceptance towards in-home monitoring technology. Namely, for digital literacy, a Spearman's rho of .22 ($p = .02$) was obtained and for personal innovativeness, a Spearman's rho of .35 ($p = .00$) was obtained, indicating significant positive yet weak associations of both digital literacy and personal innovativeness with the general acceptance towards in-home monitoring technology.

Lastly, to explore the association between 'size of care network' and 'general acceptance towards in-home monitoring technology', a non-parametric Kruskal-Wallis test was conducted. The results of this analysis yielded a p-value of .78, meaning that the null-hypothesis that there is no difference between the different sizes of care network in terms of the general acceptance towards in-home monitoring technology cannot be rejected.

Discussion

Summary of Results

From the results of this study, it can be concluded that informal caregivers of people with dementia are slightly positive towards accepting in-home monitoring technology for home-based dementia care. With regards to informal caregivers' acceptance of in-home monitoring technology towards different care scenarios, the acceptance rating was also slightly positive for each of the different care scenarios, particularly for the scenario 'acute situations'. Lastly, with regard to informal caregivers' acceptance towards different monitoring technologies, the acceptance rating for each of the different technologies was positive in the sample, meaning that most of the sample was acceptant towards each of the different monitoring technologies. Moreover, significant differences in acceptance of in-home monitoring technology were found between the different care scenarios and between the different monitoring devices/technologies. Namely, the scenario 'acute situations' was significantly more accepted than all other care scenarios. Also, visual monitoring devices were significantly less accepted as opposed to radiofrequency and object-attached monitoring devices, whereas auditory monitoring devices were significantly less accepted than object-attached monitoring devices.

Additionally, in search of potential determinants of user acceptance towards in-home monitoring technology for home-based dementia care, significant positive yet weak correlations were found between both digital literacy and the general acceptance and between personal innovativeness and the general acceptance. In addition, no association was found between the size of the care network for a single PwD and the general acceptance towards in-home monitoring technology for home-based dementia care, as no significant difference between different sizes of care network was found in terms of informal caregivers' general acceptance.

Reflection

In the field of dementia care, research into informal caregivers' acceptance towards in-home monitoring technology as a specific subcomponent of general assistive eHealth

technologies is still relatively scarce. However, some studies have been conducted which have produced results that are in line with the results of this current study. Namely, Kramer (2013) have found that informal caregivers of PwD were open-minded and interested in various types of assisting (future) monitoring technologies for home-based dementia care, meaning they were generally acceptant towards in-home monitoring technology for dementia care. The technologies researched by Kramer (2013) ranged from less advanced technologies like GPS trackers to more advanced and innovative technologies that make use of artificial intelligence (AI), like radiofrequency sensors. Together, the findings from this study and previous studies strengthen the notion that from the perspective of informal caregivers of PwD, future in-home monitoring technology can be beneficial and helpful. What's more, this study is also in line with previous studies by showing that more obtrusive monitoring technologies like cameras and microphones are less accepted than more innovative and unobtrusive monitoring technologies like motion-activated sensors that make use of AI (Thordardottir et al., 2019). This shows that the obtrusiveness of in-home monitoring systems, even for the most recent and innovative AI-based in-home monitoring systems, remains very important for their future implementation. In this light, Murphy et al. (2021) have shown that even for these innovative and less obtrusive monitoring technologies that utilize AI, challenging issues exist. Namely, by means of qualitative research, Murphy et al. (2021) have shown that ethical matters like privacy and security of their loved one's data, trust in the AI-system and the accountability and responsibility of such systems remain barriers to a successful implementation of future in-home monitoring technology.

Furthermore, it was found in this current study that digital literacy and personal innovativeness were significantly correlated with informal caregivers' general acceptance towards in-home monitoring technology for home-based dementia care. This is in line with previous research conducted by Bastoni et al. (2021) and Jaschinski et al. (2018). Namely, Bastoni et al. (2021) found by means of an umbrella review design consisting of 21 reviews that digital literacy is a personal characteristic of informal caregivers that is predictive of their implementation of assistive technologies in the domain of home-based dementia care. This is in line with the findings of this current study in which digital literacy has proven to be a determinant of end-users' general acceptance towards a more specific type of assistive technology; in-home monitoring technology. Furthermore, Jaschinski et al. (2018) found that personal innovativeness was a predictor of acceptance towards and intentions to use ambient assisted living technologies (AAL) in general. This is in line with the findings of this current study in which personal innovativeness has proven to be a determinant of informal caregivers'

general acceptance towards in-home monitoring technology for home-based dementia care, a more specific component of AAL technologies. In light of these findings, it is noteworthy that the sample in this study showed rather high levels of digital literacy and average levels of personal innovativeness, which might explain the aforementioned associations found in this study. Namely, due to the rather high digital literacy and average levels of personal innovativeness in the sample, participants might have been better aware of the risks (privacy/security breaching) of the different monitoring technologies in different use scenarios as opposed to people lower in digital literacy. Subsequently, given that risks are deemed reasonable, they would more readily accept these technologies, especially since the personal innovativeness in the sample was average. Conversely, especially for those monitoring technologies that are more advanced like AI-based systems, people lower in digital literacy might have less of an understanding of the possible risks and would therefore remain hesitant with regards to accepting the different kinds of technology as they even anticipate risks that do not necessarily exist (Hutchinson & Novotny, 2018). In the aforementioned way, the level of digital literacy and personal innovativeness in the sample thus might explain the previously mentioned associations found in this study.

Lastly, a finding from this study that is not in line with previous research is the finding that the size of the care network an informal caregiver is part of is not associated with the general acceptance of in-home monitoring technology for home-based dementia care. Namely, Demiris et al. (2008) have found that the intention to use and the acceptance towards technology-based monitoring systems significantly decreases as the care network increases. A reason for the contradictory finding in this study with previous research pertains to the sample in the different studies. Namely, Demiris et al. (2008) examined a group of community dwelling elderly that received (in)formal care, whereas in this current study informal caregivers who provide care were examined. More specifically, in this current study, the sampling procedure led to many participants being mainly the primary caregiver of their care network who take on the most important caregiving tasks and provide most of the in formal care by definition. This might be the reason that a bigger caregiving network is not really supportive for them but for the care recipient it is. Moreover, as mostly primary caregivers of differing care network sizes were involved in the study, it might explain the finding of no difference between different sizes of care network in this study compared to the study of Demiris et al. (2008). In addition to this, the sample size was not very large, with participants not being evenly distributed in terms of different care network sizes. This might also contribute to the finding of no association between

the size of the care network an informal caregiver is part of with the general acceptance of in-home monitoring technology.

Strengths and Further Limitations

A strong point in this study pertains to the psychometric properties of the utilized scale items and their translations. All scales were found to have good reliability, with Cronbach's alpha values ranging from 0.72 to 0.97 among the utilized scales and their translations. Additionally, the age of participants from the targeted audience of the study was evenly distributed across the sample, meaning it nicely addressed a wide age range of informal caregivers.

Limitations of this study pertain mostly to the characteristics of the sample. Firstly, the sample consisted of a generally highly educated group of informal caregivers, which might not be an accurate representation of the bigger population of informal dementia caregivers. This in turn might impact the results of the study. Namely, the significant association found between digital literacy and the general acceptance towards in-home monitoring technology might be explained and thus mediated by the education level in the sample, with higher education being associated with higher digital literacy. Namely, higher educated people might be more digitally literate because they have learned about the risks (privacy/security breaching) of different (in-home monitoring) technologies and feel more able to operate on them (Shopova, 2014). This leads to increased acceptance of in-home monitoring technologies given the risks are reasonable compared to less educated people who are unaware of the risks and thus remain hesitant towards acceptance. A limitation herein is that the positive levels of acceptance towards in-home monitoring technology found in this study's sample might not be generalisable to the bigger population of informal caregivers of PwD, as they are not all highly educated per se (Sheth et al., 2020). In addition, majority of the sample in this study was German, which might also impact the results of the study. Namely, digital literacy in the sample was notably higher for the minority of Dutch participants in the sample as opposed to the majority of Germans. This resulted in a generally lower digital literacy level in the sample because of the uneven distribution of participants in terms of nationality, which in turn might have lowered acceptance levels in the sample. This difference in digital literacy might be explained because Dutch people grow up in a more technologically advanced country as opposed to Germans (European Commission, 2001). Due to this difference, the results of this study are less able to be inferred to the bigger population of informal caregivers of PwD, which covers more than merely German caregivers. Lastly, digital literacy and personal innovativeness were moderately yet

significantly correlated, leading to both variables being explanatory of each other's association with the general acceptance of in-home monitoring technology, which creates a limitation for this study.

In light of these limitations, future research into similar fields should ensure a more representative sample by means of better random sampling among informal caregivers, as in this study the sample might not have been representative enough of the bigger population of informal caregivers. By doing this, more accurate inferences of results can be made towards the bigger population of informal caregivers of PwD. Moreover, as only weak associations of determinants of acceptance have been found in this study, future quantitative research should include more possible determinants in the analyses to increase the explanatory power on the variable of acceptance towards in-home monitoring technology for home-based dementia care. In other words, other potential antecedents of constructs of the TAM and UTAUT should be investigated to see whether they are able to explain and predict the acceptance towards different in-home monitoring technologies among informal caregivers of PwD. By doing this, an even better fit between the context, end-user and the technology can be warranted which increases the implementation success of future in-home monitoring technologies.

Practical Implications and Further Recommendations for Research

Following the results obtained in this study, some practical implications and recommendations for further research can be made. In the context of practical implications based on the results obtained in this study, it is important to consider the societal issue that the still increasing number of people with dementia in combination with their need of extended independent living presents us with. Namely, this issue concerns the organisation of care and its cost-effectiveness. In-home monitoring technology for home-based dementia care can be a very useful intervention to improve the cost-effectiveness of care and reduce the strain it puts upon informal caregivers who mainly deal with the growing number of PwD, preventing them from becoming the invisible second patient (Wrede et al., 2021; Brodaty & Donkin, 2009). However, as mentioned in the introduction of this article, in order to be a successful and continually utilized intervention after implementation, there must be a good fit between the end-user, the context and the technology (van Gemert-Pijnen et al., 2018). The results obtained in this study contributed to the search for determinants that influence this fit, with digital literacy and personal innovativeness being identified as important factors to consider when developing and implementing new innovative in-home monitoring technologies for home-based dementia care. Subsequently, concrete practical implications derived from this study for the development

stage are the importance of taking into account the advancement of the technology. Namely, the end-user should be narrowly involved in the development process in order to match the in-home monitoring technology that is to be developed to end-users' digital literacy level. Conversely, it is also possible to tailor the end-users' digital literacy level to the technology. Namely, a practical implication could be for governments to incorporate activities in education which further improve youngsters' digital literacy (Maureen et al., 2018). By doing this, future informal caregivers are prepared for and acceptant of the technological advancements of the future that can aid them in providing care for their loved one.

Moreover, after implementing the to be developed technology, the method of implementation should ensure high adoption of the technology over time. As this study proved that personal innovativeness was an important factor in influencing the acceptance towards in-home monitoring technology for home-based dementia care, methods of implementation should be employed that are also able to eventually persuade the people low in personal innovativeness. An example of such an implementation method is the diffusion of innovation method, in which an intervention is implemented via a stepwise approach, in this case starting with people high in personal innovativeness that in turn persuade others in their social circle who are lower in personal innovativeness accordingly (Infante et al., 2003; Rogers, 1971). This method of implementation would yield a better adoption rate of the technology over time as people low in innovativeness are more easily persuaded by friends, family and acquaintances that utilize or recommend the technology to them as opposed to other external advertisements of the technology (Rogers, 1971).

Next, in the context of research recommendations, much still has to be done as research into the determinants of acceptance of future in-home monitoring technology in the field of dementia care is still scarce. Moreover, in this study, only weak associations have been found between the investigated variables and informal caregivers' acceptance towards in-home monitoring technology. Therefore, as said before in this discussion, it is important for further research to be conducted to find more determinants of informal caregivers' acceptance of in-home monitoring technology in the specific field of home-based dementia care. By doing this, and herewith increasing the explanatory power on the acceptance towards in-home monitoring technology among informal caregivers, a more successful pre- and post-implementation process of in-home monitoring technology for home-based dementia care can be ensured. One interesting potential determinant which we have mentioned already in this discussion, is the risk perception of potential end-users of in-home monitoring technology. As mentioned before, it was already speculated using previous literature how risk perceptions might be associated

with the acceptance of in-home monitoring technology among informal caregivers of PwD. Therefore, an interesting direction is to conduct research between risk perceptions and the acceptance of future monitoring technologies. By means of qualitative research it can be explored what risks are precisely perceived by end-users and through correlational research it can be explored to what extent these perceived risks determine the acceptance of in-home monitoring technology. This is especially important for the future innovative technologies of in-home monitoring, which are AI-based and more complex. Therefore, how it works is often unknown to most end-users and many different risks can be perceived/anticipated, even risks that are not necessarily present, leading to hesitancy towards acceptance of such technologies (Murphy et al., 2021). Using the knowledge from these types of future research in this direction, we are better prepared to successfully implement these technologies of the future by creating more awareness and understanding among end-users. Also, follow-up research into informal caregivers' perceived risks can be conducted in terms of how to overcome these risks to ensure a successful implementation.

Furthermore in this light, the above recommendations merely concern the fit between the technology and the end-user. The adoption, non-adoption, abandonment, spread, scale-up, and sustainability (NASS) framework by Greenhalgh et al. (2017) illustrates more challenges that need to be explored for a successful implementation of (future) innovative monitoring technologies. Namely, other important directions for research are to explore more contextual matters like the organisation and wider system of dementia care. The organisation entails the capacity to innovate, readiness for change and funding among others. The wider system is composed of e.g. regulatory and political factors. It is of importance that future in-home monitoring technology for home-based dementia care also meets these challenges in order to be successfully implemented. Therefore, research should also be conducted into whether the to be developed in-home monitoring technologies are able to meet these other more contextual challenges for a successful implementation.

Additionally, in light of the associations found in this study, it might be a direction for future research to investigate ways to heighten the subjective digital literacy and personal innovativeness of people so that in-home monitoring technology is more readily accepted, especially among the bigger population of informal caregivers of PwD.

Lastly, as this study was only concerned with the field of home-based dementia care, it might be a useful recommendation for future research to be conducted into the field of (home-based) care of other age-related chronic diseases that are increasing in prevalence and cause a societal issue like dementia does.

Conclusion

The growing amount of PwD in combination with their growing need for extended independent living and limited residential care possibilities causes a broader societal issue. Namely, due to this, it is the case nowadays that informal caregivers mainly provide the care for PwD, which often creates a big burden for them and can lead them to becoming the invisible second patient. A possible solution to this issue is the employment of in-home monitoring technology, which would make it easier for informal caregivers of PwD to provide better quality care to their care requiring loved one, however without being as heavily burdened.

In this study, the general acceptance towards the possible intervention of in-home monitoring technology for home-based dementia among informal caregivers of PwD was investigated as well as the acceptance towards different care scenarios and towards different monitoring technologies. In addition, an attempt was made to discover determinants of informal caregivers' acceptance towards in-home monitoring technology in the field of dementia care. These determinants are important to consider in the pre- and post-implementation stage of such assistive eHealth technologies like in-home monitoring technology for home-based dementia care. However, more research still has to be conducted into additional possible determinants and broader contextual matters so that these can be accounted for in the pre- and post-implementation phases of in-home monitoring technology for home-based dementia care. Namely, by meeting these contextual challenges and by including end-users' determinants of their acceptance in the development and implementation process of such a technological intervention, a better fit between the end-user, context and technology can be ensured, leading to a more continued and successful utilization of the intervention.

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Appendices

Appendix A

INTRDOCUTION

Acceptatie van innovatieve monitoring technologie in de zorg voor thuiswonende ouderen

Hartelijk dank voor uw bereidheid om deel te nemen aan dit onderzoek. Dit onderzoek wordt uitgevoerd door studenten Psychologie aan de Universiteit Twente als deel van hun Bachelor Scriptie.

Het doel van dit onderzoek is om meer inzicht te krijgen in factoren die een rol spelen bij de acceptatie van technologie voor het monitoren van thuiswonende ouderen. We zijn in dit onderzoek in het bijzonder geïnteresseerd in de mening van mantelzorgers van ouderen met dementie. Mantelzorgers zijn informele verzorgers die op vrijwillige basis onbetaalde zorg/hulp verlenen aan een zorgbehoevende naaste. Voorbeelden van een mantelzorger zijn een echtgenoot, zoon/dochter, een ander familielid of vriend.

De vragenlijst wordt verspreid in Nederland en Duitsland. Bij het invullen van deze vragenlijst is het geen vereiste om eerdere ervaring te hebben met monitorende technologie. Deelname aan deze vragenlijst zal ongeveer 20 minuten duren.

Uw antwoorden zullen volledig anoniem worden verwerkt waardoor de gegevens dus niet tot een persoon kunnen worden herleid. Uw gegevens zullen alleen worden gebruikt voor dit wetenschappelijk onderzoek.

Uw deelname in dit onderzoek is volledig vrijwillig, wat betekent dat u op elk gewenst moment kunt stoppen met het invullen van de vragenlijst.

Indien u vragen heeft over dit onderzoek kunt u contact opnemen met Maarten Akgül (m.t.d.akguel@student.utwente.nl), een van de onderzoekers, of Dr. L.M.A. Braakman-Jansen (l.m.a.braakman-jansen@utwente.nl), de onderzoeksleider.

Om u te bedanken voor uw deelname bieden we u aan het einde van de vragenlijst de mogelijkheid aan om een prijs te winnen! U kunt namelijk een cadeaubon ter waarde van €10 winnen.

Verklaring van goedkeuring voor deelname

Ik bevestig dat ik 18 jaar of ouder ben en dat ik bovenstaande informatie gelezen en begrepen heb. Op basis van voorstaande keur ik vrijwillig goed om deel te nemen aan dit onderzoek.

o Ja

o Nee

DEMOGRAFISCHE INFORMATIE

DEEL 1: Algemene vragen over uzelf

Fijn dat u mee wilt werken aan dit onderzoek. Wij willen graag beginnen met enkele vragen over uzelf.

Wat is uw leeftijd (in jaartallen)?_____

(Geslacht)

Wat is uw geslacht?

a. Man

b. Vrouw

c. Anders

(Land van herkomst)

In welk land woont u?

a. Nederland

b. Duitsland

c. Anders

(Mantelzorger?)

Bent u een mantelzorger?

(Een mantelzorger is iemand die vrijwillig (onbetaald) zorg verleent aan een naaste zoals een echtgenoot, ouder of buurman)

a.   Ja

b.   Nee (→ Einde vragenlijst)

(Reden van zorg)

Wat is de reden voor uw mantelzorg? (Meerdere antwoorden mogelijk)

a.   Dementie of lichte cognitieve beperking / geheugen klachten (--> alleen rest van de vragenlijst als dit geselecteerd is)

b.   Ouderdom

c.   Lichamelijke beperking(en)

d.   Psychische beperking

e.   Anders

(Relatie met zorgbehoevende)

Wat beschrijft het beste uw relatie met de persoon die u zorg verleent? Ik ben …..

a. Echtgenoot/partner

b. Dochter/Zoon

c. Stiefdochter/stiefzoon

e. Kleinkind

f. Buurman/Buurvrouw

g. Anders

(Grootte van mantelzorg netwerk)

Zijn er meer mantelzorgers die een aandeel in de zorg voor uw naaste hebben?

    a. Nee, de zorg komt vooral op mij neer
    b. Ja, een andere persoon
    c. Ja, twee andere personen
    d. Ja, drie andere personen
    e. Ja, 4 of meer andere personen

(Geografische afstand)

In dit deel van de vragenlijst zijn we geïnteresseerd hoe ver u zich bevindt ten opzichte van uw zorgbehoevende naaste.
Welke van de volgende opties beschrijft het beste hoelang het gemiddeld duurt om bij de plaats van uw zorgbehoevende naaste te arriveren? (Ga hierbij uit van uw meest gebruikte manier van transport).

a. Ik leef in hetzelfde huis als mijn zorgbehoevende naaste

b. Ik ben ongeveer 5 minuten verwijderd van mijn zorgbehoevende naaste

c.   Ik ben ongeveer 15 minuten verwijderd van mijn zorgbehoevende naaste

d. Ik ben ongeveer 30 minuten verwijderd van mijn zorgbehoevende naaste

e. Ik ben ongeveer 1 uur verwijderd van mijn zorgbehoevende naaste

f.   Ik ben meer dan 1 uur verwijderd van mijn zorgbehoevende naaste

Deel 2: Algemene vragen over de zorgbehoevende naaste

(Leeftijd zorgbehoevende naaste)
Wat is de leeftijd voor de naaste voor wie u zorgt? _____

(Type dementia/cognitieve beperking)

Welk type dementie/cognitieve beperking is van toepassing op uw naaste?

a. Alzheimer

b. Lewy-Body dementie

c. Vasculaire dementie

d. Milde cognitieve stoornis

e. Ander type/weet ik niet

f. Er is nog geen diagnose vastgesteld

(Tijd sinds verschijning symptomen dementie)

Sinds wanneer vertoont uw zorgbehoevende naaste verschijnselen van dementie/geheugenklachten (naar schatting)?

a. Minder dan 1 jaar
b. 1 tot 2 jaar
c. 2 tot 3 jaar
d. 3 tot 4 jaar
e. 4 tot 5 jaar
f. Meer dan 5 jaar

(Huissituatie zorgontvanger A)

Wat is de leefsituatie van uw naaste?

a. Alleenwonend
b. Samenwonend

(Huissituatie zorgontvanger B)

Waar woont uw naaste?

a. In een eigen (huur)woning
b. Inwonend bij een familielid
c. In een aanleunwoning of aanleunappartement dat hoort bij een zorginstelling
d. In een verpleeg- of verzorgingshuis (→ End of survey)
e. Anders, namelijk: _____

(Professionele zorg)

Van welke type professionele zorg/service maakt uw zorgbehoevende naaste gebruik? (meerdere antwoorden mogelijk)

    a. Thuiszorg door een (wijk)verpleegkundige of verzorgende
    b. Casemanager dementie
    c. Dagopvang / dagbesteding/ tijdelijke opvang
    d. Huishoudelijke hulp
    e. Maaltijdservice
    f. Geen van bovenstaande

DEEL 3: Ervaren zorglast voor de mantelzorger (Bédard et al., 2001)
(Zorglast voor de mantelzorger)

Voor dit onderdeel van de vragenlijst was de schaal 'Caregiver Burden: 4-item ZBI screening scale' gebruikt. Deze schaal is verkregen via Bédard et al. (2001):

DEEL 4: Digitale vaardigheden, innovativiteit & ervaring met technologie (Kayser et al., 2018)

Om de digitale competentie van participanten te onderzoeken, was de sub-schaal van de eHLQ (Kayser et al., 2018), genaamd 'ability to actively engage with digital services in the healthcare domain' gebruikt. Participanten moesten hierin aangeven in hoeverre ze het eens of oneens waren met 5 stellingen, gebaseerd op een 4-punt Likert schaal van 1 (= Sterk mee oneens) tot 4 (= Sterk mee eens). Deze Stellingen van de eHLQ waren verkregen via Kayser et al. (2018)

(Hoe innovatief bent u?)

Hoe innovatief bent u? Geef aan in hoeverre u het eens of oneens bent met de volgende stellingen:

	Helemaal oneens	Oneens	Beetje oneens	Neutraal	Beetje eens	Eens	Helemaal eens
1. Als ik over nieuwe technologie hoor, wil ik die graag uitproberen.	O	O	O	O	O	O	O
2. Van mijn vrienden ben ik meestal de eerste die nieuwe technologie uitprobeert.	O	O	O	O	O	O	O
3. In het algemeen ben ik terughoudend in het uitproberen van nieuwe technologieën.	O	O	O	O	O	O	O

4. Ik vind het leuk om nieuwe technologie uit te proberen.

   ◯   ◯   ◯   ◯   ◯   ◯   ◯

(Ervaring met andere vormen van technologie)

Welke van de volgende technologieën heeft u gebruikt of gebruikt u momenteel? (Meerdere antwoorden zijn mogelijk).

a.   Monitorende technologie voor het monitoren van dagelijkse activiteiten of veiligheid van uw zorgbehoevende naaste (bijvoorbeeld sensoren, Alarm knoppen, GPS trackers)

b.   Digitale technologie voor communicatie om contact te behouden met uw zorgbehoevende naaste (bijvoorbeeld videobellen, sms'en whatsapp en andere messaging apps)

c.   Technologie om geheugen, oriëntatie en/of dagelijkse structuur te bevorderen (bijvoorbeeld digitale herinneringen en smart kalenders)

d.   Digitale zorgplatformen om de coördinatie van de zorg voor uw zorgbehoevende naaste te ondersteunen (bijvoorbeeld communicatieplatformen tussen mantelzorgers en professionele zorgverleners)

e.   Geen van bovenstaande

PART 5: In-home monitoring technologie

INTRODUCTIE IN-HOME MONITORING TECHNOLOGY

Er worden steeds meer technologieën ontwikkeld die tot doel hebben mantelzorgers te ondersteunen en hun naasten in staat te stellen langer thuis te kunnen wonen.

In dit deel van de vragenlijst richten we ons op een nieuwe vorm van ondersteunende technologie: Contactloze technologie voor het monitoren van uw zorgbehoevende naaste.

Bekijk a.u.b. de beschrijving en afbeelding hieronder.

Contactloze monitoring technologie is bedoeld om de mantelzorger een beter inzicht te geven in de situatie van zijn/ haar thuiswonende naaste, vooral wanneer de mantelzorger op afstand woont of het huis verlaat. De naaste hoeft hierbij geen apparaten te dragen. Zoals u kunt zien in de afbeelding kan er een klein kastje met ingebouwde sensoren in een hoek van de woning geplaatst worden. Dit slimme kastje kan met behulp van kunstmatige intelligentie het dagelijks leefpatroon van uw naaste leren herkennen en belangrijke veranderingen waarnemen, zoals minder drinken of eten of nachtelijke onrust. In geval van nood (zoals bv. een val) kan het systeem de mantelzorger alarmeren. De verzamelde informatie kan gevisualiseerd worden op een digitaal platform dat toegankelijk is voor de mantelzorger en naaste. Indien gewenst kan de informatie ook gedeeld worden met betrokken zorgprofessionals.
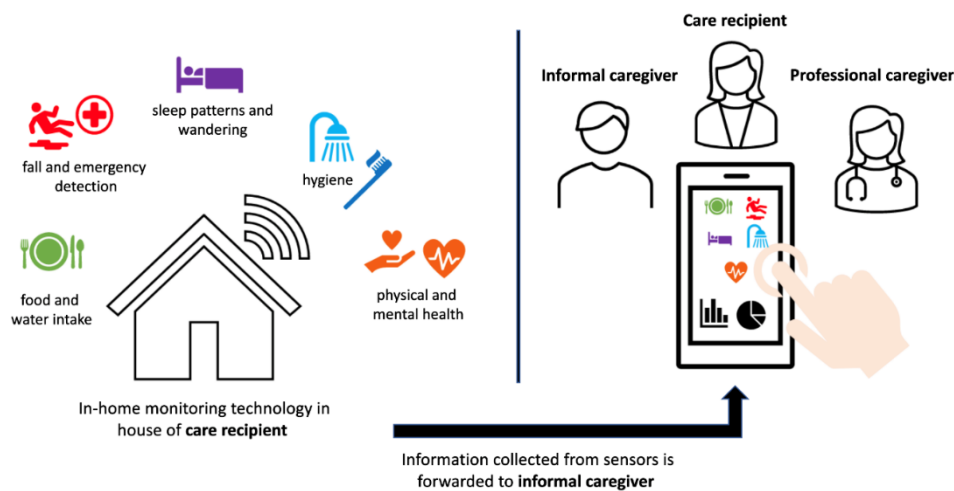
(Peilen of het is begrepen)

Hoe duidelijk/informatief vond u de beschrijving en illustraties over contactloze technologie voor het binnenshuis monitoren van uw zorgbehoevende naaste?

   a. Niet duidelijk (→ laat volgende vraag zien met invul vak)
   b. Een beetje duidelijk (→ laat volgende vraag zien met invul vak)
   c. Duidelijk

Heeft u suggesties voor het verbeteren van de duidelijkheid van de beschrijving en afbeelding?

ACCEPTATIE VAN VERSCHILLENDE MONITORING SITUATIES

In dit deel van de vragenlijst zullen we u 5 verschillende scenario's presenteren. De scenario's beschrijven verschillende situaties waarin contactloze monitoring technologie toegepast kan worden en ieder scenario omvangt andere aspecten waarover het systeem zou kunnen informeren. Voor elk scenario willen wij u graag een aantal vragen stellen.

Scenario 1: Het detecteren van noodsituaties

Stelt u zich voor: Bij uw zorgbehoevende naaste thuis is contactloze monitoring technologie geïnstalleerd. Deze technologie zal voortdurend de veiligheid van uw naaste monitoren in het gehele huis. Het systeem kan bijvoorbeeld valincidenten of dwalen detecteren en u als mantelzorger (of een door u aangewezen persoon) direct informeren over deze noodsituatie.

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken over dit scenario:

Contactloze technologie voor het detecteren van noodsituaties van mijn naaste…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Acceptability)					
Zou ik acceptabel vinden	O	O	O	O	O
Zou mijn zorgbehoevende naaste acceptabel vinden	O	O	O	O	O
(Perceived usefulness)					
Zou behulpzaam voor mij zijn	O	O	O	O	O
Zou mij ondersteunen in het verlenen of organiseren van de best mogelijke zorg	O	O	O	O	O
Zou mij in staat stellen om me gerust te voelen over de situatie van mijn naaste	O	O	O	O	O
Zou mij helpen om sneller te reageren op de zorgbehoeftes van mijn naaste	O	O	O	O	O
Zou mij helpen om mijn naaste langer thuis te laten wonen	O	O	O	O	O
Zou mij helpen om als mantelzorger langer vol te houden	O	O	O	O	O
Zou mij informatie geven die ik graag zou willen delen met de zorgprofessional(s) van mijn naaste	O	O	O	O	O
(Willingness to use)	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Ik zou contactloze technologie voor het detecteren van noodsituaties van mijn naaste in de (nabije) toekomst willen gebruiken.	O	O	O	O	O

Scenario 2: Het voorspellen van acute situaties

Stelt u zich voor: Bij uw zorgbehoevende naaste thuis is contactloze monitoring technologie geïnstalleerd. Deze heeft als doel om acute situaties niet alleen te detecteren maar te voorspellen. Zo kan de technologie bijv. voortdurend de loopsnelheid en looppatroon van uw naaste monitoren. Door middel van deze informatie kan het systeem het risico op vallen van uw naaste voorspellen en u (of een door u aangewezen persoon) inlichten over de situatie. Het doel hiervan is om noodsituaties zoals bijv. vallen te voorkomen.

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken over dit scenario:

Contactloze technologie voor het voorspellen van acute situaties van mijn naaste…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Acceptability)					
Zou ik acceptabel vinden	O	O	O	O	O
Zou mijn zorgbehoevende naaste acceptabel vinden	O	O	O	O	O
(Perceived usefulness)					
Zou behulpzaam voor mij zijn	O	O	O	O	O
Zou mij ondersteunen in het verlenen of organiseren van de best mogelijke zorg	O	O	O	O	O
Zou mij in staat stellen om me gerust te voelen over de situatie van mijn naaste	O	O	O	O	O
Zou mij helpen om sneller te reageren op de zorgbehoeftes van mijn naaste	O	O	O	O	O
Zou mij helpen om mijn naaste langer thuis te laten wonen	O	O	O	O	O
Zou mij helpen om als mantelzorger langer vol te houden	O	O	O	O	O
Zou mij informatie geven die ik graag zou willen delen met de zorgprofessional(s) van mijn naaste	O	O	O	O	O
(Willingness to use)					
Ik zou contactloze technologie voor het voorspellen van acute situaties van mijn naaste in de (nabije) toekomst willen gebruiken.	O	O	O	O	O

Scenario 3: Het monitoren van zelfzorg

Stelt u zich voor: Bij uw zorgbehoevende naaste thuis is contactloze monitoring technologie geïnstalleerd. Deze technologie zal voortdurend de zelfzorg van uw zorgbehoevende naaste monitoren zoals eten, drinken en persoonlijke hygiëne (bijv. wassen, toiletteren, aankleden). Het monitoring systeem kan belangrijke afwijkingen in de zelfzorg detecteren en u (of een door u aangewezen persoon) hierover inlichten.

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken over dit scenario:

Contactloze technologie voor het monitoren van de zelfzorg van mijn naaste…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Acceptability)					
Zou ik acceptabel vinden	O	O	O	O	O
Zou mijn zorgbehoevende naaste acceptabel vinden	O	O	O	O	O
(Perceived usefulness)					
Zou behulpzaam voor mij zijn	O	O	O	O	O
Zou mij ondersteunen in het verlenen of organiseren van de best mogelijke zorg	O	O	O	O	O
Zou mij in staat stellen om me gerust te voelen over de situatie van mijn naaste	O	O	O	O	O
Zou mij helpen om sneller te reageren op de zorgbehoeftes van mijn naaste	O	O	O	O	O
Zou mij helpen om mijn naaste langer thuis te laten wonen	O	O	O	O	O
Zou mij helpen om als mantelzorger langer vol te houden	O	O	O	O	O
Zou mij informatie geven die ik graag zou willen delen met de zorgprofessional(s) van mijn naaste	O	O	O	O	O
(Willingness to use)	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Ik zou contactloze technologie voor het monitoren van de zelfzorg van mijn naaste in de (nabije) toekomst willen gebruiken.	O	O	O	O	O

Scenario 4: Het monitoren van welzijn gedurende de nacht

Stelt u zich voor: Bij uw zorgbehoevende naaste thuis is contactloze monitoring technologie geïnstalleerd. Deze technologie zal voortdurend het welzijn van uw zorgbehoevende naaste monitoren gedurende de nacht. Het monitoring systeem kan afwijkingen van het gewoonlijke nachtelijke patroon (zoals nachtelijke onrust, slaapproblemen of een instabiel dag- en nachtritme) detecteren en u (of een door u aangewezen persoon) hierover inlichten.

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken over dit scenario:

Contactloze technologie voor het monitoren van het welzijn van mijn naaste gedurende de nacht…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Acceptability)					
Zou ik acceptabel vinden	O	O	O	O	O
Zou mijn zorgbehoevende naaste acceptabel vinden	O	O	O	O	O
(Perceived usefulness)					
Zou behulpzaam voor mij zijn	O	O	O	O	O
Zou mij ondersteunen in het verlenen of organiseren van de best mogelijke zorg	O	O	O	O	O
Zou mij in staat stellen om me gerust te voelen over de situatie van mijn naaste	O	O	O	O	O
Zou mij helpen om sneller te reageren op de zorgbehoeftes van mijn naaste	O	O	O	O	O
Zou mij helpen om mijn naaste langer thuis te laten wonen	O	O	O	O	O
Zou mij helpen om als mantelzorger langer vol te houden	O	O	O	O	O
Zou mij informatie geven die ik graag zou willen delen met de zorgprofessional(s) van mijn naaste	O	O	O	O	O
(Willingness to use)	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Ik zou contactloze technologie voor het monitoren van het welzijn van mijn naaste gedurende de nacht in de (nabije) toekomst willen gebruiken.	O	O	O	O	O

Scenario 5: Het monitoren van geleidelijke gezondheidsveranderingen

Stelt u zich voor: Bij uw zorgbehoevende naaste thuis is contactloze monitoring technologie geïnstalleerd. Deze technologie zal over een langere termijn veranderingen die geleidelijk ontwikkelen in de gezondheid van uw zorgbehoevende naaste monitoren. Het monitoring systeem kan u (of een door u aangewezen persoon) bijvoorbeeld informeren over cognitieve of fysieke veranderingen van uw naaste in een bepaalde periode.

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken over dit scenario:

Contactloze technologie voor het monitoren van geleidelijke gezondheidsveranderingen van mijn naaste…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Acceptability)					
Zou ik acceptabel vinden	O	O	O	O	O
Zou mijn zorgbehoevende naaste acceptabel vinden	O	O	O	O	O
(Perceived usefulness)					
Zou behulpzaam voor mij zijn	O	O	O	O	O
Zou mij ondersteunen in het verlenen of organiseren van de best mogelijke zorg	O	O	O	O	O
Zou mij in staat stellen om me gerust te voelen over de situatie van mijn naaste	O	O	O	O	O
Zou mij helpen om sneller te reageren op de zorgbehoeftes van mijn naaste	O	O	O	O	O
Zou mij helpen om mijn naaste langer thuis te laten wonen	O	O	O	O	O
Zou mij helpen om als mantelzorger langer vol te houden	O	O	O	O	O
Zou mij informatie geven die ik graag zou willen delen met de zorgprofessional(s) van mijn naaste	O	O	O	O	O
(Willingness to use)					
Ik zou contactloze technologie voor het monitoren van geleidelijke gezondheidsveranderingen in de (nabije) toekomst willen gebruiken.	O	O	O	O	O

VOORDELEN EN ZORGEN

In het volgende willen wij u enkele vragen stellen over de algemene voor- en nadelen m.b.t. contactloze monitoring technologie in de zorg voor uw naaste.

(Voordelen)

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken:

Ik denk dat contactloze monitoring technologie mij kan helpen om…

	Helemaal mee oneens	Mee oneens	Neutraal	Eens	Helemaal mee eens
1. Te controleren of mijn naaste voldoende voor zichzelf zorgt (bijv. Eten/drinken)	O	O	O	O	O
2. Onnodige bezoekjes ter controle van de zelfzorg van mijn naaste te voorkomen	O	O	O	O	O
3. Gerust te zijn over de veiligheid van mijn naaste	O	O	O	O	O
4. Meer vrijheid en mobiliteit voor mijzelf te verkrijgen	O	O	O	O	O
5. Factoren te identificeren en te verwijderen die de zelfstandigheid van mijn naaste mogelijk belemmeren	O	O	O	O	O
6. Sneller te reageren op de zorgbehoeftes van mijn naaste om gezondheidsrisico's te voorkomen (bijv. ondervoeding, slaapproblemen, eenzaamheid.)	O	O	O	O	O
7. Anderen, inclusief professionele zorgverleners, een goed beeld van de situatie van mijn naaste te verstrekken	O	O	O	O	O
8. Het optimale moment te achterhalen waarin mijn naaste de overstap kan maken naar een andere woonvorm	O	O	O	O	O

(Zorgen)

Geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende uitspraken

Als ik contactloze monitoring technologie zou gebruiken, voel ik me…

	Helemaal mee oneens	Mee oneens	Neutraal	Eens	Helemaal mee eens
1. Bezorgd om met te veel informatie beladen te worden	O	O	O	O	O
2. Bezorgd dat de monitoring informatie mij nodeloos bezorgd zou maken	O	O	O	O	O
3. Onzeker of ik wel of niet moet reageren op informatie uit het systeem	O	O	O	O	O
4. Bezorgd dat de monitoring informatie gedeeld wordt met derde partijen zonder toestemming	O	O	O	O	O
5. Bezorgd dat de voordelen niet opwegen tegen de schending van de privacy van mijn naaste	O	O	O	O	O
6. Bezorgd dat de technologie wellicht het menselijk contact vervangt.	O	O	O	O	O

ALGEMENE ACCEPTATIE VAN CONTACTLOZE MONITORING TECHNOLOGIE

In het volgende willen wij u graag een aantal algemene vragen stellen over contactloze monitoring technologie. Met wat u nu weet over monitoring technologie, geeft u alstublieft aan in hoeverre u het eens of oneens bent met de volgende stellingen:

(Perceived usefulness) Ik denk dat contactloze monitoring technologie in de zorg voor mijn naaste behulpzaam is voor mij…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Op dit moment in mijn leven	O	O	O	O	O
Wanneer de cognitieve of fysieke gezondheid van mijn naaste verslechterd	O	O	O	O	O

(Intention to use) Ik zou contactloze monitoring technologie in de zorg voor mijn naaste willen gebruiken…	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Op dit moment in mijn leven	O	O	O	O	O
Wanneer de cognitieve of fysieke gezondheid van mijn naaste verslechterd	O	O	O	O	O

	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
(Attitude towards)					
Het is een goed idee om contactloze monitoring technologie te gebruiken in de zorg voor mijn naaste	O	O	O	O	O
(Social influence)					
Mijn familie en vrienden zouden het positief vinden wanneer ik contactloze monitoring technologie gebruik in de zorg voor mijn naaste.	O	O	O	O	O
De zorgverleners van mijn naaste zouden het positief vinden wanneer ik contactloze monitoring technologie gebruik in de zorg voor mijn naaste.	O	O	O	O	O
(Perceived ease of use)					
Het zou voor mij gemakkelijk zijn om de aan het monitoring systeem gekoppelde informatieplatform (app) te leren bedienen	O	O	O	O	O
(Facilitating conditions)					
Ik verwacht dat ik voldoende kennis en ondersteuning heb/ krijg om contactloze monitoring technologie in de zorg voor mijn naaste te gebruiken	O	O	O	O	O

(Educatie)

Wat is uw hoogst genoten opleiding (diploma behaald)?

a.   Basisonderwijs of lager

b.   Voortgezet onderwijs: VMBO

c.   Voortgezet onderwijs: HAVO, VWO

d.   Middelbaar beroepsonderwijs (MBO)

e. Bachelor/ Master of gelijkwaardig diploma (HBO of Universiteit)

f. Doctoraal diploma

g. Anders

ACCEPTATIE VANVERSCHILLENDE VORMEN VAN MONITORINGTECHNOLOGIE

Wij zijn nu aangekomen in het laatste gedeelte van de vragenlijst. Monitoring technologie voor de thuisomgeving kan gebruik maken van verschillende apparaten/sensoren om informatie in te winnen over de toestand van uw zorgbehoevende naaste. Wij zijn benieuwd wat u van deze apparaten vind. Geeft u alstublieft voor elk van onderstaande apparaten/ sensoren aan in hoeverre u ze acceptabel vindt in de zorg voor uw naaste.

	Helemaal mee oneens	Mee oneens	Neutraal	Mee eens	Helemaal mee eens
Draagbare apparaten (apparaten die dicht bij het lichaam gedragen worden; zoals smartwatches, mobiele telefoons, draagbare alarm knoppen)	O	O	O	O	O
Visuele apparaten (zoals camera's die geanonimiseerde beelden produceren, d.w.z. beelden waarop gezichten niet herkenbaar zijn)	O	O	O	O	O
Apparaten gebaseerd op geluidsdetectie (zoals microfoons, smart speakers)	O	O	O	O	O
Apparaten gebaseerd op radiofrequenties (zoals bv. een centraal geplaatste sensor die bewegingen binnen het huis kan detecteren via radar)	O	O	O	O	O
Object-gebonden apparaten (apparaten die vast zitten aan dagelijks gebruikte voorwerpen; zoals bewegingssensoren aan deuren of de koelkast of druksensoren op bed matrassen)	O	O	O	O	O

END OF SURVEY

Hartelijk dank voor uw deelname! U maakt nu kans om een prijs te winnen!

Wij danken u voor uw deelname en hulp bij ons onderzoek. Als u nog vrienden, familie of kennissen kent die ook mantelzorger zijn, zouden wij het zeer waarderen als u deze vragenlijst met hun zou delen.

Voor meer informatie met betrekking tot dit onderzoek kunt u terecht bij Dr. Annemarie Braakman-Jansen (l.m.a.braakman-jansen@utwente.nl), de projectleider, of bij Maarten Akgül (m.t.d.akguel@student.utwente.nl), een van de onderzoekers.

Om u nogmaals te bedanken voor uw deelname en hulp, maakt u kans op een cadeaubon ter waarde van €10,-. In totaal zullen er d.m.v. een loting willekeurig 4 winnaars bekend worden gemaakt. Indien u wilt meedoen aan de loterij kunt u hieronder uw e-mailadres achterlaten:

E-mail:

Wij vinden het erg belangrijk om mantelzorgers te kunnen betrekken bij het ontwikkelen van technologie die ondersteuning kan bieden. Zouden wij u mogen benaderen voor toekomstig onderzoek? Zo ja, dan kunt u hieronder uw e-mailadres voor ons achterlaten.

(De gegevens worden uitsluitend gebruikt om contact op te nemen en worden apart van uw antwoorden verwerkt.)

E-mail:

Appendix B

EINLEITUNG

Akzeptanz von Überwachungstechnologien in der Pflege älterer Menschen

Vielen Dank für Ihr Interesse an der Teilnahme an dieser Studie über den Einsatz von Technologien in der häuslichen Pflege. Die Studie wird von Psychologie-Studenten der Universität Twente im Rahmen ihrer Bachelor-Arbeiten durchgeführt.

Ziel der Forschungsstudie ist es, herauszufinden, wie pflegende Angehörige über die Nutzung von Überwachungstechnologien für die Pflege älterer Menschen denken. Pflegende Angehörige sind Personen, die unbezahlte Pflege für ein Familienmitglied, einen Freund oder einen Nachbarn leisten. Wenn Sie eine informelle Pflegeperson einer älteren Person, einer Person mit Demenz oder leichter kognitiver Beeinträchtigung sind, sind Sie herzlich eingeladen, an unserer Studie teilzunehmen. Die Teilnahme wird etwa 15-20 Minuten dauern.

Ihre Angaben sind anonym, da wir keine persönlich identifizierbaren Informationen sammeln werden. Die erhobenen Daten werden ausschließlich für wissenschaftliche Forschungszwecke verwendet und nicht an Dritte weitergegeben.

Ihre Teilnahme an dieser Studie ist freiwillig und Sie können jederzeit ohne Angabe von Gründen von der Teilnahme zurücktreten. Sollten Sie Fragen zur Studie haben, können Sie sich gerne an Ronja Rosenkranz (r.rosenkranz@student.utwente.nl), eine der Student*innen, oder Frau Dr. Braakman-Jansen (l.m.a.braakman-jansen@utwente.nl), die Projektleiterin, wenden.

Einverständniserklärung

Ich bestätige, dass ich 18 Jahre alt bin und mit der oben beschriebenen Verarbeitung der Daten einverstanden bin. Ich nehme freiwillig an dieser Studie teil.

o Ja

o Nein

USER CHARACTERISTICS

TEIL 1: Allgemeine Fragen zu Ihrer Person

Im ersten Teil des Fragebogens stellen wir Ihnen einige Fragen zu Ihrer Person und Ihrer Rolle als pflegender Angehöriger.

(Alter)

Wie alt sind Sie (in Jahren)? _____

(Geschlecht)

Mit welcher der folgenden Optionen identifizieren Sie sich am meisten?

a. Männlich

b. Weiblich

d. Anders/ Keine Angabe

(Wohnort)

In welchem Land leben Sie?

a. Deutschland

b. Niederlande

c. Keine der genannten Optionen trifft zu

(Informelle Pflege)

Sind Sie eine informelle Pflegekraft?
(Eine informelle Pflegekraft leistet unbezahlte Pflege für eine ihnen nahestehende Person, wie zum Beispiel Partner, Eltern oder Nachbarn)

a.   Ja

b.   Nein (Ende der Umfrage)

(Grund der Pflege)

Was ist der Grund für die Pflege? (mehrere Antworten sind möglich)

a.   Demenz oder leichte kognitive Beeinträchtigung/ Gedächtnisstörungen

b.   Folgen des normalen Alterungsprozess

c.   Somatische Beeinträchtigung

d.   Psychische Krankheit

e.   Andere Gründe

(Beziehung zu der Person, die Sie pflegen)

Was beschreibt die Beziehung zu der Person, die Sie pflegen, am besten? Ich bin...

a. (Ehe)Partner

b. Tochter/Sohn

c. Schwiegertochter/-sohn

e. Nachbar(in)/ Freund(-in)

f. Enkel

g. Anders, nämlich:____

(Größe vom Sozialen Pflegenetz)

Gibt es mehr Menschen, die die ältere Person informell betreuen?

a.   Nein, ich bin die einzige Person

b.   Ja, 1 weitere Person

c.   Ja, 2 weitere Personen

d.   Ja, 3 weitere Personen

e.   Ja, 4 oder mehr andere Personen

(Geographische Entfernung)

Bitte geben Sie an, wie lange Sie brauchen, um zu dem Haus der zu betreuenden Person zu gelangen. Bitte beziehen Sie sich dabei auf das Fortbewegungsmittel, welches Sie überwiegend für diese Strecke nutzen (z.B. zu Fuß, Fahrrad, Bus, Bahn, Auto etc.)

Wie weit leben Sie von der Person, die Sie pflegen, entfernt?

a. Ich lebe im gleichen Haus

b. Ich lebe zwischen 1 und 5 Minuten entfernt

c. Ich lebe zwischen 6 und 15 Minuten entfernt

c. Ich lebe zwischen 16 und 30 Minuten entfernt

d. Ich lebe zwischen 31 Minuten und 1 Stunde entfernt

e. Ich lebe mehr als 1 Stunde entfernt

TEIL 2: Allgemeine Fragen zu der Person, die Sie betreuen/ pflegen

Im zweiten Teil dieses Fragebogens haben wir einige allgemeine Fragen zu der Person, die Sie betreuen/ pflegen.

(Age care recipient)
Wie alt ist die Person die Sie betreuen/ pflegen (in Jahren)? _____

(Zeit seit Beginn der Symptome)

Seit wann hat die Person, die Sie betreuen/pflegen, Symptome einer Demenz oder einer leichten kognitiven Beeinträchtigung (Schätzung)?

a.   Weniger als 1 Jahr

b.   1 bis 2 Jahre

c.   2 bis 3 Jahre

d.   3 bis 4 Jahre

e.   4 bis 5 Jahre

f.   Mehr als 5 Jahre

(Demenztyp)

Welche Art von Demenz oder kognitiver Beeinträchtigung betrifft die Person, die Sie pflegen?

a. Alzheimer

b. Lewy-Body-Demenz bzw. Lewy-Körper-Demenz

c. Vaskuläre Demenz

d. Leichte kognitive Störung

e. Anders/ Weiß ich nicht

f. Es wurde (noch) keine Diagnose festgestellt

(Wohnsituation der Person, die Sie pflegen)

Wie ist die aktuelle Wohnsituation der Person, die Sie pflegen?

a.   Die zu betreuende Person lebt allein

b.   Die zu betreuende Person lebt mit anderen Personen zusammen

Wo wohnt die Person, die Sie pflegen?

a.   In einem eigenen (Miet-)Haus / einer eigenen (Miet-)Wohnung

b.   In der Wohnung eines Familienmitglieds

c.   In einer (betreuten) Seniorenwohnung oder einer Wohnung, die zu einer Gesundheitseinrichtung gehört

d.   In einem Pflegeheim (--> Ende)

e.   Anders, nämlich:___

(Inanspruchnahme der professionellen Pflege)

Welche Art von professioneller Pflege/Dienstleistung erhält Ihr Angehöriger? (Mehrere Angaben möglich)

a.   Häusliche Pflege durch eine Krankenschwester oder einen Pfleger

b.   Eine feste Ansprechperson welche die Pflege Ihres Angehörigen koordiniert

c.   Tagespflege/ Tagesbetreuung

d.   Hilfe für den Haushalt

e.   Essen auf Rädern

f.   Keiner der oben genannten Punkte

TEIL 3: Wahrgenommene Belastung durch die Pflege (Bédard et al., 2001)

(Caregiver burden)

Für diesen Teil des Fragebogens wurde die Skala 'Caregiver Burden: 4-item ZBI screening scale' verwendet. Diese Skala wurde von Bédard et al. (2001) übernommen:

TEIL 4: Digitale Fähigkeiten und Erfahrung mit Technologie (Kayser et al., 2018)

(Digitale Kompetenz)

Um die digitale Kompetenz der Teilnehmer zu untersuchen, wurde die eHLQ-Subskala (Kayser et al., 2018) "Fähigkeit zur aktiven Auseinandersetzung mit digitalen Diensten im Gesundheitswesen" verwendet. Die Teilnehmer mussten angeben, inwieweit sie fünf Aussagen auf einer vierstufigen Likert-Skala von 1 (= stimme überhaupt nicht zu) bis 4 (= stimme voll und ganz zu) zustimmten oder nicht zustimmten. Diese Aussagen des eHLQ stammen von Kayser et al. (2018)

(Personal innovativeness)

Wie innovativ sind Sie? Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

	Stimme überhaupt nicht zu	Stimme nicht zu	Stimme eher nicht zu	Neutral	Stimme eher zu	Stimme zu	Stimme voll und ganz zu
1. Wenn ich von einer neuen Informationstechnologie höre, suche ich nach Möglichkeiten, sie auszuprobieren.	O	O	O	O	O	O	O
2. Unter meinen Kollegen bin ich normalerweise die erste Person, die neue Informationstechnologien ausprobiert.	O	O	O	O	O	O	O
3. Ich bin im Allgemeinen zögerlich, wenn es darum geht, neue Technologien auszuprobieren.	O	O	O	O	O	O	O
4. Ich experimentiere gerne mit neuen Informationstechnologien.	O	O	O	O	O	O	O

(Erfahrung mit verschiedenen Technologien)

Welche der folgenden Technologien nutzen Sie derzeit oder haben Sie in der Vergangenheit bereits genutzt?

a. Technologien zur Überwachung der täglichen Aktivitäten/des Lebensstils Ihres Angehörigen (z. B. Sensortechnologie, Alarmknöpfe, GPS-Tracker)

b. Digitale Kommunikationstechnologie, um mit Ihrem Angehörigen in Kontakt zu bleiben (z.B. Videoanrufe, Nachrichten Systeme, WhatsApp)

c. Technologie zur Unterstützung des Gedächtnisses, oder der Tagesstruktur Ihres Angehörigen (z. B. Erinnerungssysteme, Smartwatch (elektronische Multifunktions-Armbanduhr), automatischer Medikamentenspender (der die Einnahme von Medikamenten kontrolliert)

d. Digitale Pflegeplattformen zur Unterstützung der Koordination der Pflege Ihres Angehörigen (z. B. Plattformen zur Erleichterung der Kommunikation zwischen informellen und professionellen Pflegekräften)

e. Keine der oben genannten Technologien

TEIL 5: In-Home-Überwachungstechnologie

Bitte sehen Sie sich die folgende Beschreibung und Illustration and, bevor Sie mit den nächsten Fragen fortfahren.

Es werden immer mehr Technologien entwickelt, die darauf abzielen, pflegende Angehörige zu unterstützen und es ihren Angehörigen zu ermöglichen, länger zu Hause zu leben. In diesem Teil des Fragebogens konzentrieren wir uns auf eine spezielle Form der unterstützenden Technologie: kontaktlose Überwachungstechnologien.

Bei kontaktloser Heimüberwachungstechnologie handelt es sich um ein Sensorsystem, das in der Wohnung älterer Personen installiert werden kann und rund um die Uhr Informationen über deren Lebensstil, Gesundheit und Sicherheit liefert. Die Technologie soll dem pflegenden Angehörigen einen besseren Einblick in die Situation des älteren Menschen geben, insbesondere wenn der pflegende Angehörige weit entfernt wohnt oder das Haus verlässt.

Die Technologie funktioniert kontaktlos, d.h. ältere Menschen müssen keine Geräte tragen. Wie in dem Bild zu sehen ist, kann eine kleine Box mit eingebauten Sensoren in einer Ecke der Wohnung platziert werden. Mit Hilfe künstlicher Intelligenz kann dieses System lernen den täglichen Lebensstil Ihres Angehörigen zu erkennen und wichtige Veränderungen zu signalisieren, wie z.B. weniger essen und trinken oder nächtliche Unruhe. In Notfällen (z.B. Sturz) kann das System den pflegenden Angehörigen alarmieren. Die gesammelten Informationen können in Echtzeit auf einer digitalen Plattform angezeigt werden, auf die der pflegende Angehörige, die pflegebedürftige Person und, falls gewünscht, das medizinische Fachpersonal aus der Ferne zugreifen können.
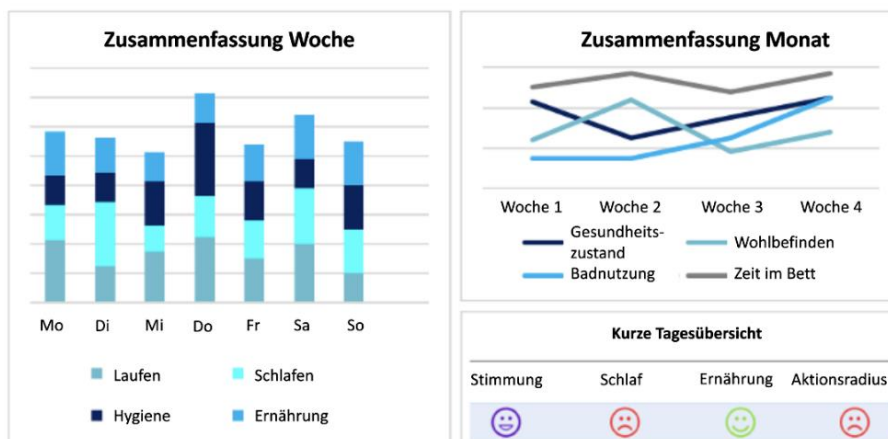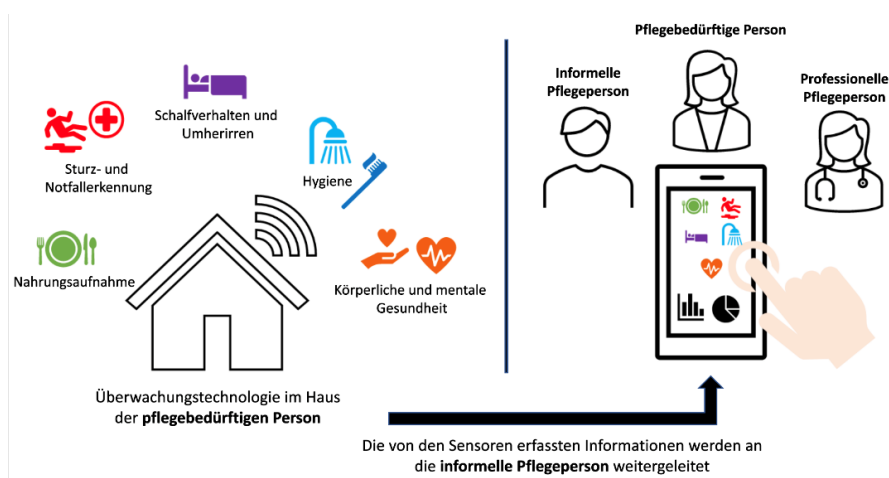
(Prüfen Sie auf Verständlichkeit)

Wie verständlich fanden Sie die obige Beschreibung und die Bilder über die kontaktlose In-Home-Überwachungstechnologie?

a.   Nicht klar (-> folgende Frage zeigen)

b.   Ziemlich klar (-> folgende Frage zeigen)

c.   Eindeutig

Haben Sie Vorschläge, wie man die Klarheit der Beschreibung verbessern kann?

AKZEPTANZ FÜR VERSCHIEDENE NUTZUNGSSZENARIEN

Im Folgenden werden Ihnen 5 verschiedene Szenarien vorgestellt. Die Szenarien sind Beschreibungen von Situationen, in denen kontaktlose Überwachungstechnologien in der häuslichen Pflege eingesetzt werden könnten. Alle Szenarien enthalten verschiedene Aspekte, die überwacht werden können. Bitte beantworten Sie die folgenden Fragen für jedes Szenario.

Szenario 1: Erkennen von Notsituationen

Stellen Sie sich Folgendes vor: In der Wohnung Ihres Angehörigen wird eine kontaktlose Überwachungstechnologie installiert. Diese Technologie überwacht kontinuierlich sicherheitsgefährdende Aspekte, wie z.B. Stürze oder Umherirren. Es kann solche Notsituationen in Echtzeit erkennen und Sie oder eine andere autorisierte Person alarmieren.

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zu Szenario 1 zustimmen:

Kontaktlose Überwachungstechnologie zur Erkennung von Notsituationen meines Angehörigen…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Acceptability)					
Würde ich akzeptabel finden	O	O	O	O	O
Würde mein Angehöriger akzeptabel finden	O	O	O	O	O
(Perceived usefulness)					
Wäre nützlich für mich	O	O	O	O	O
Würde mich dabei unterstützen, die bestmögliche Pflege für meinen Angehörigen zu leisten	O	O	O	O	O

Würde mich dabei unterstützen, mich über die Situation meines Angehörigen rückzuversichern	O	O	O	O	O
Würde mir dabei helfen, schneller auf die Pflegebedürfnisse meines Angehörigen einzugehen	O	O	O	O	O
Würde dazu beitragen, dass mein Angehöriger länger zu Hause leben kann.	O	O	O	O	O
Würde mir dabei helfen, als pflegender Angehöriger länger durchzuhalten.	O	O	O	O	O
Würde mir Informationen liefern, die ich mit der/den medizinischen Fachkraft(en) meines Angehörigen teilen möchte.	O	O	O	O	O
(Willingness to use)					
Ich würde die kontaktlose Überwachungstechnologie zur Erkennung von Notsituationen meines Angehörigen in (naher) Zukunft nutzen wollen.	O	O	O	O	O

Szenario 2: Risikovorhersagen

Stellen Sie sich Folgendes vor: In der Wohnung Ihres Angehörigen wird eine kontaktlose Überwachungstechnologie installiert. Diese zielt darauf ab, akute Situationen nicht nur zu erkennen, sondern vorherzusagen. So kann die Technologie z.B. kontinuierlich die Gehgeschwindigkeit und das Gehverhalten Ihres Angehörigen überwachen. Anhand dieser Informationen kann das System das Sturzrisiko vorhersagen und Sie oder eine andere autorisierte Person darüber informieren. Das Ziel ist es, Notsituationen wie z.B. Stürze zu verhindern.

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zu Szenario 2 zustimmen:

Kontaktlose Überwachungstechnologie zur Vorhersage von Risiken meines Angehörigen…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Acceptability)					
Wuerde ich akzeptabel finden	O	O	O	O	O

Wuerde mein Angehoeriger akzeptabel finden	O	O	O	O	O

(Perceived usefulness)					
Waere nützlich für mich	O	O	O	O	O
Würde mich dabei unterstützen, die bestmögliche Pflege für meinen Angehörigen zu leisten	O	O	O	O	O
Würde mich dabei unterstützen, mich über die Situation meines Angehörigen rückzuversichern	O	O	O	O	O
Würde mir dabei helfen, schneller auf die Pflegebeduerfnisse meines Angehörigen einzugehen	O	O	O	O	O
Würde dazu beitragen, dass mein Angehöriger länger zu Hause leben kann.	O	O	O	O	O
Würde mir dabei helfen, als pflegender Angehöriger länger durchzuhalten.	O	O	O	O	O
Würde mir Informationen liefern, die ich mit der/den medizinischen Fachkraft(en) meines Angehörigen teilen möchte.	O	O	O	O	O

(Willingness to use)					
Ich würde kontaktlose Ueberwachungstechnologie zur Vorhersage von Risiken meines Angehörigen in (naher) Zukunft nutzen wollen.	O	O	O	O	O

Szenario 3: Überwachung des Selbstpflegeverhaltens

Stellen Sie sich Folgendes vor: In der Wohnung Ihres Angehörigen wird eine kontaktlose Überwachungstechnologie installiert. Diese überwacht kontinuierlich die Selbstversorgung Ihres Angehörigen wie Essen, Trinken und Körperpflege (z. B. Baden, Toilettengang, Anziehen). Das System kann größere Abweichungen im Selbstpflegeverhalten erkennen und Benachrichtigungen an Sie oder eine andere autorisierte Person senden.

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zu Szenario 3 zustimmen:

Kontaktlose Technologie zur Überwachung des Selbstpflegeverhaltens meines Angehörigen…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Acceptability)					
Würde ich akzeptabel finden	O	O	O	O	O
Wuerde mein Angehoeriger akzeptabel finden	O	O	O	O	O
(Perceived usefulness)					
Waere nuetzlich fuer mich	O	O	O	O	O
Wuerde mich dabei unterstuetzen, die bestmoegliche Pflege fuer meinen Angehoerigen zu leisten	O	O	O	O	O
Wuerde mich dabei unterstuetzen, mich ueber die Situation meines Angehoerigen rueckzuversichern	O	O	O	O	O
Wuerde mir dabei helfen, schneller auf die Pflegebeduerfnisse meines Angehoerigen einzugehen	O	O	O	O	O
Wuerde dazu beitragen, dass mein Angehoeriger laenger zu Hause leben kann.	O	O	O	O	O
Wueder mir dabei helfen, als pflegender Angehoeriger laenger durchzuhalten.	O	O	O	O	O
Würde mir Informationen liefern, die ich mit der/den medizinischen Fachkraeft(en) meines Angehörigen teilen möchte.	O	O	O	O	O
(Willingness to use)					
Ich wuerde kontaktlose Technologie zur Überwachung des Selbstpflegeverhaltens meines Angehoerigen in (naher) Zukunft nutzen wollen.	O	O	O	O	O

Szenario 4: Überwachung des Wohlbefindens während der Nacht

Stellen Sie sich Folgendes vor: In der Wohnung Ihres Angehörigen wird eine kontaktlose Überwachungstechnologie installiert. Diese überwacht kontinuierlich das Wohlbefinden der Person während der Nacht. Das System kann Abweichungen (z. B. nächtliche Unruhe, Schlafprobleme oder einen gestörten Tag-Nacht-Rhythmus) erkennen und Benachrichtigungen an Sie oder eine andere von Ihnen bevollmächtigte Person senden.

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zu Szenario 4 zustimmen:

Kontaktlose Technologie zur Überwachung des Wohlbefindens meines Angehörigen während der Nacht…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Acceptability)					
Wuerde ich akzeptabel finden	O	O	O	O	O
Wuerde mein Angehoeriger akzeptabel finden	O	O	O	O	O
(Perceived usefulness)					
Waere nuetzlich fuer mich	O	O	O	O	O
Wuerde mich dabei unterstuetzen, die bestmoegliche Pflege fuer meinen Angehoerigen zu leisten	O	O	O	O	O
Wuerde mich dabei unterstuetzen, mich ueber die Situation meines Angehoerigen rueckzuversichern	O	O	O	O	O
Wuerde mir dabei helfen, schneller auf die Pflegebeduerfnisse meines Angehoerigen einzugehen	O	O	O	O	O
Wuerde dazu beitragen, dass mein Angehoeriger laenger zu Hause leben kann.	O	O	O	O	O
Wuerde mir dabei helfen, als pflegender Angehoeriger laenger durchzuhalten.	O	O	O	O	O
Würde mir Informationen liefern, die ich mit der/den medizinischen Fachkraeft(en) meines Angehörigen teilen möchte.	O	O	O	O	O

(Willingness to use)					
Ich wuerde kontaktlose Technologie zur Überwachung des Wohlbefindens meines Angehörigen während der Nacht in (naher) Zukunft nutzen wollen.	O	O	O	O	O

Szenario 5: Überwachung von langfristigen Gesundheidsveränderungen

Stellen Sie sich Folgendes vor: In der Wohnung Ihres Angehörigen wird eine kontaktlose Überwachungstechnologie installiert. Diese überwacht mögliche Veränderungen des Gesundheitszustandes der Person, die sich im Laufe der Zeit entwickeln. Das System kann Sie oder eine andere autorisierte Person beispielsweise darüber informieren, ob es in einem bestimmten Zeitraum zu einer kognitiven oder körperlichen Verschlechterung gekommen ist.

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zu Szenario 5 zustimmen:

Kontaktlose Technologie zur Überwachung langfristiger Gesundheidsveraenderungen meines Angehoerigen…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Acceptability)					
Wuerde ich akzeptabel finden	O	O	O	O	O
Wuerde mein Angehoeriger akzeptabel finden	O	O	O	O	O
(Perceived usefulness)					
Waere nuetzlich fuer mich	O	O	O	O	O
Wuerde mich dabei unterstuetzen, die bestmoegliche Pflege fuer meinen Angehoerigen zu leisten	O	O	O	O	O
Wuerde mich dabei unterstuetzen, mich ueber die Situation meines Angehoerigen rueckzuversichern	O	O	O	O	O
Wuerde mir dabei helfen, schneller auf die Pflegebeduerfnisse meines Angehoerigen einzugehen	O	O	O	O	O
Wuerde dazu beitragen, dass mein Angehoeriger laenger zu Hause leben kann.	O	O	O	O	O

Wuerde mir dabei helfen, als pflegender Angehoeriger laenger durchzuhalten.	◯	◯	◯	◯	◯
Würde mir Informationen liefern, die ich mit der/den medizinischen Fachkraeft(en) meines Angehörigen teilen möchte.	◯	◯	◯	◯	◯
(Willingness to use)					
Ich wuerde kontaktlose Technologie zur Überwachung langfristiger Gesundheidsveraenderungen meines Angehoerigen in (naher) Zukunft nutzen wollen.	◯	◯	◯	◯	◯

VORTEILE & BEDENKEN

Im Folgenden möchten wir Sie nach den von Ihnen wahrgenommenen Vorteilen und Bedenken in Bezug auf kontaktlose Überwachungstechnologie fragen.

(Vorteile)

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Ich glaube, dass mir kontaktlose Überwachungstechnologie in der häuslichen Pflege helfen kann …

	Stimme überhaupt nicht zu	Stimme nicht zu	Neutral	Stimme zu	Stimme voll und ganz zu
1. Um zu überprüfen, ob mein Angehöriger angemessen für sich selbst sorgt (z. B. Essen, Trinken)	◯	◯	◯	◯	◯
2. Nicht erforderliche Besuche zu vermeiden wie z.B Besuche zur Kontrolle der Selbstpflege meines Angehörigen	◯	◯	◯	◯	◯
3. Mich bezüglich der Sicherheit meines Angehörigen zu vergewissern	◯	◯	◯	◯	◯
4. Meine Freiheit und Mobilität wiederzuerlangen	◯	◯	◯	◯	◯
5. Faktoren, welche die Unabhängigkeit meines Angehörigen einschränken, zu erkennen und zu beseitigen.	◯	◯	◯	◯	◯

6. Schneller auf den Pflegebedarf meines Angehörigen zu reagieren, um Gesundheitsrisiken vorzubeugen (z.B. Unterernährung, Schlafprobleme, Einsamkeit)	O	O	O	O	O
7. Anderen Personen (einschließlich Pflegefachkräften) einen objektiven Einblick in die Situation meines Angehörigen zu geben	O	O	O	O	O
8. Den optimalen Zeitpunkt für den Übergang meines Angehörigen in ein Pflegeheim oder zu einer anderen Wohnform zu finden	O	O	O	O	O

(Bedenken)

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen:

Wenn ich kontaktlose Überwachungstechnologie in der häuslichen Pflege einsetzen würde, wäre

ich…

	Stimme überhaupt nicht zu	Stimme nicht zu	Neutral	Stimme zu	Stimme voll und ganz zu
1. Besorgt, mit zu vielen Informationen überhäuft zu werden	O	O	O	O	O
2. Besorgt, dass die Überwachungsinformationen mich unnötig beunruhigen würden	O	O	O	O	O
3. Verunsichert, auf welche Informationen ich reagieren sollte	O	O	O	O	O
4. Besorgt, dass Überwachungsdaten ohne unsere Zustimmung an Dritte weitergegeben werden könnten	O	O	O	O	O
5. Verunsichert, ob die Vorteile des Systems die Verletzung der Privatsphäre meines Angehörigen rechtfertigen	O	O	O	O	O
6. Besorgt, dass die Technologie den menschlichen Kontakt ersetzen könnte	O	O	O	O	O

ALLGEMEINE AKZEPTANZ GEGENÜBER KONTAKTLOSER UEBERWACHUNGSTECHNOLOGIE

Nun interessieren wir uns für Ihre allgemeine Akzeptanz von kontaktloser Überwachungstechnologie in der häuslichen Pflege. Bitte berücksichtigen Sie alle Informationen, die Sie nun über die Funktion und den Einsatz dieser Technologien haben und geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen.

(Perceived usefulness) Ich denke, dass kontaktlose Überwachungstechnologie in der Pflege meines Angehörigen nützlich sein kann..	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
zu diesem Zeitpunkt in meinem Leben	O	O	O	O	O
wenn sich die kognitive oder körperliche Gesundheit meiner Pflegeperson verschlechtert	O	O	O	O	O

(Intention to use) Ich würde kontaktlose Überwachungstechnologie in der Pflege meines Angehörigen nutzen wollen…	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
zu diesem Zeitpunkt in meinem Leben	O	O	O	O	O
wenn sich die kognitive oder körperliche Gesundheit meiner Pflegeperson verschlechtert	O	O	O	O	O

	Stimme überhaupt nicht zu	stimme nicht zu	Neutral	Stimme zu	stimme völlig zu
(Attitude towards)					
Es ist eine gute Idee kontaktlose Überwachungstechnologie in der Pflege meines Angehörigen zu nutzen.	O	O	O	O	O
(Social influence)					
Meine Familie und Freunde würden es gut finden, wenn ich bei der Pflege meines Angehörigen kontaktlose Überwachungstechnologie einsetzen würde.	O	O	O	O	O
Die professionellen Pflegekräfte meines Angehörigen würden es gut finden, wenn ich bei der Pflege meines Angehörigen kontaktlose Überwachungstechnologie einsetzen würde.	O	O	O	O	O

(Perceived ease of use)

Die an das Überwachungssystem angeschlossene digitale Plattform (App) bedienen zu lernen wäre leicht für mich.	O	O	O	O	O

(Facilitating conditions)

Ich denke, dass ich das nötige Wissen und die Unterstützung habe/ bekomme um kontaktlose Überwachungstechnologie in der Pflege meines Angehörigen zu verwenden.	O	O	O	O	O

(Bildung)

Was ist der höchste schulische Abschluss, den Sie erworben haben?

a.   Grundschulabschluss oder kein Abschluss

b.   Haupt-/Realschulabschluss

c.   Abitur

d.   Berufsabschluss

e.   Bachelor-/ Masterabschluss oder Diplom

f.   Doktorgrad

g.   Keine der genannten Optionen trifft zu

AKZEPTANZ VERSCHIEDENER UEBERWACHUUNGSTECHNOLOGIEN

 Wir sind nun beim letzten Teil des Fragebogens angelangt. Häusliche Überwachungstechnologie kann verschiedene Geräte/Sensoren einsetzen, um Informationen über pflegebedürftige Menschen zu sammeln. Uns interessiert, was Sie von diesen Geräten halten. Bitte geben Sie für jedes der unten aufgeführten Überwachungsgeräte an, inwiefern Sie dessen Einsatz für die Pflege Ihres Angehörigen für akzeptabel halten.

	Stimme überhaupt nicht zu	Stimme nicht zu	Neutral	Stimme zu	Stimme voll und ganz zu
1. Tragbare Geräte (Technologie, die am oder in der Nähe des Körpers getragen wird, wie z. B. Smartwatches, Mobiltelefone, tragbare Alarmknöpfe)	O	O	O	O	O
2. Visuelle Geräte (z.B. Kameras, die anonymisierte Bilder erzeugen, d. h. Bilder, auf denen Gesichter nicht erkennbar sind)	O	O	O	O	O

3. Auf Ton basierende Geräte (z.B. Mikrofon, Smart Speaker)	O	O	O	O	O
4. Radiofrequenz Geräte (z.B. Sensoren, die an einer zentralen Stelle im Haus angebracht werden und Bewegungsdaten per Radar erfassen)	O	O	O	O	O
5. Objekt-gebundene Technologie: Sensoren, die an Gegenständen des täglichen Gebrauchs angebracht sind (z.B. Bewegungssensoren an Türen, am Kühlschrank oder Drucksensoren an der Bettmatratze)	O	O	O	O	O

ENDE DER UMFRAGE

Vielen Dank für Ihre Teilnahme! Sie haben jetzt die Möglichkeit, einen Preis zu gewinnen!

Wir danken Ihnen für Ihre Hilfe und Entscheidung, an unserer Studie teilzunehmen. Kennen Sie Freunde, Familienmitglieder oder Bekannte, die informelle Pflegepersonen sind und an dieser Studie teilnehmen könnten? Dann wären wir Ihnen sehr dankbar, wenn Sie diese Umfrage weiterleiten würden.

Als Dankeschön für Ihre Teilnahme haben Sie die Möglichkeit, einen 10-Euro-Mydays-Gutschein (falls Sie in Deutschland leben) oder einen cadeaubon-Gutschein (falls Sie den Niederlanden leben) zu gewinnen. Insgesamt werden 4 Gewinner nach dem Zufallsprinzip verlost. Um an der Verlosung teilzunehmen, können Sie unten Ihre E-Mail-Adresse angeben. Diese Adresse wird nicht mit Ihren Antworten in Verbindung gebracht und wird nicht weitergegeben.

E-mail:

Wir glauben, dass es sehr wichtig ist, informelle Betreuer in die Entwicklung und Verbesserung von Technologien zur Unterstützung einzubeziehen. Dürfen wir Sie für zukünftige Forschung ansprechen? Wenn ja, können Sie uns unten Ihre E-Mail-Adresse hinterlassen (freiwillig).

Nochmals vielen Dank für Ihre Teilnahme!

E-mail:

Appendix C

INTRDOCUTION

Acceptance of innovative monitoring technology in the care of elderly people living at home

Thank you for your willingness to participate in this study. This research is conducted by psychology students at the University of Twente as part of their Bachelor Thesis.

The purpose of this study is to gain more insight into factors that play a role in the acceptance of technology for monitoring elderly people living at home. We are particularly interested in the opinions of informal caregivers of older people with dementia. Informal caregivers are people who voluntarily provide unpaid care/help to a loved one in need of care. Examples of an informal carer are a spouse, son/daughter, other family member, or a friend.

The questionnaire is distributed in the Netherlands and Germany. Previous experience with monitoring technology is not required to complete this questionnaire. Participation in this questionnaire will take approximately 20 minutes.

Your answers will be processed completely anonymously so that the data cannot be traced to any individual. Your data will only be used for this scientific study.

Your participation in this study is completely voluntary, which means that you can stop filling in the questionnaire at any time.

If you have any questions about this study, please contact Maarten Akgül (m.t.d.akguel@student.utwente.nl), one of the researchers, or Dr. L.M.A. Braakman-Jansen (l.m.a.braakman-jansen@utwente.nl), the study leader.

To thank you for your participation, we offer you the opportunity to win a prize at the end of the questionnaire! You could win a gift voucher worth €10.

Declaration of consent for participation

I confirm that I am 18 years or older and that I have read and understood the above information. On the basis of the above, I voluntarily consent to take part in this survey.

o Yes

o No