# User Acceptance of Lifelogging Technologies: The Power of Experience and Technological Self-Efficacy

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Abstract: Today, innovations in the field of lifelogging technology and its assistance in everyday life enable different users to gain an overview of different areas of their lives. Especially for older and frail people, lifelogging offers useful solutions that allow them to stay longer in their private environment and maintain their autonomy. Although lifelogging is already used in many contexts, opinions of users on the different lifelogging applications and the influence of user characteristics on their acceptance still remain underexplored. In this study, we investigate the acceptance of lifelogging technology for activities of daily living and examine the impact of user characteristics on its key determinants according to the Technology Acceptance Model, which is used as a theoretical background. For data collection we used a quantitative online survey and took opinions of *N*=209 German adults into consideration in the statistical analyses. Our findings demonstrate that an already existing experience with lifelogging is the main influencing factor for user acceptance: High levels of the experience and technological self-efficacy in handling of the technology significantly enhance the acceptance of lifelogging for activities of daily living, while age and gender shape the acceptance indirectly. This study contributes to the user acceptance research of lifelogging in private environments, and our findings deepen the understanding of how adoption of lifelogging technologies is shaped by different users.

## 1 INTRODUCTION

In the today's world, lifelogging technology has become pervasive, taking over more and more areas of life. Digital self-tracking, as described by Selke (2016), enables the collection, storage, retrieval, and sophisticated analyses of information about a person's life and behaviour. The growth of information acquisition, along with the range of information that can be gathered, is almost limitless, but users mostly gather information that is relevant to their main interests and needs (O'Hara et al., 2008).

Lifelogging applications are used in many contexts, for instance for self-monitoring, fun, improvement of well-being, and/or performance. The fields of application are thus diverse and relate to both private and professional areas of life. While in the early days in particular younger people used lifelogging, the fields of application became increasingly interesting for older users as well. Especially in the area of ambient systems, where information and communication technology is able to monitor people's activities, detect emergencies, and recognise their behaviour deviations, lifelogging applications have a great potential to support ageing. This technology thus gains more and more importance for older and frail individuals, assisting them in their necessities and processes of the everyday life. However, the availability of advanced technical solutions does not equate an active use: Much more user acceptance of the lifelogging solutions is an essential precondition for an appropriate meeting of the care needs of older adults. Yet, in the area of technology acceptance little is known about (i) who is using or not using which lifelogging applications and why, (ii) what users think about the different lifelogging applications, and (iii) how the user characteristics affect the technology's adoption.

Hence, the present empirical study investigates the acceptance of lifelogging technology through the

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example of applications referring to activities of daily living. The main focus lies on the user characteristics—not only the demographic attributes but also technological self-confidence and previous experience of users—and their impact on the accepted use. In the following, we firstly provide a theoretical background and briefly outline relevant findings in related research. We then describe the method applied in this study and present the outcomes of the statistical analyses before discussing the findings and critically reflecting on the study.

# 2 THEORETICAL BACKGROUND

In the following, previous research on developments in the field of lifelogging applications as well as on their perception and acceptance is presented.

## 2.1 Lifelogging Technology for Assistance in Everyday Life

Lifelogging refers to a recording of everyday life and can be realized by different variants of digital self-tracking (Selke, 2016). It enables digital recordings in different levels of detail and for different reasons by collecting, archiving, observing, and reflecting health-related physiological and behavioural data (Gurrin et al., 2014). The technical realizations as well as the application contexts of lifelogging are diverse and cover a broad spectrum, ranging from assisting lifelogging applications for older people or people in need of care up to sportive applications, which are predominantly used by younger people. The latter aims at a tracking (and improvement) of physical activity and eating habits, enabling also game-based competitions (Schoeppe et al., 2016).

Being realised as wearable (e.g., McAdams et al., 2011) or ambient-installed systems (e.g., Rashidi and Cook, 2009), diverse sensors (e.g., Poli et al., 2020), audio-based technologies (e.g., Shah et al., 2012), or video-based technologies (Climent-Perez et al., 2020) can be used to monitor and track health-related physiological and behavioural data (Rashidi and Mihailidis, 2013). Besides sportive motivation, tracking and analysis of different activities of daily living (ADL) collected by lifelogging applications are also useful from a medical diagnostic and preventive perspective, and can be realized in private environments as well as in professional care institutions. Such lifelogging technologies can provide support and assistance for older and frail people as well as for their caregivers (e.g., Jalal et al., 2014, Climent-Perez et al., 2020). This way, security-relevant functions like fall detection can be realized (e.g., Mubashir et a., 2013), activities and movements can be monitored (Rashidi and Cook, 2009; Suzuki et al., 2007), and changes in movements or behaviours can be identified as indicators for specific clinical pictures (Hayes et al., 2008).

In addition, lifelogging can serve as a human memory augmentation as it allows us to capture digital snapshots of the different moments of our lives and store this information (Harvey et al., 2016). A study of Chen and Jones (2012) investigated intentions that potential users have for lifelogging and revealed that besides purposes of sharing memories, the most desired lifelogging functions and applications refer to emotional purposes (reminiscing), task-based purposes (recollecting or extracting specific information for re-use or evidence), and well-being supporting purposes (analysing and comparing current life pattern, exercises, work-related and financial processes).

These examples show that the potential of lifelogging applications is high, as they assist and motivate people to live a healthier lifestyle, while they are also able to relieve tasks in the everyday life and increase the autonomy for older people (in need of care). Simultaneously, the daily usage of technologies tracking everyday activities and health-related, personal information also entails scepticism due to concerns about data security and privacy (Kelly et al., 2013, Lidynia et al., 2018; Wolf et al., 2014).

## 2.2 User Factors Influencing Technology Acceptance

Based on the trade-off between the enormous potential and the existing concerns in terms of the daily use of lifelogging applications, user acceptance of these applications has to be examined in detail. Previous research on the acceptance of lifelogging technologies used for tracking activities of daily living showed that reminding functions (Morganti et al., 2013) as well as collecting and sharing information with related people (Caprani et al., 2014) represent the most relevant motives to use lifelogging. In contrast, an unauthorized forwarding to third parties and a perceived loss of control over sensitive data were identified to be the major barriers for the everyday use of lifelogging applications (Lidynia et al., 2018). Beyond these insights, lifelogging technology acceptance for tracking activities of daily living has not been systematically investigated based on the well-known acceptance parameters.

The Theory of Reasoned Action (Fishbein and Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1991) represent two relevant and influential

models for the prediction of factors promoting or reducing acceptance. Within both models, a strong relationship has been postulated between an individual's intention towards a behaviour and the actual behaviour. The behavioural intention is thereby impacted by the individual factors or personal attitudes. Based on these models, Davis (1989) set up the Technology Acceptance Model (TAM) continuing the relationship between the intention towards a behaviour and the actual behaviour. Beyond that, the model assumes that two key components, the perceived usefulness and perceived ease of use, significantly influence the attitude towards using, which is closely related with the behavioural intention to use and, thus, with the actual use of a technology (Davis, 1989). The perceived ease of use refers to an individual's perception of how difficult/easy it will be to learn to use the technology, while the perceived usefulness relates to an individual's idea of how useful the technology is for improving processes. Research on health-related technologies applied and adapted the TAM in various ways, confirming both key acceptance determinants as useful predictors for the acceptance of an innovative technology (Rahimi et al., 2018).

Beyond that, specific individual user characteristics—i.e., factors referring to the users of the considered technology—have been regarded in the technology acceptance research as well. In a first step, Davis (1989) postulated so-called external variables as potential influencing factors on the acceptance key components, perceived ease of use and perceived usefulness. Later, the users' age, gender, and previous experience have been integrated into the acceptance research and the respective acceptance models (e.g., Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). These individual user characteristics have been proven to be relevant influencing parameters for the user acceptance of information and communication technologies in various contexts, such as gender with regard to the invasive medical technology (Ziefle and Schaar, 2011) and life prolonging technologies (Arber et al., 2008), or age (Ziefle and Bay, 2005) and previous experience (Venkatesh and Bala, 2008). As a further factor, the technological self-efficacy has been examined in previous research (Beier 1999). Several studies showed that female users expressed a lower perceived control, stronger fears, lower self-confidence, as well as less use of, and experience with, computers compared to male users (e.g., Broos, 2005, Durndel and Haag, 2002).

In the next section, we describe the used method and study design providing all details on how we operationalised the research questions of the study.

# 3 METHOD

Considering the lifelogging technology with its potential of a comprehensive digital self-monitoring in different areas of life, the present research focuses on user acceptance of lifelogging applied for the activities of daily living. The lifelogging applications refer to both basic activities, such as personal care, dietary intake, mobility, and instrumental activities, like for instance medicine intake, food preparation, money management, etc.

We adopted a mixed-method approach to investigate the research questions. In the first step, qualitative interviews ($N$=14) were conducted to explore the general knowledge of, and attitudes towards, already existing lifelogging technologies. The valuable findings of the individual interviews were then validated by a quantitative survey ($N$=209). Note: Due to space restrictions, in this paper we address only the *quantitative* findings.

## 3.1 Research Questions (RQ)

In terms of the adoption of lifelogging for ADL, the main question of this study is to examine to what extent the particular characteristics of the user significantly affect his/her accepted use (RQ 1). To understand which user profiles favour and which profiles impede the use, can be very valuable not only for the research but especially for the mercantile purposes. The second research topic relates to the question whether, and to what extent, the potential users intend to use lifelogging for the different activities of daily living (RQ 2), e.g., to monitor their nutrition or communication habits. And also, it is of interest how the user acceptance constructs interrelate (RQ 3) and therefore validate the established technology acceptance models in the context of lifelogging.

## 3.2 Study Design

The quantitative study investigated the users' adoption of lifelogging technology for the activities of daily living (ADL) and examined the influence of different user characteristics on their attitudes toward technology acceptance and on the key components thereof.

As dependent variables, we examined the following key determinants of the technology acceptance:

- *Perceived ease of use* (PEU),
- *Perceived usefulness* (PU),
- *Attitude toward using* (AT), and
- *Intention to use* (ItU) the ADL applications.

Table 1 summarizes all items for the acceptance variables PEU, PU, and AT used in the survey, while the intention to use lifelogging technology for ADL is elaborated in detail in the results-part (Figure 4).

In addition, technological self-efficacy (TSE)—referring to the perceived competence when interacting with, or handling of, a technology—was included as one of the main study constructs (see Table 1). According to a significant difference between the male and female participants in the general handling of technology (see Section 3.4), TSE was considered as one of the user characteristics, the impact of which was statistically tested.

As independent variables, i.e., user characteristics, we used the following:

- *Age*: young (<30 years), middle-aged (30–59 years), and older adults (≥60 years);
- *Gender*: male vs. female users;
- *Lifelogging experience* (LLE: with experience vs. no experience); and
- *Technological self-efficacy* (TSE: high vs. low).

The described research variables are depicted in Figure 1; the user characteristics are thereby summarized as the external variables in the research design.

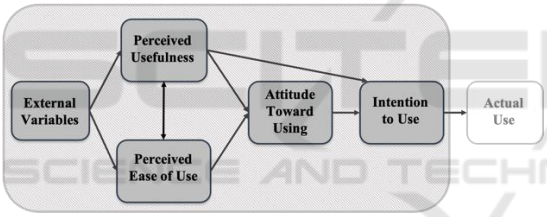


Figure 1: Research design of the study adopted from TAM (Davis, 1989): The grey frame encompasses the study contents.

## 3.3 Quantitative Data Collection

The quantitative data of the present study were collected by a standardized online survey, structured in three main parts.

In the first part we collected the demographic data of the participants, including age, gender, education, health status and place of residence. To gain information about their perceived self-efficacy in using technology, participants were asked to respond to questions referring to technological self-confidence according to Beier (1999).

The second part of the survey started with a short explanation of the term "lifelogging". Also, examples of different contexts of possible application fields were given, among others health monitoring, location and presence detection, performance measurement at work, consumption tracking, etc. Here, the participants' knowledge of, and experience with, lifelogging technologies in their everyday lives was investigated. If they actively used lifelogging technologies, they additionally answered questions regarding the type of lifelogging used and their motives for using it.

In the third part, we asked the participants to envision logging of activities of daily living for their own use, for instance taking medication, making phone calls, cleaning of the living spaces, showering, walking/jogging, etc. A short scenario described the ADL application as well as the types of sensors used to log the data. After that, participants were asked to share their opinions regarding technology acceptance,

Table 1: Items used in the online survey for the assessment of acceptance in lifelogging applications recording ADL.

| Construct | Items |
|---|---|
| Perceived ease of use (3 items; $\alpha$ =.71) | - "With the help of lifelogging technologies, data of my daily activities can be collected with little effort."<br>- "I expect the lifelogging application to be easy to use."<br>- "The handling of the lifelogging technologies should be intuitive." |
| Perceived usefulness (4 items; $\alpha$ =.74) | - "It is useful to get an overview of activities in one's life with the help of lifelogging technologies."<br>- "Logging of activities of daily life is only useful for people with health problems." [recoded]<br>- "With the help of lifelogging, parts of daily life can be optimized."<br>- "With the help of specific lifelogging to record activities of daily life, health problems can be partly identified." |
| Attitude toward using lifelogging (3 items; $\alpha$ =.91) | - "I think it makes sense to record the different activities of daily life using lifelogging technologies."<br>- "I evaluate the use of lifelogging technologies to record activities of daily life negatively." [recoded]<br>- "I consider it beneficial to record activities using lifelogging." |
| Technical self-efficacy (4 items; $\alpha$ =.81) | - "I can solve quite a few of the technical problems I face on my own."<br>- "Technical devices are often inscrutable and difficult to control." [recoded]<br>- "Even when there are obstacles, I can still solve a technical problem."<br>- "Most technical problems are so complicated that there is little point in dealing with them." [recoded] |

including aspects of technology acceptance such as the perceived ease of use, the perceived usefulness, and their general attitude towards the ADL application. Table 1 summarizes the relevant constructs and items used in the study. The assessment scales provided the forced choice format for the responses ranging from 1 (='totally disagree') to 6 (='totally agree'). To avoid any biases, the items were alternated between positive and negative items. For the statistical analyses, we transformed all scales of the used constructs to 100 points to better compare the results.

### 3.4 Data Analyses

In this study, the relevant aspects of technology acceptance and data resulting from logging of ADL are reported by means of descriptive statistics, like mean (*M)*, median (*Md*), and standard deviations (*SD*). Percentages (%) of the examined sample are given to report proportions. To statistically compare the means for the different user groups, *f*-tests were calculated. Multiple analysis of variance (MANOVA) tests for statistical effects of the examined user factors on the key determinants of the technology acceptance; effect sizes were calculated by eta squared ($\eta^2$) according to Cohen (1988). For correlative analyses, Pearson's product-moment correlation *(r*) was calculated for continuous variables, Spearman's rank order correlation ($\rho$) for dichotomous variables. The level of statistical significance (*p*) was set at the conventional level of 5%.

### 3.5 Participants

The target population for this study consisted of *N*=209 adults between 18 and 79 years of age (*M*=37, *SD*=15.1) and 54% of them were female (*n*=112). The vast majority enjoyed good or very good health (94%; *n*=196), 19% reported chronic disease or a physical impairment (*n*=39), and 22% stated to regularly take medication (*n*=46). Moreover, 56% of the respondents (*n*=117) stated to already actively use lifelogging technologies; Table 2 summarizes the users' experience regarding the used technology, their motives and the context of use. According to the outcomes, participants use apps in their smartphones most frequently for health monitoring, location detection and consumption tracking, and they report self-monitoring and fun as the main motives for the lifelogging usage. As opposed to that, cameras are used the least and the performance measurement at the workplace as well as the use for comparison reasons are the less preferred options for logging one's own data.

Table 2: Used technologies, contexts of use and usage motives among the participants who use lifelogging in their daily life (*N*=117).

| | Proportion of users |
|---|---|
| **Used technology** | |
| Fitness wristband | 12.9% (*n*=27) |
| Smartphone app | 37.8% (*n*=79) |
| Personal computer (manual entry) | 13.9% (*n*=29) |
| Stationary and portable cameras | 5.3% (*n*=11) |
| **Context of usage** | |
| Health monitoring | 37.3% (*n*=78) |
| Location and presence detection | 39.7% (*n*=83) |
| Performance measurement (work) | 8.6% (*n*=18) |
| External "memory" | 18.2% (*n*=38) |
| Consumption tracking | 28.2% (*n*=59) |
| **Usage motives** | |
| Self-monitoring | 31.1% (*n*=65) |
| Fun / Interest in the subject matter | 40.2% (*n*=84) |
| Improvement of performance | 21.5% (*n*=45) |
| Improvement of well-being | 16.3% (*n*=34) |
| Comparison with others | 4.8% (*n*=10) |
| Financial reasons | 9.1% (*n*=19) |

The outcome revealing that more than half of the examined sample used lifelogging technologies led to the analysis of how the subjects perceived their general technological self-efficacy. Respondents reached on average *M*=18.4 (*SD*=3.5) from 24 possible points on the TSE scale. The results in technological self-efficacy significantly differed depending on the participants' gender [$F(1,208)=18.02$, $p\leq.001$; $\eta^2=.08$]; but less so for the different age groups [$F(2,208)=1.7$, *n.s.*]. Given this finding, we assigned high and low levels of technological self-efficacy according to the gender-related median-splitting of the sample ($Md_{male}=20$, $SD=2.9$; $Md_{female}=17$, $SD=3.5$).

## 4 RESULTS

In this section, we firstly examine the influence of the external variables on the acceptance of lifelogging technology and present then the results of intended use of lifelogging in different activities of daily living. Eventually, correlations between the relevant research variables are displayed.

### 4.1 Effects of the External Variables on the Acceptance

In a multiple analysis of variance, we included all independent variables (age groups, gender, TSE, LLE) and tested their impact on the acceptance criteria PEU, PU, and AT.

The analysis revealed a moderate effect of the *technological self-efficacy* [$F(3,184)=3.9$, $p=.010$; $\eta^2=.06$] and showed that participants with a high level of TSE ($M=83.3$, $SD=11.3$) perceived the lifelogging applications for ADL as easier to use than participants with a low level in TSE ($M=79.3$, $SD=13$). At the same time, the overall scores for perceived usefulness (low: $M=65$, $SD=13.6$; high: $M=62.7$, $SD=17.2$) and the attitude toward using lifelogging (low: $M=62.4$, $SD=16.5$; high: $M=62.1$, $SD=22$) were reversed for persons with high and low levels of TSE. The means are depicted in Figure 2.

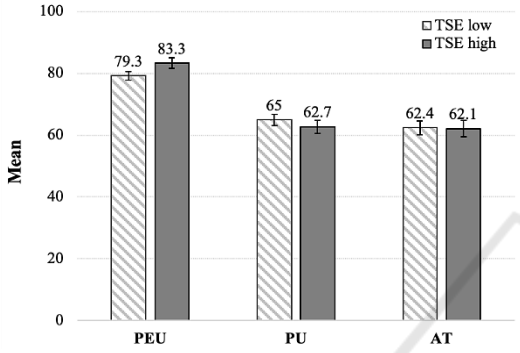


Figure 2: Effect of technological self-efficacy on acceptance.

In addition, the MANOVA revealed a significant impact of the existing *lifelogging experience* on the acceptance [$F(3,184)=4.1$, $p=.008$; $\eta^2=.06$]. This moderate effect with the resulting means is showed in Figure 3 and discloses that participants with experience reach in all acceptance criteria higher means (PEU: $M=84.4$, $SD=10.4$; PU: $M=67.2$, $SD=14.7$; AT: $M=67$, $SD=17.8$) than participants without experience (PEU: $M=77.5$, $SD=13.5$; PU: $M=59.5$, $SD=15.6$; AT: $M=56.1$, $SD=19.8$).

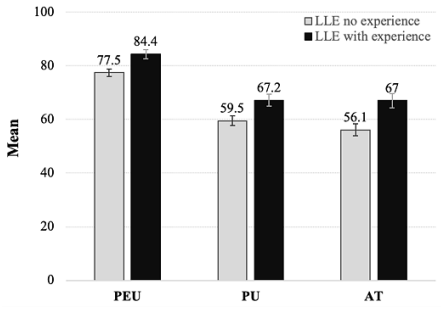


Figure 3: Effect of lifelogging experience on acceptance.

## 4.2 Intention to Use Lifelogging Technology for ADL

In the next step, we present the results of intention to use lifelogging technology. Participants of the online survey were asked to indicate on a four-point Likert scale whether they would permit (=4) or reject (=1) the lifelogging for different activities of daily living.

The resulting means are summarized in Figure 4. As can be seen there, the opinions in our sample were not very distinct. Most of the activities were rather slightly rejected (means < 2.5). Only two activities, i.e., the medication intake ($M=2.9$, $SD=1.2$) and the mobility behaviour ($M=2.9$, $SD=1.2$), were on average slightly permitted and for the preparation of meals resulted a neutral opinion ($M=2.5$, $SD=1.2$). By contrast, logging of body care and hygiene was most clearly rejected by the respondents ($M=1.5$, $SD=1$).

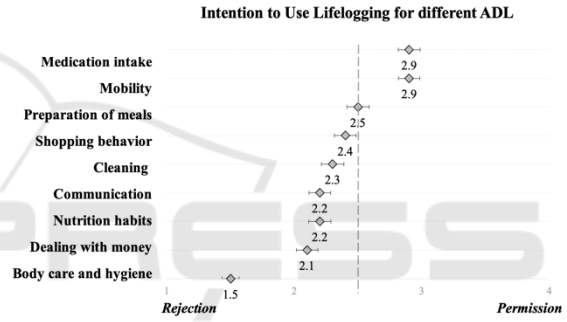


Figure 4: Means resulting for the intention to use lifelogging technology for different activities of daily living.

## 4.3 Correlations between the Relevant Research Variables

Given the above outcomes, we provide now an overview of correlative relationships between the relevant research variables.

Considering firstly the correlations between the user characteristics (=external variables) and the user acceptance, lifelogging experience positively correlated with all key criteria (PEU: $\rho=.26$, $p\leq.001$; PU: $\rho=.25$, $p\leq.001$; AT: $\rho=.29$, $p\leq.001$) and the technological self-efficacy moderately shaped the PEU ($r=.30$, $p\leq.001$). Among the demographic variables, age negatively correlated with the user acceptance criteria (PEU: $r=-.20$, $p\leq.003$; PU: $r=-.20$, $p\leq.004$; AT: $r=-.15$, $p\leq.026$). Additionally, the self-efficacy ($r=-.23$, $p\leq.001$) and the experience ($r=-.25$, $p\leq.001$) decreased with increasing age. Even though the correlations were rather weak, these results make clear that age is an important carrier for the technology

adoption. Gender correlated directly "only" with PU ($\rho$=–.19, $p$≤.006), however, it also significantly shaped the self-efficacy ($\rho$=–.38, $p$≤.001) thus indirectly interrelating with the other acceptance criteria. All these correlations are provided in Figure 5.

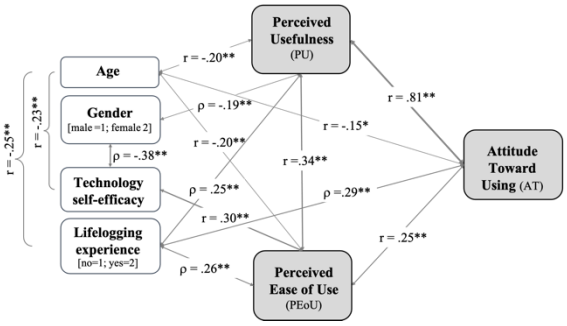


Figure 5: Correlations between user factors and the key acceptance criteria ($N$=209; ** $p$≤.01, * $p$≤.05).

Next, we specify the correlative relationships between the beliefs and attitudinal constructs. PEU and PU resulting from this study were positively associated ($r$=.34, $p$≤.001), but their connections to the attitude toward using lifelogging varied considerably in strength: While PEU only moderately ($r$=.25, $p$≤.001) correlated with the general attitude toward using lifelogging technology, PU was very strongly connected to it ($r$=.81, $p$≤.001).

Following Technology Acceptance Model (Davis, 1989), the general attitude toward using the technology significantly affects the intention to use it. Figure 6 depicts the correlation coefficients to all activities of daily living enquired in the survey. As it is evident, AT was significantly associated with using lifelogging for different ADL. A positive AT correlated strongly with the intention to use lifelogging for the mobility behaviour ($r$=.63, $p$≤.001), shopping ($r$=.58, $p$≤.001), and for preparation of meals ($r$=.56, $p$≤.001).

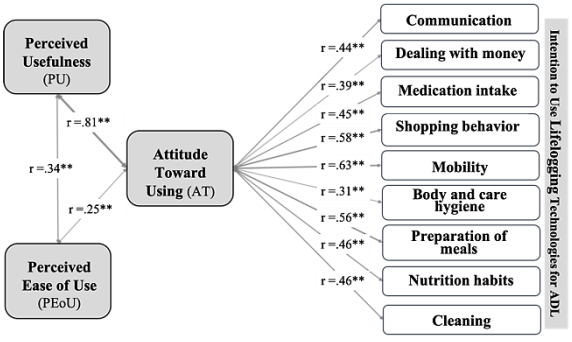


Figure 6: Correlations between the attitude toward using lifelogging and different ADL ($N$=209; **$p$≤.001).

The smallest correlation coefficient resulted between the AT and lifelogging for body hygiene ($r$=.31, $p$≤.001), suggesting a weaker relationship between the variables. Overall, the higher the attitude the higher was the intention to use lifelogging for different activities of daily living.

# 5 DISCUSSION

The presented research investigated the adoption of lifelogging technology, examining the influence of different user factors on the key predictors of user acceptance. Using technology acceptance constructs according to TAM (Davis, 1989), the study analysed how external variables (i.e., user characteristics) affect the users' attitudes, and how the key acceptance criteria are related to the intention of using lifelogging technologies for the activities of daily living. In the following, we discuss the key results and the limitations of this study.

## 5.1 Key Results

In reference to the first research question (RQ1), our findings show that the most influential external factors, referring to the user characteristics, are the technological self-efficacy and lifelogging experience. In comparison, the demographic variables of age and gender are less influential—at least these variables do not directly affect the user's acceptance.

According to the results, high levels of gender-specific self-efficacy cause the users to perceive lifelogging as easier to use, but this does not apply to the perceived usefulness of, and the general attitude toward, using lifelogging for ADL. This outcome indicates that high competence in handling of lifelogging technology influences the users' acceptance in the way of an easy interaction with the technology, even though this perceived competence does not significantly affect the attitude toward lifelogging or its usefulness. To the contrary, the experience with lifelogging affects user acceptance throughout. In concrete terms, having the experience makes users perceive the lifelogging applications as significantly more useful and easier to use, and these users are generally more positive about using this technology for the activities of daily living. This outcome corroborates previous findings referring, for example, to the assistive social robots (Heerink, 2011), blog assistance behaviours (Chang and Yang, 2013) or even autonomous vehicles (Cho et al., 2017).

According to the correlation analyses, among the demographic variables age is weakly associated with

user acceptance. The negative coefficients indicate that with increasing age users perceive the technology as less easy to use and less useful, with their positive attitude toward using the technology diminishing. Although several other studies have found a significant impact of age on the user acceptance of technology in different contexts (e.g., Heerink, 2011; Miller and Bell, 2012), according to our analyses the influence of age plays no significant role in the context of lifelogging.

Interestingly, we observe in our findings also the missing impact of gender on the acceptance of the lifelogging technology for the activities of daily living. At the same time, user acceptance is significantly affected by the technological self-efficacy, the levels of which were assigned to the participants on the basis of the gender-specifically varying medians. This exciting result suggests that even though gender itself does not directly influence acceptance ratings, it indirectly diverges the attitudes of the potential users, playing thus an important role regarding their acceptance or rejection of the technology.

Referring to the second research question (RQ2) of this study, we can state that the overall intention to log different activities of the daily life is rather reluctant. According to our results, there is no activity—among those investigated—which would be enthusiastically used by the survey participants. While on average people still permit to monitor their medication intake and mobility behaviour, they clearly reject the observation of their body hygiene habits. The remaining activities, like shopping, cleaning, communication or nutrition, are less interesting for lifelogging among the respondents.

Furthermore, the key predictors of technology acceptance, PEU and PU, are both positively connected, being in accordance with the TAM (Davis, 1989). The attitude toward using lifelogging is very strongly correlated especially with the perceived usefulness and is also positively associated with the intention to use lifelogging for the different activities of daily living. These findings are in line with previous research on the technology acceptance (RQ3).

Summing up, from our results follows that the key to make an efficient use of lifelogging for ADL lies in trying it out and making the own experience on the applications, strengthening at the same time the own technological self-efficacy. Among the user characteristics, age and gender are less influential but shape the using behaviour indirectly: The hurdle seems to be higher, the older are the users and women approach lifelogging with less technological confidence than men. Conversely, this means that in the less technically adept user groups communication and marketing strategy on the potential and the benefits of lifelogging should be anew elaborated to overall optimise the adoption.

### 5.2 Limitations and Future Research

Before concluding, some limitations of the research and also the potential for future studies should be addressed.

Firstly, due to the structure of our sample the risk of a beta-error regarding the impact of age on using lifelogging for ADL represents an issue. We used an arbitrary division of the test persons to the respective age groups, trying to depict young ($n$=112), middle-aged ($n$=76), and older parts of the society and technology users at the same time. However, the group sizes varied greatly: Especially the proportion of the adults aged 60 years and above was comparably small ($n$=21), so that statistical validity is questionable; this could lead to a missing disclosure of statistically considerable differences.

In addition, the focus on the use of lifelogging technology reaches primarily an already selected group of people, who are most probably familiar with technological innovations. To meet the needs of less technology-savvy persons, and thereby increase the representativeness of the findings, future research has to extend the radius of the addressees up to surveys with traditional paper and pencil data collection in addition to the online survey method.

## 6 CONCLUSIONS

The presented empirical study shows that—likewise many previous technologies—the use of lifelogging technologies for the activities of daily living broadly depends on the perceived usefulness and an easy use, which shape the user's general attitude and the intention to use them. However, user characteristics decisively influence the acceptance of this technology. The previous experience with lifelogging and the technological self-efficacy significantly affect the user acceptance, but also the carrying variables age and gender shape the actual use—even though not in a direct way.

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## REFERENCES

Ajzen, I., 1991. The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179–211.

Arber, S., Vandrevala, T., Daly, T., Hampson, S., 2008. Understanding gender differences in older people's attitudes towards life-prolonging medical technologies. *Journal of Aging Studies*, *22*(4), 366–375.

Beier, G., 1999. Kontrollüberzeugungen im Umgang mit Technik [Control convictions in dealing with technology]. *Report Psychologie, 9,* 684–693.

Broos, A., 2005. Gender and information and communication technologies (ICT) anxiety: Male self-assurance and female hesitation. *CyberPsychology & Behavior*, *8*(1), 21–31.

Caprani, N., Piasek, P., Gurrin, C., O'Connor, N. E., Irving, K., Smeaton, A. F., 2014. Life-long collections: motivations and the implications for lifelogging with mobile devices. *International Journal of Mobile Human Computer Interaction (IJMHCI)*, *6*(1), 15–36.

Chang, Y. S., Yang, C., 2013. Why do we blog? From the perspectives of technology acceptance and media choice factors. *Behaviour & Information Technology*, *32*(4), 371–386.

Chen, Y., Jones, G. J.F., 2012. What do people want from their lifelogs? In: 6th Irish Human Computer Interaction Conference (iHCI2012), 20-21 June 2012, Galway, Ireland.

Cho, Y., Park, J., Park, S., Jung, E. S. (2017). Technology acceptance modeling based on user experience for autonomous vehicles. *Journal of the Ergonomics Society of Korea*, *36*(2), 87–108.

Climent-Pérez, P., Spinsante, S., Mihailidis, A., Florez-Revuelta, F., 2020. A review on video-based active and assisted living technologies for automated lifelogging. *Expert Systems with Applications*, *139*, 112847.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*, Lawrence Erlbaum Associates. New York, 2nd edition.

Davis, F. D., 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13*(3), 319–340.

Durndell, A., Haag, Z., 2002. Computer self-efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior*, *18*(5), 521–535.

Fishbein, M. and Ajzen, I., 1975. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Addison-Wesley Publishing Company, Inc., Reading, MA, USA.

Gurrin, C., Smeaton, A. F., Doherty, A. R., 2014. Lifelogging: Personal big data. *Foundations and Trends in Information Retrieval*, *8*(1), 1–125.

Harvey, M., Langheinrich, M., Ward, G., 2016. Remembering through lifelogging: A survey of human memory augmentation. *Pervasive and Mobile Computing, 27*, 14–26.

Hayes, T. L., Abendroth, F., Adami, A., Pavel, M., Zitzelberger, T. A., Kaye, J. A., 2008. Unobtrusive assessment of activity patterns associated with mild cognitive impairment. *Alzheimer's & Dementia*, *4*(6), 395–405.

Heerink, M., 2011. Exploring the influence of age, gender, education and computer experience on robot acceptance by older adults. *In 2011 6th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, pp. 147-148. IEEE.

Jalal, A., Kamal, S., Kim, D., 2014. A depth video sensor-based life-logging human activity recognition system for elderly care in smart indoor environments. *Sensors*, *14*(7), 11735–11759.

Kelly, P., Marshall, S. J., Badland, H., Kerr, J., Oliver, M., Doherty, A. R., Foster, C., 2013. An ethical framework for automated, wearable cameras in health behavior research. *American journal of preventive medicine*, *44*(3), 314–319.

Lidynia C., Schomakers EM., Ziefle M., 2019. What Are You Waiting for? – Perceived Barriers to the Adoption of Fitness-Applications and Wearables. In: Ahram T. (eds) *Advances in Human Factors in Wearable Technologies and Game Design*. AHFE 2018. Advances in Intelligent Systems and Computing, vol 795. Springer, Cham.

McAdams E., Krupaviciute A., Gehin C., Dittmar A., Delhomme G., Rubel P., Fayn J., McLaughlin J., 2011. Wearable Electronic Systems: Applications to Medical Diagnostics/Monitoring. In: Bonfiglio A., De Rossi D. (eds.) *Wearable Monitoring Systems*. Springer, Boston.

Miller, L. M. S., Bell, R. A., 2012. Online health information seeking: the influence of age, information trustworthiness, and search challenges. *Journal of aging and health, 24(*3), 525–541.

Morganti, L., Riva, G., Bonfiglio, S., Gaggioli, A., 2013. Building collective memories on the web: the Nostalgia Bits project. *International Journal of Web Based Communities*, *9*(1), 83–104.

Mubashir, M., Shao, L., Seed, L., 2013. A survey on fall detection: Principles and approaches. *Neurocomputing*, *100*, 144–152.

O'Hara, K., Tuffield, M.M., Shadbolt, N., 2008. Lifelogging: Privacy and empowerment with memories for life. *IDIS, 1*, 155–172.

Poli A., Strazza A., Cecchi S., Spinsante S., 2020. Identification Issues Associated with the Use of Wearable Accelerometers in Lifelogging. In: Gao Q., Zhou J. (eds) *Human Aspects of IT for the Aged Population. Technologies, Design and User Experience*. HCII 2020. LNCS, vol 12207. Springer, Cham.

Rahimi, B., Nadri, H., Afshar, H. L., Timpka, T., 2018. A systematic review of the technology acceptance model in health informatics. *Applied clinical informatics*, *9*(3), 604.

Rashidi, P., Cook, D. J., 2009. Keeping the resident in the loop: Adapting the smart home to the user. *IEEE Transactions on systems, man, and cybernetics-part A: systems and humans*, *39*(5), 949–959.

Rashidi, P., Mihailidis, A., 2013. A survey on ambient-assisted living tools for older adults. *IEEE Journal of Biomedical and Health Informatics*, *17*(3), 579–590.

Schoeppe, S., Alley, S., Van Lippevelde, W., Bray, N. A., Williams, S. L., Duncan, M. J., Vandelanotte, C., 2016. Efficacy of interventions that use apps to improve diet, physical activity and sedentary behaviour: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *13*(1), 127.

Selke, S., 2016. *Lifelogging: Digital self-tracking and Lifelogging-between disruptive technology and cultural transformation*. Springer Fachmedien Wiesbaden.

Shah, M., Mears, B., Chakrabarti, C., Spanias, A., 2012. Lifelogging: Archival and retrieval of continuously recorded audio using wearable devices. In *2012 IEEE International Conference on Emerging Signal Processing Applications* (pp. 99–102). IEEE.

Suzuki, T., Murase, S., Tanaka, T., Okazawa, T., 2007. New approach for the early detection of dementia by recording in-house activities. *Telemedicine and e-Health*, *13*(1), 41–44.

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

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

Wolf, K., Schmidt, A., Bexheti, A., Langheinrich, M., 2014. Lifelogging: You're wearing a camera?. *IEEE Pervasive Computing*, *13*(3), 8–12.

Ziefle, M., Schaar, A. K., 2011. Gender differences in acceptance and attitudes towards an invasive medical stent. *Electronic Journal of Health Informatics*, *6*(2), 13.

Ziefle, M., Bay, S., 2005. How older adults meet complexity: aging effects on the usability of different mobile phones. *Behaviour & information technology*, *24*(5), 375–389.