Living on Video: Insights on the User Perspective of Video-Based AAL Technology

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Abstract: Research on video-based Ambient Assisted Living (AAL) technologies is increasing due to their potential of providing abundant sensory information about a person in need of support. Acceptance of these visual sensors is limited among potential users as perceptions of barriers persist, most importantly privacy concerns. The current study aimed to investigate potential users' behavioural intention to use video-based AAL and their evaluations of relevant benefits and barriers during activities of daily living in their own homes. Special focus was on exploring the influences of individual differences (demographics and psychometrics) on evaluation patterns. In total, evaluations of 122 participants (age range: 17-81 years) were assessed through an online survey. The results are in line with previous findings on perceived benefits and barriers and their relevance to the acceptance of AAL technology. Beyond that, the results revealed significant relationships and impacts of individual differences, i.e., privacy perception, self-consciousness, and body consciousness, on the perceived barriers and indirectly also on the acceptance of video-based AAL technology. Further, three clusters of potential users were identified, differing significantly in their evaluation of video-based AAL technology as well as in their individual characteristics, i.e., privacy perception and self-consciousness. The findings of this study are useful to derive recommendations for user-tailored development and communication of video-based AAL technology.

1 INTRODUCTION

Ambient Assisted Living (AAL) technology is embedded through various environmental and wearable sensors into a person's daily living environment to provide support for activities of daily living and prevent risky incidents for people in need of assistance. Among others, vital signs and changes in mobility and activity patterns can be monitored with AAL contributing to more safety, well-being, and autonomy (Choukou et al., 2021; Blackman et al., 2016; Calvaresi et al., 2017). Visual sensors such as RGB or depth cameras are increasingly included among the AAL set-up as these video-based technologies have the advantage of providing abundant sensory information (Climent-Pérez et al., 2020). This way, other sensors may even become redundant because any activity in a specific room can be monitored by one single camera (Cardinaux et al., 2011). While the trend towards visual sensors may be reasonable from a technological perspective, studies depicting the user perspective suggest an instead rejecting attitude towards video-based monitoring mentioning privacy issues as one main concern in the process of technology acceptance (e.g., (Beach et al., 2009; Arning and Ziefle, 2015; Offermann-van Heek et al., 2019)).

1.1 AAL Acceptance and Privacy

Robust models such as the Technology Acceptance Model (TAM) (Davis, 1987) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2012) with their main variables Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) prevail in research on technology acceptance but lack possibilities for context-specific evaluations (Chen and Chan, 2011). To specifically understand AAL acceptance, (Jaschinski et al., 2021) highlighted relevant belief antecedents for AAL acceptance including Attitude towards using AAL, Social Norm, Personal Norm and Perceived behaviour control as decisive multidimensional belief constructs in their conceptual model. The latter model succeeded to ex-

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plain 69% of the variance in behavioural intention to use AAL technology and depicts the relative importance of various acceptance factors including benefits and barriers of such technology use.

Indeed, previous research on assistive technology has identified that acceptance is considerably impacted by the evaluation of several barriers (privacy implications, lack of control over technology, false alarms, obtrusiveness, low ease of use, high costs, stigmatization) and benefits (increased safety, perceived usefulness, increased independence, reduced burden for family caregivers, mobility and support with daily activities) (e.g., (Jaschinski and Allouch, 2015; Jaschinski and Allouch, 2019; Zander et al., 2021; Peek et al., 2014; Yusif et al., 2016; Garg et al., 2014; Gövercin et al., 2010; Wild et al., 2008)). Findings suggest that benefits and barriers are typically traded-off against each other when it comes to a decision whether to adopt this technology or not (Offermann-van Heek and Ziefle, 2019; Jaschinski et al., 2021; Ehrari et al., 2020). While increased safety is most often a decisive driver of AAL technology acceptance (Schomakers and Ziefle, 2022), concerns regarding privacy and related aspects like the feeling of permanent surveillance, (unauthorized) data access and misuse of personal information, information sensitivity, invasion of personal space, and obtrusiveness are the most relevant barriers in that trade-off process (Garg et al., 2014; Schomakers and Ziefle, 2019; Lorenzen-Huber et al., 2011).

Especially in contexts where visual sensors such as video-based AAL are installed in the daily living environment for constant monitoring, privacy concerns are paramount (Arning and Ziefle, 2015; Mulvenna et al., 2017; Berridge et al., 2019; Maidhof et al., 2022a). In fact, actions, situations, (mental) states, places and objects can all be labelled as private (Rössler, 2001) which at the same time can all be captured and easily interpreted by a visual sensor. In this manner, the preservation of privacy in such an intimate place as the own home (e.g., (Wiles et al., 2012)) is challenged on different levels. (Burgoon, 1982) provides a privacy framework that adequately covers the multidimensionality of studying privacy perceptions in video-based AAL and has already been applied previously in the field (Schomakers and Ziefle, 2019; Maidhof et al., 2022b). The author (Burgoon, 1982) divides between four dimensions of privacy, namely, dimensions of social privacy (control over social contacts, interaction, and communication), of physical privacy (degree of physical inaccessibility) as well as of psychological privacy (degree of inaccessibility to thoughts, feelings, and intimate information), and of informational privacy (control over personal information). To adequately adhere to these concerns raised by potential users, their subjective privacy perceptions in all these dimensions have to be considered.

1.2 Individual Differences

Several individual differences among a variety of potential AAL users have been identified to influence the trade-off process of benefits and barriers and with that the behavioural intention of adopting AAL. As such, age has been reported to play a role. For instance, (Arning and Ziefle, 2009) reported that utilization barriers are perceived as higher for older adults who also expressed more concerns about data safety issues. Focusing on both age and gender, findings from (Wilkowska et al., 2010) suggested a decreasing trust and motivation to use medical technology with age among females and a varying trust and motivation to use these technologies among males throughout the age. Disability or the perceived need for care has also been identified as a relevant motivator for technology acceptance with disabled people being more acceptant of sharing and recording information captured by a monitoring device compared to non-disabled persons (Beach et al., 2009). Indeed, (Offermann-van Heek et al., 2019), showed that the perception of benefits, barriers, and general acceptance of assisting technologies is influenced by personal care needs. If care needs are higher, the benefits of technology are more acknowledged and barriers are partly more rejected.

Besides these demographic markers, psychological differences may be relevant in the acceptance processes but have not been studied extensively so far in relation to video-based AAL. Especially, in a setting where visual sensors are involved, it might be interesting how potential users frame their perceptions of benefits and barriers including their subjective privacy perceptions based on the unfolding of a specific their specific aspect of their personality, namely their dispositional tendencies towards self-awareness. This disposition, conceptualized as self-consciousness, is a relatively stable individual difference concerning the tendency to direct attention and thought toward oneself (Fenigstein et al., 1975; Fenigstein, 2009). Research has consistently shown that self-consciousness is composed of two, largely independent dimensions: public and private self-consciousness. Private self-consciousness comprises ”the tendency to be aware of and attentive to the covert, internal aspects of oneself, such as one’s thoughts and feelings and aspirations” ((Fenigstein, 2009); p.496). Public self-consciousness, on the other

hand, concerns ”an awareness of and interest in the external manifestations of the person, such as appearance, social behaviour and the impression made on others” ((Fenigstein, 2009); p.496). Privately and publicly self-conscious people differ in the identities they try to create for themselves. Whereas public self-conscious people portray themselves as cooperative team players trying to adapt their behaviour to conform expectations and preferences of others, private self-conscious people present themselves as being autonomous and independent and trying to convey these conceptions in social interactions (Schlenker and Weigold, 1990). It is important to note that self-consciousness is not value-loaded (neither positive nor negative) but is considered as a relatively pure attentional tendency (Fenigstein, 2009). These psychological factors of self-consciousness are also associated with an interest in the bodily aspects of oneself. Analogous to self-consciousness, it includes private body consciousness, the attentional focus on internal bodily sensations (e.g., heartbeat, pain) and public body consciousness meaning a chronic tendency to focus on and be concerned with the external appearance of the body (e.g. hairstyle, body shape), which is essentially the same personality trait as public self-consciousness (Miller et al., 1981a).

While these dispositional constructs have not been studied in relation to video-based monitoring of activities in the own home, self-consciousness has been explored within research on consumer acceptance behaviour. For instance, self-consciousness is reported to affect consumer adoption of online shopping (López-Bonilla et al., 2021) and the consumer decision-making process of fashion items (Lee and Workman, 2020).

In this study, the behavioural intention to use video-based AAL technology during activities of daily living in the own home is assessed including evaluations of perceived benefits, perceived general barriers and perceived privacy barriers. Furthermore, the influences of public and private self-consciousness as well as body consciousness in the acceptance process of video-based AAL are explored.

2 METHOD AND MATERIALS

In this chapter, the empirical approach of the study is presented. First, the design of the online survey and its subsequent data analysis are explained. Second, the participants of the study are described.

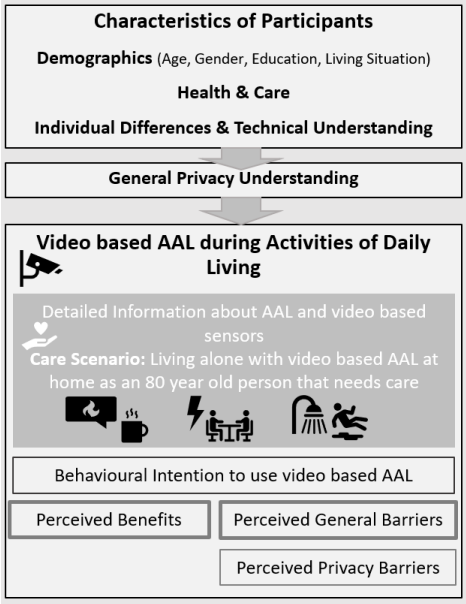

Figure 1: Empirical Design.

2.1 Online Questionnaire

Based on the previously described literature and a preceding qualitative study, a questionnaire was developed and delivered online through the social media channels of one of the researchers. It addressed participants of all ages. The questionnaire was divided into two main parts.

The first part of the questionnaire started with demographics, such as age, gender, educational level, as well as living situation and place of living. Then, information about participants' health (i.e., if they suffered from a chronic illness and if they needed care), as well as information about having experience in caring for another person was asked. Subsequently, additional user factors such as working field, technical understanding (four items) (Beier, 1999; Beier, 2003), and psychometrics were assessed. For the latter, user factors relevant in the context of video-based AAL were chosen, such as body consciousness (three items) (Miller et al., 1981b), private and public self-consciousness (three items each) (Fenigstein et al., 1975; Scheier and Carver, 1985). In addition, general privacy attitudes (16 items) (partly based on (Burgoon, 1982)) were assessed to evaluate participants' understanding of the meaning of privacy in daily life.

The second part of the questionnaire introduced video-based AAL with a detailed explanation. Participants were then asked to evaluate their overall acceptance (partly based on (Davis, 1987; Venkatesh et al., 2012; Jaschinski et al., 2021)) of imagining themselves living with such a technology. Specific refer-

ence was made to several activities of daily living in the own home. Participants had to indicate their overall acceptance (three items) and their evaluation of benefits (five items) and barriers (six items). Among the barriers, three items dealt with privacy invasion, which later in the analysis became one construct. For further analyses of the general acceptance of video-based analyses the respective constructs (*Perceived Benefits*, *General Perceived Barriers*, *Perceived Privacy Barriers*, and *Behavioral Intention to Use* video-based AAL technology) were summarized and not investigated separately for each type of activity.

In conclusion, participants were given the opportunity to share their thoughts or critiques about the questionnaire. All scales were rated on six-point Likert scales (1 = completely disagree, 6 = completely agree). An overview of the empirical approach of the study is given in Figure 1.

2.2 Data Analysis

Reliability analysis ensured the measurement quality of all constructs (Cronbach's $\alpha > .7$). The measured constructs are reported by means of descriptive statistics such as means (M) and Standard Deviations (SD) and percentages (%) of the examined sample.

To analyze potential relationships between the acceptance and perception of video-based AAL technology on the one hand and user factors like body consciousness, and private- and public-self consciousness, on the other hand, Pearson Correlation coefficients (r) were calculated for continuous variables. Based on the results of the correlation analysis, linear regression analysis was conducted in order to analyze which type of benefits and barriers was most decisive for the acceptance of video-based technology. Linear regression analyses were also conducted to analyze the effects of the above-mentioned user factors on the perception of the two types of barriers in more detail.

Beyond analyses of the whole sample, cluster analyses were used to identify segments or groups of participants according to their similarities in their evaluation patterns (Hair, 2011). Thereby, a two-step cluster analysis approach (Hierarchical and K- means cluster analysis) was applied based on the constructs *Perceived Benefits*, *General Perceived Barriers*, *Perceived Privacy Barriers*, and *Behavioral Intention to Use* video-based AAL technology. ANOVAs corroborated the validity of the cluster segmentation, as the three clusters significantly differed regarding specific user factors and the respective construct scores.

The level of statistical significance (p) was set at the conventional level of 5%($*p < .05; **p < .01$), thus values above the significance level of $p > 0.05$ were interpreted as not significant (n.s.).

2.3 Participants

Overall, 122 participants completed the questionnaire. Their age ranged from 17 to 81 (M=38.39; SD=16.69) with 63.9% females (N=78), and 32.1% males (N=44) (no participant indicated being divers or disclosed information). Asked for participants' highest educational degree, 5.7% (N=7) participants had at least a secondary school diploma or 29.5% (N=36) a high school diploma/A-Level degree. The remaining 64.7% either had a university degree (N=75) or a promotion/doctoral degree (N=4). 34.4% (N=42) indicated working in a technical environment compared to 65.6% (N=80) not having a technical profession. The general technical understanding was quite decent (M= 4.14; SD= 1.07; Cronbach's $\alpha =$ .74). The majority (64.2%; N=70.5%) were living in the city, only 10.7% (N=13) in the suburbs and 18.9% (N=23) indicated living in the countryside. Some participants (19.7%; N=24) lived alone, 42.6% shared their living space with another person such as a partner and the remaining 37.7% (N=46) stated to live together with more than one person such as a family or flatmates. Participants' privacy understanding was quite good (16 items; M= 4.80; SD= 0.60; Cronbach's $\alpha = .76$). On average, scores for private self-consciousness were higher (three items; M= 4.40; SD= 1.08; Cronbach's $\alpha = .70$) than scores for public self-consciousness (three items; M= 4.10; SD= 1.10; Cronbach's $\alpha = .78$). Scores of (Private) Body-Consciousness were on average rather balanced (three items; M= 3.88; SD= 1.00; Cronbach's $\alpha = .70$).

3 RESULTS

This section presents the results of the empirical study. First, the evaluations of video-based AAL technology are descriptively presented for the whole sample of participants. Then, the relationships between acceptance and perception of AAL technology as well as relevant user factors in this context are described. Finally, the results of a cluster analysis are introduced.

3.1 Acceptance of Video-Based AAL Technology

Figure 2 shows the descriptive results for the whole sample of participants, indicating the evaluation of all single items referring to the constructs *Perceived Benefits*, *General Perceived Barriers*, *Perceived Pri-*

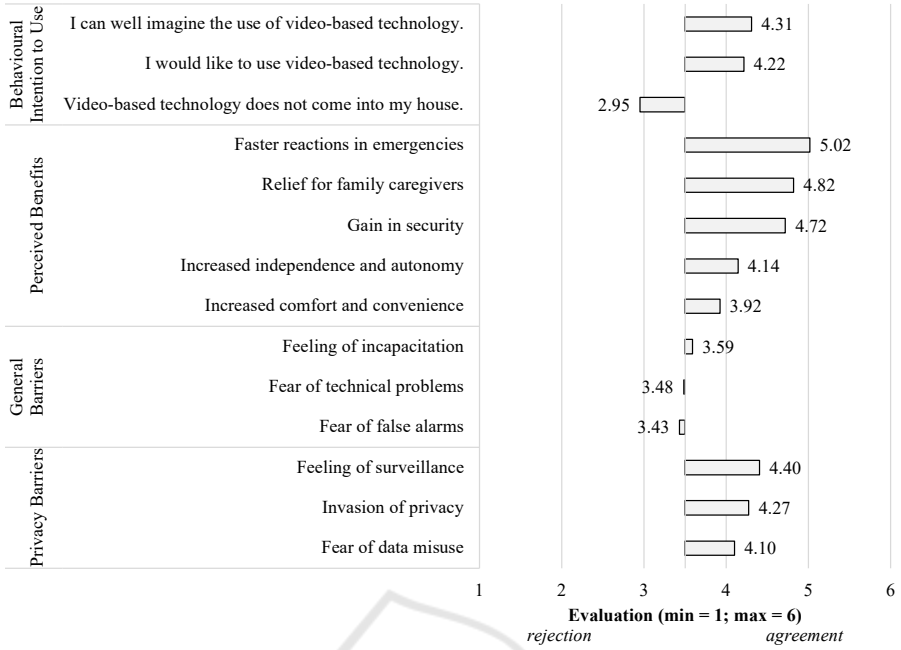

Figure 2: Evaluation of video-based AAL technology (N = 122).

vacy Barriers, and *Behavioral Intention to Use* video-based AAL technology.

The overall *Behavioral Intention to Use* video-based AAL technology was rather high (M=4.06; SD=.72). In this regard, the participants confirmed both positive statements (e.g., "I can well imagine the use of video-based technology" (M=4.31; SD=.96)) and slightly rejected the negative statement: "Video-based technology does not come into my house for this purpose" (M=2.95; SD=1.12).

Moving to the *Perceived Benefits*, the participants generally acknowledged and confirmed the potential benefits of using video-based AAL technology (M=4.52; SD=.76). This was also true for all five single items, but to a different extent. The benefits related to "Faster reactions in emergencies", "Relief for family caregivers", and "Gain in security" received the highest agreement and were thus most relevant. The benefits "Increased independence and autonomy" and "Increased comfort and convenience" received lower, but still confirming evaluations.

Further, the *General Perceived Barriers* (M=3.50; SD=.92) were evaluated neutrally, reaching the mean of the scale. This was also true for all three single items, which all circulated closely around the mean of the scale (see Figure 2). Finally, the *Perceived Privacy Barriers* received a clearly higher evaluation and were confirmed to be relevant barriers of using video-based AAL technology (M=4.26; SD=1.00). Here, the "Feeling of surveillance" received the highest agreement, followed by "Invasion of Privacy" and "Fear of data misuse".

3.2 Relationships and Interactions

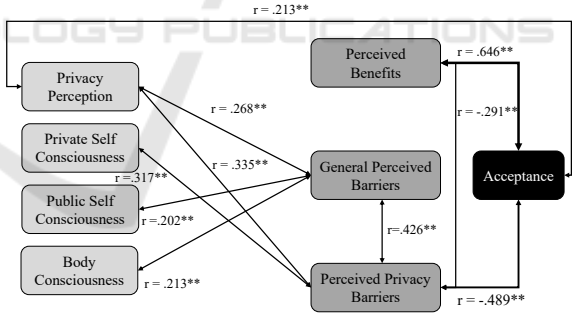

Figure 3: Correlations between constructs and user factors (N = 122) (r: correlation coefficient).

Figure 3 shows all results of the conducted correlation analyses. The strongest correlations between the perception and the *Acceptance* of video-based AAL technology (here operationalized as behavioural intention to use) are presented. Thereby, *Acceptance* was strongly connected with the *Perceived Benefits* (r=.646; $p < .01$) and moderately negatively related with the *Perceived Privacy Barriers* (r=-.489; $p < .01$). Interestingly, there was no significant direct correlation with the *General Perceived Barriers*, which in turn were moderately related with the *Perceived Privacy Barriers* (r=.426; $p < .01$). In addition, the

Perceived Privacy Barriers were negatively related with the *Perceived Benefits* (r=-.291; $p < .01$).

Beyond these relationships, it was also analyzed to what extent attitudinal characteristics and user factors of the participants are related to the perception and acceptance of video-based AAL technology. Here, the participants' *Privacy Perception* was the own user factor that was directly related to the *Acceptance* of video-based AAL technology (r=.213; $p < .01$). In addition, the *Privacy Perception* was also connected with the *General Perceived Barriers* (r=.268; $p < .01$) as well as with the *Perceived Privacy Barriers* (r=.335; $p < .01$). Further, the participants' *Private Self-Consciousness* showed a moderate relationship with the *Perceived Privacy Barriers* (r=.317; $p < .01$), while the participants' *Public Self-Consciousness* (r=.202; $p < .01$) as well as their *Body Consciousness* (r=.213; $p < .01$) were both related with the *General Perceived Barriers*.

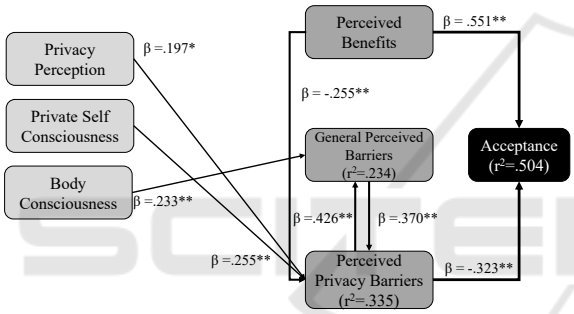

Figure 4: Results of regression analysis: constructs and user factors (N = 122) (β : standardized regression coefficient).

Based on the results of the correlation analysis, linear regression analyses were conducted (see Figure 4). In the first step, the *Acceptance* of video-based AAL technology was focused. The results show that 50.4% of variance of the *Acceptance* of video-based AAL technology (adj. r^2 =.504) can be explained by the constructs *Perceived Benefits* (β =.551; $p < .01$) and *Perceived Privacy Barriers* (β =-.323; $p < .01$). Furthermore, the results of the correlation analyses suggested analyzing the *Perceived Privacy Barriers* and the *General Perceived Barriers* in more detail. Starting with the *Perceived Privacy Barriers* the linear regression analysis revealed that 33.5% of its variance (adj. r^2 =.335) can be explained by the constructs *General Perceived Barriers* (β =.370; $p < .01$) and the user factors *Privacy Perception* (β =.197; $p < .05$) as well as *Private Self-Consciousness* (β =.255; $p < .01$). With regard to the *General Perceived Barriers*, still 23.4% of its variance (adj. r^2 =.234) can be explained by the *Perceived Privacy Barriers* (β =.426; $p < .01$) as well as the user factor *Body Consciousness* (β =.233; $p < .01$).

3.3 Acceptance, Privacy Concerns and the Self: A Cluster Analysis

Beyond the results for the whole sample of participants, we conducted a two-step cluster analysis approach to identify user groups with specific evaluation patterns of video-based AAL technology. Based on the previous results, we assumed that these clusters will also differ with regard to individual user factors.

According to the hierarchical cluster analysis, three clusters were identified as optimal cluster solution in the data set. The first cluster included n=26 (21.3%) participants, the second cluster n=45 (36.9%), and the third cluster n=51 (41.8%) respondents. Based on that, a K-means Cluster analysis was conducted to segment respondents into three distinct groups based on the four construct scores (Hair, 2011): *Perceived Benefits*, *General Perceived Barriers*, *Perceived Privacy Barriers*, and *Behavioral Intention to Use* video-based AAL technology. Confirming the assumption, ANOVAs corroborated the validity of the cluster segmentation, as the three clusters significantly differed regarding the construct scores (see Figure 5 and user factors (see Table 1).

The presentation of the cluster analysis results is structured as follows: First, the findings regarding differences between the three clusters (demographic characteristics and the factors scores) are reported. Second, the clusters are characterized by their evaluations of the items of the respective constructs.

Starting with differences regarding user factors (see Table 1), Cluster 2 was significantly older than Cluster 1 and 3, while those two clusters did not differ significantly with regard to age. Related to other demographic characteristics, the three clusters did not reveal any significant differences (i.e., gender, educational level, health status, care needs, experiences in care, and living situation). Taking other user factors, such as attitudinal characteristics, into account, the private and public self-consciousness, as well as individual privacy perception, characterized the three clusters differed significantly. With regard to each of the mentioned variables, Cluster 3 showed the highest, Cluster 1 the lowest, and Cluster 2 medium evaluations. To sum up, Cluster 2 can be characterized as the oldest user group with a medium evaluated private and public self-consciousness and a medium level of individual privacy perception. Cluster 1 is clearly younger and can be distinguished by the in comparison lowest evaluations of private and public self-consciousness as well as a comparably low individual privacy perception. Cluster 3 is almost as young as Cluster 1, but in contrast, the participants are characterized by the highest evaluations in private

Table 1: Influences of user factors on the cluster segmentation.

	Cluster 1 (n = 26) "Privacy-Conscious rejecters"	**Cluster 2 (n = 45) "adopters"**	**Cluster 3 (n = 51) "Privacy-Conscious adopters"**	**Inference Statistics**
Age (M, SD)	34.24 (15.18)	45.00 (17.71)	34.71 (14.90)	F(2,116)=5.770; p <.01
Private Self-Consciousness (M, SD)	4.54 (0.90)	3.97 (0.94)	4.72 (0.87)	F(2,121)=8.586; p <.01
Public Self-Consciousness (M, SD)	3.99 (1.09)	3.75 (1.03)	4.45 (1.03)	F(2,121)=5.589; p <.01
Privacy Perception (M, SD)	4.67 (0.68)	4.57 (0.55)	5.01 (0.52)	F(2,121)=7.760; p <.01

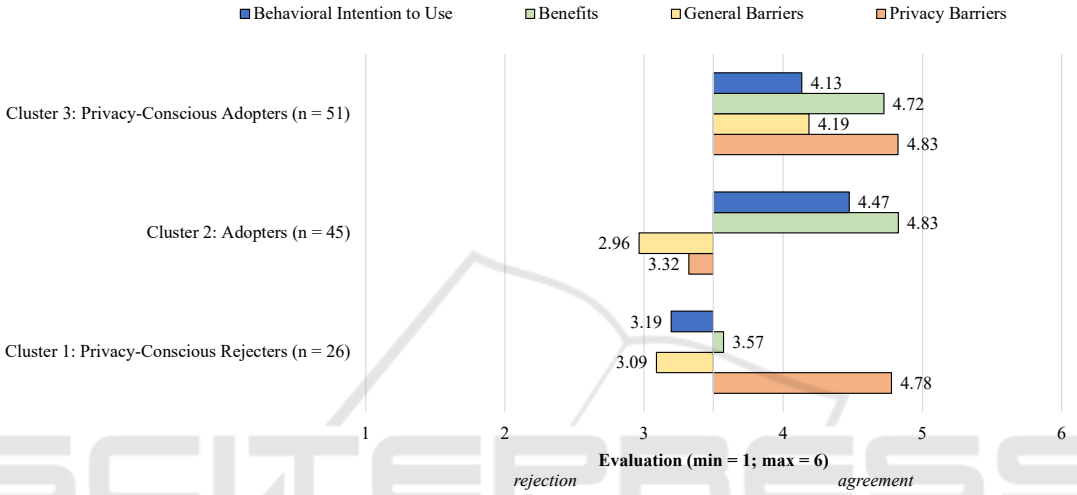

Figure 5: Cluster identification based on constructs (N = 122).

and public self-consciousness as well as the comparably highest individual privacy perception.

Moving to the basis of the cluster segmentation, the evaluation of the constructs (Figure 5) is now presented. The *Behavioral Intention to Use* video-based AAL technology varied distinctly for the three clusters ($F(2,121) = 45.619$; $p < .01$): Cluster 2 showed the highest confirming evaluation (M=4.47; SD=.45), while Cluster 3 showed a lower, still positive intention to use this type of AAL technology (M=4.13; SD=.54); in contrast, Cluster 1 showed a slightly rejecting, clearly lower evaluation of the intention to use video-based AAL technology (M=3.19; SD=.70). All differences between the three groups were on a significant level. Considering the *Perceived Benefits* ($F(2,121) = 43.511$; $p < .01$), Cluster 2 (M=4.83; SD=.54) and Cluster 3 (M=4.72; SD=.47) showed strong confirmations of the potential benefits of using video-based AAl technology and did not differ in their evaluations significantly. However, Cluster 1 (M=3.57; SD=.82) expressed a completely neutral, and significantly lower evaluation of the *Perceived Benefits*. Related to the *General Perceived Barriers* ($F(2,121) = 40.752$; $p < .01$), distinct evaluation patterns were found as well. While Cluster 3 (M=4.19; SD=.65) was the only Cluster confirming the potential general barriers, Cluster 2 (M=2.96; SD=.65) and Cluster 1 (M=3.09; SD=.91) showed similar slightly rejecting evaluations. Finally, the strongest differences were identified for the evaluations of *Perceived Privacy Barriers* ($F(2,121) = 64.909$; $p < .01$): while Cluster 1 (M=4.78; SD=.85) and Cluster 3 (M=4.83; SD=.57) showed strong agreements of the *Perceived Privacy Barriers*, they were evaluated with slightly rejecting values by Cluster 2 (M=3.32; SD=.73).

Based on these results, it was possible to characterize, understand and label the three identified Clusters in more detail. Starting with Cluster 1, this group was characterized by a very high evaluation of *Perceived Privacy Barriers*, a low evaluation of *General Perceived Barriers*, the comparably lowest evaluation of *Perceived Benefits* as well as the lowest, slightly negative *Behavioral intention to use* and thus lowest acceptance of using video-based AAL technology. We labelled this group "Privacy-Conscious rejecters" as they do not want to use video-based AAL technology based on a high perception of privacy-related barriers. Cluster 2 represents almost the opposite of Cluster 1 and is characterized by slightly rejecting evaluations of *Perceived Privacy Barriers* and

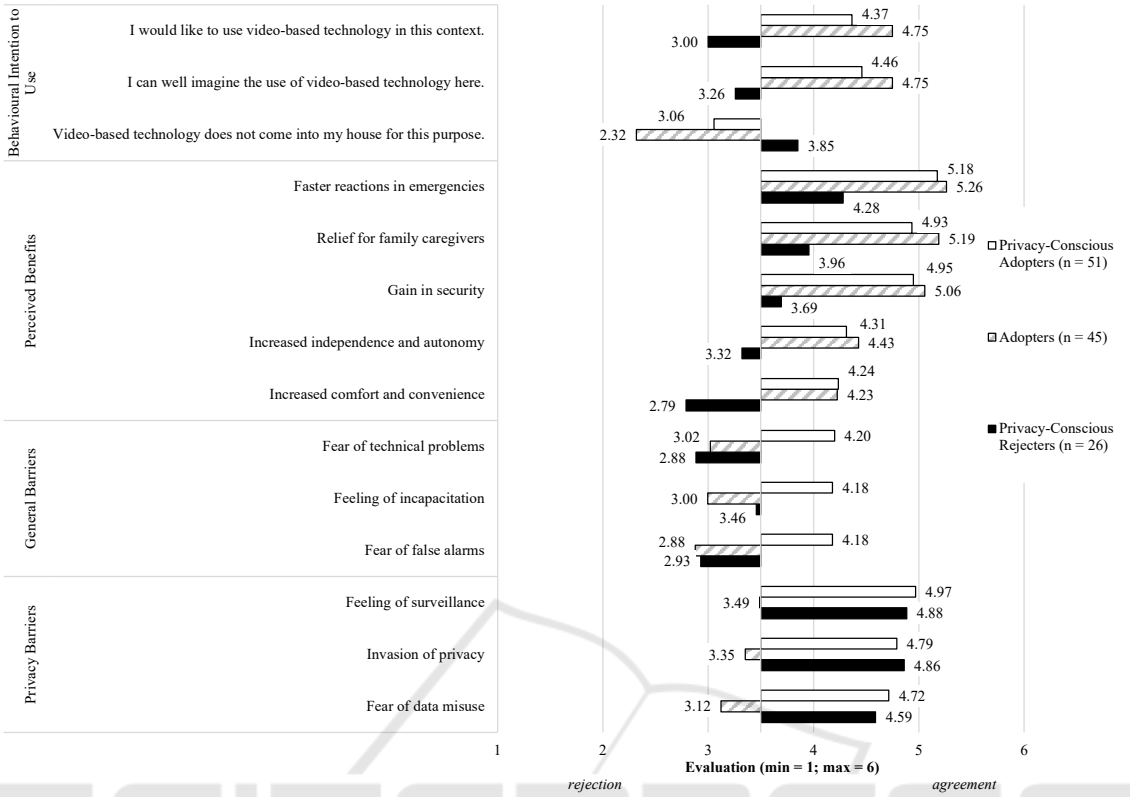

Figure 6: Evaluation patterns of identified clusters (N = 122).

General Perceived Barriers. In addition, this cluster showed the highest evaluation of *Perceived Benefits* and the highest evaluations of the *Behavioral intention to use* video-based AAL technology. As this group acknowledges the benefits and shows a positive usage intention, we labelled this group ”adopters”. Cluster 3 shows the most indifferent evaluation pattern, as the participants acknowledged the *Perceived Benefits*, showed a positive *Behavioral intention to use* video-based AAL technology, but simultaneously they also evaluated *Perceived Privacy Barriers* and *General Perceived Barriers* to be relevant factors. As they showed a positive usage intention and the trade-off between potential barriers and benefits are relevant for this group, we labelled this group as ”Privacy-Conscious adopters”.

Beyond the construct evaluations and based on the understanding of the three clusters, the evaluations within the constructs are now focused (see Figure 6). Since the differences in all 14 items are highly significant overall, in the following, only the general evaluation patterns are described. Starting with the *Behavioral intention to use* video-based AAL technology, ”adopters” and ”Privacy-Conscious adopters” showed similar positive evaluations of the two positive statements, while these statements were slightly rejected by the ”Privacy-Conscious rejecters”. Considering the negative statement, the ”Privacy-Conscious rejecters” showed a slight agreement, while the ”Privacy-Conscious adopters” showed slight and the ”adopters” even clearer rejecting evaluations. Looking at the emphPerceived Benefits, ”adopters” and ”Privacy-Conscious adopters” showed similar positive evaluations of the benefits ”Fast reactions in emergencies”, ”Relief for family caregivers”, and ”Gain in security”, while the evaluations of the ”Privacy-Conscious rejecters” successively decrease. Lower, but still positive evaluations of the benefits of ”Increased independence and autonomy” and of ”increased comfort and convenience” by the ”adopters” and ”Privacy-Conscious adopters” contrast with rejecting evaluations of the ”Privacy-Conscious rejecters”.

Considering the *General Perceived Barriers*, all single items were confirmed to be relevant barriers by the group of ”Privacy-Conscious adopters”. Instead, all three items were rejected to be relevant barriers by the group of ”adopters”. The ”Privacy-Conscious rejecters” rejected the barriers of ”Fear of technical problems” and of ”Fear of alarms”, while they evaluated the barrier of ”Feeling of incapacitation” neutrally. The results for the *Perceived Privacy*

Barriers showed strong confirmations of all three items by the "Privacy-Conscious adopters" as well as the "Privacy-Conscious rejecters". In contrast, the "adopters" showed neutral ("Feeling of surveillance") up to slightly rejecting evaluations ("Fear of data misuse").

Within the next section, the results for the whole sample, but also the cluster-specific results are summarized, discussed, and used to derive recommendations with respect to the development of user-centred video-based AAL technology.

4 DISCUSSION

This study explored and quantified potential users' perceptions and evaluations of being supported with video-based AAL in their own homes during activities of daily living. In particular, the behavioural intention was assessed including the evaluation of the benefits and barriers of installing video-based AAL. In a second step, potential influences of general privacy perception, self - and body consciousness on acceptance of video-based AAL were explored through correlation, regression and cluster analysis.

4.1 Interpretation of the Key Findings

Generally, the behavioural intention to use video-based AAL was rather high among all participants. This positive trend is further enhanced by overall higher evaluations of benefits compared to the evaluations of barriers and is in line with literature reporting a positive perception of AAL technology (e.g., (Garg et al., 2014; Gövercin et al., 2010; Wild et al., 2008)). With regard to the here evaluated video-based AAL technology, the results contradict the so far rather negative evaluations of and attitudes towards video-based AAL technology (Beach et al., 2009; Arning and Ziefle, 2015; Offermann-van Heek et al., 2019), which could be due to the rather generic description within the scenario-based approach (see section 4.3).

Regarding benefits, potential users particularly appreciated faster reactions in case of an emergency, relief for family caregivers and increased safety. Previous findings have already highlighted safety as an important contributor to technology acceptance and a suitable incentive to negotiate benefits and barriers (Schomakers and Ziefle, 2022; Ehrari et al., 2020). In this trade-off process, usually, the most relevant counterpart is privacy concerns (Garg et al., 2014; Ehrari et al., 2020; Peek et al., 2014; Offermann-van Heek and Ziefle, 2019) which were confirmed to be the higher barriers in this study compared to perceived general barriers regarding technical issues or feelings of incapacitation. Furthermore, correlational and regression analysis revealed that perceived benefits and perceived privacy barriers are explaining factors of technology acceptance suggesting that acceptance increases with higher evaluated benefits and lower ratings of privacy barriers. General perceived barriers do not seem to influence acceptance decisively as no direct statistical relationship could be found. Hence, these results suggest the idea that in a scenario where video-based AAL is applied, it is mostly privacy that evokes hesitation or denial of AAL use.

To gain a better understanding of potential users, influences of relevant attitudinal and dispositional user factors were explored. Among them, general privacy perception was directly related to video-based AAL acceptance as well as both, general barriers and privacy barriers. This suggests that potential users with an elaborate understanding of the meaning of privacy in daily life tend to accept the technology with or despite an elevated awareness of the potential barriers at stake. Public self-consciousness and body consciousness were related to perceived general barriers but only body consciousness could explain some variance of perceived barriers. In turn, private self-consciousness influenced ratings of privacy barriers and could explain some variance of the latter construct. This leads to suggest that persons focusing more on the internal aspects of themselves are more concerned about privacy issues. It remains unclear whether these privately self-conscious users perceived privacy barriers as more important because they are more concerned about the privacy of their thoughts and feelings or whether privacy is one readily available thought in this trade-off process which is even more easily retrievable for people with a chronic tendency to focus on their thoughts. Another explanation of this influence of private self-consciousness may be that being able to act autonomously is considered as one function of privacy (Rössler, 2001) and autonomy is crucial in the identity of privately self-conscious persons (Schlenker and Weigold, 1990). In fact, private self-conscious people attempt to portray an autonomous identity which as a consequence may lead to more acknowledgement of privacy and its related concerns in cases where it is threatened.

4.2 User-Specific Findings and Recommendations

In addition, the present study identified three distinctive preference profiles of potential users of video-based AAL, namely, privacy-conscious rejecters, adopters and privacy conscious-rejecters.

Starting with the *privacy-conscious rejecters*, this group was characterized by the highest perception of privacy-related barriers, leading to the lowest intention to use video-based AAL technology and a neutral evaluation of potential barriers. Other potential barriers were not relevant for this group.

In line with their name, the *adopters* showed the highest intention to use and also the highest evaluation of potential benefits of video-based AAL technology. Neither general barriers nor privacy-related barriers played a decisive role for this group. Considering individual differences, this group was significantly older than the other two clusters and hold the lowest ratings regarding self-consciousness and privacy perception. Especially the latter explains and fits perfectly with the evaluation patterns of this group.

The *privacy-conscious adopters* showed the most complex evaluation patterns. They showed high perceptions of both, the privacy-related barriers as well as potential benefits of using video-based AAL technology. Further, they had a rather positive intention to use video-based AAL technology and confirmed also general barriers to be relevant. Looking at the individual characteristics, this group was characterized by the highest evaluations of self-consciousness and privacy perception. These characteristics in turn fit and explain the evaluation patterns of this group of potential users of video-based AAL technology.

Communication strategies informing potential users about video-based AAL should be specifically tailored and targeted depending on the varying evaluation patterns of the different user groups. Based on the theoretical framework of the elaboration likelihood model (Petty and Cacioppo, 1986), a central route of communication may be adequate for both, privacy-conscious rejecters and privacy-conscious adopters who seem to grasp the whole scenario including the advantages and disadvantages of adopting video-based AAL and are well aware of the pitfalls regarding privacy. Indeed, messages for these groups should be based on technological evidence and logical arguments connecting to their current beliefs uncovered through the evaluation patterns. For privacy-conscious rejecters, this means adhering primarily to their huge concern about privacy infringements. Perhaps technical privacy preservation techniques such as filters or privacy-by-design and privacy-by-context approaches should be highlighted (Climent-Pérez et al., 2020; Ravi et al., 2021). Further, the legal basis including, for instance, regulations of the GDPR should be mentioned (He, 2022). Their evaluation patterns seem to suggest that privacy concerns and low perceptions of benefits are the reason why they reject the use of video-based AAL. Therefore, the benefits of using such a technology should be included perhaps depicting realistic and reasonable use cases where video-based AAL is particularly efficient. For privacy-conscious adopters, benefits are very clear and important, and their behavioural intention is given despite high privacy concerns. These concerns should be tackled in a similar way as for privacy-conscious rejecters and in general messages should show facts with evidence-based explanations. Contrarily, for adopters with lower scores for self-consciousness, lower perceived barriers and with a comparatively high behavioural intention to use video-based AAL a peripheral route of communication may be most adequate. Perhaps a suitable testimonial could be part of the communication strategy and the focus should be more on evoking emotions.

4.3 Limitations and Future Work

The present study successfully replicated findings on the evaluations of benefits and barriers in the acceptance process of video-based AAL. However, participants for the study were recruited via convenience sampling which resulted in a relatively small sample size. Furthermore, in terms of gender, the sample consisted of a slightly higher proportion of female participants. Overall, participants of this study were rather young, comparably highly educated and either German or Bulgarian. Ideally, future work should analyze behavioural intention and influences of dispositional user differences with a larger sample which is more evenly distributed in terms of demographics. Also, cultural influences should be considered in the analysis and different cultural backgrounds should be compared. The examined technology - video-based AAL - has not been widely adopted as described in the scenario in this online survey. In fact, the scenario used in this online survey was fictitious to project a possible future scenario and did not provide a detailed explanation of the technological functioning. Here, it has to be considered that especially the positive evaluations (e.g., intention to use) of video-based AAL technology could be due to the scenario-based evaluation and could thus differ from evaluations in real contexts enabling hands-on experience. As this gap between reported attitudes and real behaviour is well-known (Ajzen and Fishbein, 2000), future work should provide more details and ideally show the technology either during workshop sessions or video clips. Furthermore, participants were asked to imagine that they were the ones needing care. It would also be interesting to replicate this study for other contexts such as professional care environments (i.e., nursing homes) or from an informal carers perspective.

5 CONCLUSION

This quantitative study provided detailed insights into the perception and acceptance of video-based AAL technology taking privacy-related barriers as well as individual characteristics of the participants (i.e., privacy perception, self- and body consciousness) into account. Beyond that, three user groups were segmented differing in their evaluation patterns of video-based AAL technology as well as in their individual characteristics. The results may be used as a basis for recommendations and guidelines for user-tailored development and communication of innovative video-based AAL technology.

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