Privacy challenges in mobile technology acceptance research

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Abstract. *This paper presents an analysis of privacy issues and potential countermeasures in the context of mobile technology acceptance research. Automated usage tracking and user-generated content analysis are examples for novel methods that are utilized for acceptance research. These introduce privacy as a new issue to acceptance research. Some promising countermeasures could be derived from other fields that make use of this kind of methods. These are identified, discussed and supplemented by some novel approaches. Living Lab environemts with a high level of transparency seem to mitigate most privacy concerns and also provide additional value to users.*

Keywords: privacy, data collection, mobile technology, acceptance research methods

1 Introduction

Technology acceptance research seemed to be a mature field of research where only a few answers were yet missing [4] until recently. Despite a couple of problems inherent to the dominant methods and models the field did not change a lot. Most models implicitly assume that acceptance is a static factor that does not change over time. Recent studies unveiled that not only the level of acceptance changes over time as already indicated by the results of a follow-up in the course of technology acceptance model (TAM) [6] validation but also acceptance factors themselves change dynamically [20]. Other studies investigated the assumption that actual usage is an immediate consequence of behavioural intention to use a technology. The results suggest that the immediate effect is questionable as quite a number of psychological steps occur between these two factors [3]. Moreover, it has been shown that behavioural intention is not even a satisfying predictor of actual technology usage [10]. Also most models neglect the influence of context on technology acceptance and, thus, on the results of technology evaluation. A recent analysis of environmental factors of mobile phone usage concluded that these may have significant effects on the resources of the user and on the mobile phone itself [12]. Even standard application such as contact management tools without context-aware functionalities gave evidence that contextual influence is a significant issue [18].

Two important factors enable novel forms of mobile technology acceptance research and evaluation that address these shortcomings of traditional methods: First of all, new technologies and corresponding usage patterns produce incredible amounts of data, e.g. in form of location information or log files. Data is collected and processed for certain tasks such as recommendations or personalization issues.

Secondly, people produce incredible amounts of data and often share them voluntarily with the public, e.g. in form of social media entries or blogs.

Utilization of these data sources introduces novel privacy issues to technology acceptance research. Privacy as a constraint to technology acceptance has already been analysed before but privacy concerns regarding technology acceptance research methods have not been relevant until now. In other fields of application that make use of the same sort of data as intended in acceptance research the situation is different to acceptance research. In many cases the applications provide additional benefits to users, and are therefore widely accepted. The added value to services may, thus, be considered as one possible countermeasure to privacy concerns.

The main research question that will be addressed by this paper is, thus: What are relevant privacy issues with regard to novel technology acceptance research methods and how can we face them?

An analytical approach is applied to address this question. In a first step it will be necessary to classify novel research methods with regard to the privacy issues they have in common. These will be opposed by potential benefits that result from utilization of these research methods. The benefits are derived from other fields of application in which privacy has already been studied.

The remainder of this paper is organized as follows. Section two provides an overview of

technology acceptance methods. The classification of novel technology acceptance research and their corresponding privacy issues is adressed in section three followed by a discussion of potential countermeasures. The paper concludes with some remarks from technology acceptance research practice and suggestions for future research.

2 Background

Traditional technology acceptance research primarily makes use of standardized questionnaires. These can provide rich data and enable statistical analysis but very often lack context information. Some recent survey-based research on technology acceptance did include context information in their research models. Mallat et al. [11] examined the use of a mobile ticketing service and included some context items (I use/expect to use mobile tickets if... travel card has no value or the period is expired, I have no cash for purchasing the ticket, I'm in a hurry or need the ticket fast, I need the ticket unexpectedly and have not prepared for purchasing it, if there are queues in points of ticket sale) in their survey. Venkatesh et al [19] included social influence and facilitating conditions as context factors in their extension of the Unified Theory of Acceptance and Use of technology. A recent analysis of users switching behaviour between fixed internet and mobile internet examined intentions to use mobile internet in future considering passing time, task-related, social and work contextual conditions [7]. Most of the hypothesized effects of context turned out to be significant. Nevertheless, the range of included context dimensions was limited in all cases as one can only include a limited number of items in questionnaires. Moreover, due to the research design the results were self-reported context perceptions.

In many situations the user is not aware of the impact of context and, thus, does not provide the researcher with this additional information. To get crucial insights, contextual inquiries are conducted in which the designer interviews the user directly on the spot where the usage takes place, e.g. on the work place while the user is performing tasks in order to gather this missing data about the usual context and setting [8]. Applying this method on ubiquitous applications causes difficulties such as location changes where the interviewer has to follow the user, and probably affects the behaviour by interrupting in crucial moments. This leads to a less realistic usage behaviour. Using user observation could also be problematic, because the designer has to be extremely close to the user, which could have a bias on the results, especially referring to private tasks or locations.

Another approach for more authentic user involvement is to install an application on the mobile device, to give the user the possibility to give in-situ feedback and to get user requirements [14]. Examples for this kind of applications are ConTexter [21] and iRequire [15]. Besides that there exist several applications that automatically track usage behaviour. This kind of mechanisms is included in many applications that are offered in application stores, e.g. Google Play Store and Apple AppStore. The user is asked for permission to access data sources on his or her mobile phone when downloading an app. Very often the application itself does not make use of the data but it is required for further services, e.g. advertisements.

The Living Lab approach also considers contextual factors of technology usage and is often referred to as accelerator of acceptance of innovations as future users are included at early stages of product development [13]. A Living Lab is "a user-centric innovation milieu built on everyday practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values" [5]. Evaluation methods within Living Labs are, thus, based on inclusion of context information with special regard to realism of the context in which the evaluation takes place. Living Lab is rather a methodology than a single method but it is considered in the present analysis due to its characteristics as an acceptance evaluation environment.

3 Tackling privacy issues

Prior research intended to classify privacy concerns into categories. A recent conceptualization of internet privacy concerns that is based on four empirical studies in different settings resulted in six main privacy concerns [9]:

- Collection – refers to privacy issues that occur when a person is asked to provide information
- Secondary usage – refers to privacy issues that are related to further usage of data in addition to the specific purpose it was provided for
- Errors – refers to privacy issues that are related to data quality and maintenance
- Improper access – refers to security measures that are taken in order to protect the provided data from being accessed by other people or organizations
- Control – refers to a person's perception that he or she can decide which information is provided and what data is collected
- Awareness – refers to the information being provided regarding the purpose of data collection and usage

This classification of privacy issues is used for the assessment of potential privacy issues regarding novel technology acceptance methods. Table 1 depicts the

summarized results of the analysis which was conducted based on the methodological particularities inherent to the technology acceptance research methods..

Table 1. Potential privacy issues of five types of technology acceptance methods

	Collection	Secondary usage	Errors	Improper access	Control	Awareness
standardized survey including context items	x	x		x		x
contextual inquiry	x		x		x	x
applications for in situ user feedback		x		x		x
applications for automated behaviour tracking		x	x	x	x	
Living Lab	x					

Standardized surveys that include context items may raise privacy issues when people are asked for context information. Secondary usage can be a relevant topic as quantitative data is often shared for different purposes. As data is usually collected in one single survey, error handling is not that important. Improper access issues might arise in case of online surveys as the user cannot tell where and how data is stored. Control issues are not relevant in the context of standardized surveys as the user can decide himself which questions are answered, and thus, which information is provided. In most cases users are not informed regarding the purpose of data collection and usage. This fact might raise awareness issues.

Contextual inquiry is often conducted at the work place. Users may have privacy concerns related to collection when they are asked to participate. Moreover control issues can occur as the user cannot decide which information is provided as the researcher who conducts the inquiry takes notes from observation as well. The purpose of data collection and usage might also cause awareness issues. Users worry about data being used for productivity assessment and the like. Secondary usage and improper access issues are not that important in the case of contextual inquiries as data usually is not stored online. Errors might raise privacy issues as the user cannot even check the data for errors, and thus, might be afraid of erroneous information related to himself.

Applications for in situ feedback and self-tracking cause privacy issues related to secondary usage and improper access as well as awareness as one provides a lot of information but cannot tell for what it is actually used or will be used in future. Data is transferred and stored online which might enable

improper access. Perceptions regarding collection and control will be positive as the user himself decides which information is being published. Errors are not an important topic in this context.

Automated user behaviour tracking may cause privacy issues on every dimension as the user himself does not know which behaviour is tracked, when it is tracked and for which purpose. Collection might be a topic only in case of explicit access permissions, e.g. most applications available in mobile app stores require access permissions for a big number of data sources on the mobile phone, even if they are not utilized at all. Awareness is important in cases, in which the user is aware of being tracked.

Living Lab methods may raise collection issues when the user agrees to become a member of the Living Lab. As data collection purposes, secondary usage issues, error handling and access control are defined from the very beginning they do not cause important privacy issues. In most cases the user participates in the research work and is therefore not only object but also subject. This fact causes higher perceptions of control and awareness.

4 Discussion of countermeasures

Privacy threats very often initiate certain responses by people who perceive them (e.g. negative word-of-mouth, direct complaint, indirect complaint, removal and the like) in order to protect their privacy. These responses are usually negative and, thus, require countermeasures. Several countermeasures have been empirically tested and discussed in different settings so far [17]. We will discuss information transparency, benefits of personalization and individual reasons related to the application with regard to the five types of technology acceptance methods. As benefits of personalization and individual reasons related to the application are too specific for being discussed in the context of acceptance research in general, these two categories are summarized in the new category – additional value. Activities to be set and their expected impact on privacy issues are outlined in tables 2 and 3.

Information transparency is one of the countermeasures that have been suggested. Information transparency includes features that provide the user with knowledge regarding the information that is collected and the procedures that are applied to it. Information transparency seems to be an important issue. Nevertheless empirical studies indicate that people who are privacy sensitive and do ask for information transparency are less likely to participate in personalization [2]. Information transparency in the context of mobile technology acceptance can be achieved by additional communication efforts. There exist some constraints to communication activities as acceptance research requires realistic data. Usage behaviour, and thus,

data might be biased if users are completely aware of what is collected and what it is used for from the very beginning. Table 2 outlines reasonable activities that increase information transparency and at the same time do not harm the obtained results.

Table 2. Information transparency in the context of technology acceptance methods

	activity	impact
standardized survey including context items	explanation of data usage and analysis process subsequently to interview/survey	mitigate secondary usage and awareness issues; results can be biased if user is aware of purpose
contextual inquiry	exposing notes to user after inquiry; communicating purpose	mitigate control and error issues; increasing awareness
applications for in situ user feedback	communicating purpose and data storage process	support awareness; mitigate secondary usage and improper access issues
applications for automated behaviour tracking	obtaining explicit tracking permissions including details on data that will be tracked; communication data storage and data protection procedures	improve control perceptions and collection issues; mitigate secondary usage and improper access concerns
Living Lab	explicit communication of all data collection and usage processes at the beginning of membership	improve collection issues in advance

Benefits of personalization are also often argued as countermeasures to privacy concerns. In the context of ubiquitous commerce applications the effects of emergency situations have been tested [16]. These included personalization features that support fast and accurate help and, thus, an immediate benefit to users. Convenience is mentioned as another reason to accept privacy issues [1]. People are usually willing to provide their personal data for the benefit of easy access, faster processes or less complexity. Examples for this trade-off between privacy and convenience are usage of Facebook login for several services in order to avoid a new registration and a new password, usage of Google services to avoid extra login for each

service, acceptance of recommender systems (e.g. amazon.com) to enable quicker purchasing decisions with less complex information.

Besides actual benefits there also exist individual reasons for accepting services even though there are privacy issues. One of these reasons is identity presentation which is inherent to most social media services. An extensive analysis of reasons for sharing photos on online and mobile platforms, its perceived benefits unveiled that reasons for using this kind of services that have inherent privacy issues is in most cases connected to additional privacy issues [1]. Identity presentation was mentioned as an important reason for using such platforms but on the other hand the issues of image damaging are important to many users. According to the results of this study it is also important to users of such platforms to provide convenience to other users, e.g. make photos easily accessible. Examples for the impact of identity presentation needs on privacy concerns are the increasing number of personal blogs, the upcoming trend of ego clips, i.e. videos showing the everyday life of a person, and of course the usage of social media (e.g. Facebook) that already became part of people's daily routines.

Adding value or providing reasons is a non-trivial issue in the context of mobile technology acceptance research. Acceptance research can either make use of data that is available from other services that add value to users. This approach limits the range of possible results as the researcher has to focus on data types and information sources that are required for the service in question, e.g. usage of history data for recommender systems. Another option is the actual creation and communication of value to users. This approach is more difficult as participation in research itself usually does not provide any immediate advantage to the user. Rather than that it means additional effort. Nevertheless there are quite a few possibilities to make use of current usage patterns. One opportunity is the trend of self-monitoring tools that provide people with a possibility to gain new insights about themselves (e.g. calorie tracking, sports monitoring, health reports). Co-creation is another issue that might contribute to value creation. People want to influence new technologies and they want to be part of the development at early stages. The perception to be able to change technologies that will be part of their lives in future is to be considered as an additional value. Moreover co-creation is often based on community building activities that are similar to social networks (e.g. gamification, user interaction, events), and thus, provide additional value. Besides that it is also possible to make use of traditional incentives, such as monetary rewards or drawings. Table 3 depicts possible activities that provide additional value to users and their expected impact in specific methodological settings.

Table 3. Additional value in the context of technology acceptance methods

	activity	impact
standardized survey including context items	providing feedback; include drawing	user receives new insights; incentive
contextual inquiry	reaction on suggestions	situation of the user is improved
applications for in situ user feedback	providing self-monitoring features (e.g. usage history)	user receives new insights and monitoring desires are fulfilled
applications for automated behaviour tracking	communicate benefits via better services that are possible because of it; communicate improved convenience due to less survey data required	User accepts less control in exchange for higher convenience
Living Lab	emphasize the important role of users in co-creating services; communicate opportunity to actually influence innovations	user is part of a community; perception regarding importance and influence in exchange to efforts of participation

5 Conclusions and outlook

The present analysis suggests that Living Lab methods raise less privacy issues than other technology acceptance methods. An immediate comparison to other methods of acceptance research might not be appropriate as Living Labs are not a specific method but rather a general approach towards product and service design. Living Lab studies might include a combination of the mentioned methods such as behaviour tracking or self-reporting tools for in situ feedback. Living Labs can, thus, be regarded as environments that might serve as countermeasures for privacy issues. The results of the present analysis indicate that countermeasures that, e.g. transparent communication with the community on a long term basis or the user perception of really influencing innovations, can be rather realized in Living Labs than other types of panels or else.

In future it will be necessary to systematically apply the novel methods of mobile technology acceptance research within comparable Living Lab environments, preferably within the same community,

and then evaluate privacy issues that occur. It is planned to analyse privacy issues of a semi-automated context tracking tool within a mobile Living Lab. The mobile Living Lab is a permanent community that creates, designs and evaluates mobile innovations. Mobile phones are the main channel of communication within this community and most of the administration is performed via mobile. Assessment of context, therefore, requires methods that are either automated or performed by the Living Lab member himself. The context tracking tool is outlined as a semi-automated tool in order to enable evaluation of privacy that arise. The tool is developed in co-creation with the Living Lab members and considers their requirements and constraints with regard to privacy issues. The option to include self-reporting elements is based on the assumption that privacy issues are also related to the type of information that is collected, transferred and utilized. Some kinds of data will require special attention even though information transparency is high and added value to the member is communicated and perceived. The next steps in this research project emphasize on the identification of these critical data types and will result in a functional prototype of the context-tracking tool.

References

[1] Ahern, S.; Eckles, D.; Good, N.; King, S.; Naaman, M.; Nair, R. Over-Exposed? Privacy Patterns and Considerations in Online and Mobile Photo Sharing. In *Proceedings of CHI 2007*, ACM Press (2007).

[2] Awad, N. F.; Krishnan, M. S. The Personalization Privacy Paradox: An Empirical Evaluation of Information Transparency and the Willingness to be Profiled Online for Personalization. *MIS Quarterly*, 30 (1): 13-28, 2006.

[3] Bagozzi, R. P. The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift, *Journal of the Association for Information Systems,* 8 (4): 243-254, 2007.

[4] Benbasat, I.; Barki, H. Quo vadis, TAM?, *Journal of the Association for Information Systems,* 8 (4): 211-218,2007.

[5] Bergvall-Kåreborn, B.; Eriksson, C. I.; Ståhlbröst, A.; Svensson, J. A Milieu for Innovation – Defining Living Labs. In *2nd ISPIM Innovation Symposium*, New York, USA, 2009.

[6] Davis, F.D. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information

Technology, *MIS Quarterly,* 13(3): 319–340, 1989.

[7] de Reuver, M.; Ongena, G.; Bouwman, H. Should mobile internet be an extension to the fixed web? Fixed-mobile reinforcement as mediator between context of use and future use. *Telematics and Informatics,* 30: 111-120, 2013.

[8] de Sá, M.; Carriço, L.; Duarte, C. Mobile Interaction Design: Techniques for Early Stage In-Situ Design. In Asai, K. (Ed.), *Human Computer Interaction: New Developments*, Published: October 1, 2008 under CC BY-NC-SA 3.0 license.

[9] Hong, W.; Thong, J. Y. L. Internet Privacy Concerns: An Integrated Conceptualization and Four Empirical Studies. *MIS Quarterly*, 37 (1): 275-298, 2013.

[10] Limayem, M.; Hirt, S. G.; Cheung, C. M. K. How Habit Limits the Predictive Power of Intention: The Case of Information Systems Continuance, *MIS Quarterly*, 31 (4): 705-737, 2007.

[11] Mallat, N.; Rossi, M.; Tuunainen, V. K.; Öörni, A. The impact of use context on mobile service acceptance: The case of mobile ticketing. *Information & Management,* 46: 190-195, 2009.

[12] Ronkainen, S.; Koskinen, E.; Liu, Y., Korhonen, P. Environment Analysis as a Basis for Designing Multimodal and Multidevice User Interfaces. *Human-Computer Interaction,* 25: 148-193, 2010.

[13] Schaffers, H.; Turkama, P. Living Labs for Cross-Border Systemic Innovation. *Technology Innovation Management Review*. 2012 (September): 25-30, 2012.

[14] Seyff, N.; Graf, F.; Maiden, N. Using Mobile RE Tools to Give End-Users Their Own Voice. In *Proc. of the 18th IEEE International Requirements Engineering Conference*, IEEE Press (2010), 37-46.

[15] Seyff, N.; Ollmann, G.; Bortenschlager, M. iRequire: Gathering end-user requirements for new apps. In *Proc. Of the 19th IEEE International Requirements Engineering Conference*, IEEE Press (2011), 347-348.

[16] Sheng, H.; Nah, F. F.; Siau, K. An Experimental Study on Ubiquitous Commerce Adoption: Impact of Personalization and Privacy Concerns. *Journal of the Association for Information Systems*, 9 (6): 344-376, 2008.

[17] Son, J.; Kim, S. S. Internet Users' Information Privacy-Protective Responses: A Taxonomy and a Nomological Model. *MIS Quarterly*, 32 (3): 503-529, 2008.

[18] Stefanis, V.; Plessas, A.; Kominos, A.; Garofalakis, J. Patterns of Usage and Context in Interaction with Communication Support Applications in Mobile Devices. In *Proceedings of MobileHCI'12*, ACM Press (2012), 25-34.

[19] Venkatesh, V.; Thong, J.; Xu, X. Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, 36 (1): 157-178, 2012.

[20] Waarts, E.; van der Everdingen, Y. M. The dynamics of factors affecting the adoption of innovations, *Journal of Product Innovation Management,* 19 (6) (2002) 412-423.

[21] Wehrmaker, T.; Gärtner, S.; Schneider, K. ConTexter feedback system. In *Proc. of the 2012 International Conference on Software Engineering*, IEEE Press (2012), 1459-1460.