
Proxemo or How to Evaluate User Experience for People with Dementia

Stephan Huber

Julius-Maximilians-Universität Würzburg
Würzburg, Germany
stephan.huber@uni-wuerzburg.de

Alexander Bejan

Furtwangen University
Furtwangen, Germany
beja@hs-furtwangen.de

Beate Radzey

Demenz Support Stuttgart gGmbH
Stuttgart, Germany
b.radzey@demenz-support.de

Jörn Hurtienne

Julius-Maximilians-Universität Würzburg
Würzburg, Germany
joern.hurtienne@uni-wuerzburg.de

ABSTRACT

Most user experience (UX) evaluation tools require users to self-reflect and to communicate their thoughts (e.g. thinking aloud, retrospective interviews, questionnaires). In the context of designing for people with dementia, however, conditions like aphasia and general cognitive decline restrict the applicability of these methods. In this paper, we report on the iterative design of *Proxemo*, a smartwatch app for the documentation of observed emotions in people with dementia. Evaluations of *Proxemo* in dementia care facilities showed that observers considered *Proxemo* easy to use and preferred it over note-taking on paper. The agreement between different coders was substantial ($\kappa = .71$). We conclude that *Proxemo* is a promising tool for UX evaluations in the dementia context – and possibly beyond, but further research on the analysis of its generated data is required.

KEYWORDS

User experience; Quality of Life; dementia; reminiscence; observation; formative evaluation; emotion

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

CHI'19 Extended Abstracts, May 4–9, 2019, Glasgow, Scotland, UK.

© 2019 Copyright is held by the author/owner(s).

ACM ISBN 978-1-4503-5971-9/19/05.

DOI: <https://doi.org/10.1145/3290607.3313018>



Figure 1: The Proxemo App in use. Tapping one of the emojis documents its associated emotion with a timestamp.

1 INTRODUCTION

With the expectation of a continuously growing number of people living with dementia, the interest in designing interactive technology for them has been increasing over the past two decades. While mainstream research and practice has been focusing on safety and security (e.g. location monitoring, reminder systems) more recent research has focused on enhancing the *Quality of Life* (QoL) of people with dementia. One particular area is the support of reminiscence through technology. A well-known example is the multimedia system CIRCA [1], which allows caregivers and people with dementia to explore reminiscence stimuli such as images, music and video on a touch screen. Some other systems are designed to trigger memories through tangible interaction [3; 7] and even virtual reality experiences (Fig. 3, [2; 3]).

But how can we design and reliably evaluate interfaces for reminiscence in the dementia context? Neither User Experience (UX) tools nor QoL methods are appropriate for evaluating reminiscence with people with dementia [4]. QoL questionnaires are filled in by proxy, focus on the care environment and cannot capture the fine-grained emotional experiences and their triggers during technology use. Most UX evaluation methods require users to self-reflect and to communicate their thoughts (e.g. thinking aloud, retrospective interviews, questionnaires). In the context of designing for people with dementia, however, conditions like aphasia and general cognitive decline restrict the applicability of these methods. Instead of reflection and self-report we would like to emphasize the use of observation as the method of choice. With *Proxemo* [4], a method and tool was suggested that is able to address this lack of UX evaluation methods. Proxemo is a smartwatch app for the documentation of observed emotions by proxy. As it was not applied in practice recently, we conducted ‘in the wild’ studies [5] and contribute insights about the usability of Proxemo, the reliability of the generated data and its development into Proxemo 2.0.

Proxemo is an application to log emotions in-situ and later map these to triggering stimuli via video analysis. Proxemo was designed to run on a smartwatch to facilitate a discrete and quick interaction for observers. Observed emotions are documented by tapping an emoji representing the associated category (Fig. 1). Between interactions, observers have their hands free to engage with residents, for example, to act as a Wizard-of-Oz or to take further notes on paper. Proxemo originally used the emotion categories from the QoL method Observed Emotion Rating Scale [6]. Proxemo is flexible in its use as the documentation of emotions is not bound to fixed time intervals. Proxemo is less complex than QoL tools and therefore has the potential to be learned quickly even by novice observers in the context of dementia.

We implemented Proxemo for the Tizen® (The Linux Foundation) smartwatch operating system (Fig. 2). In this paper, we explore in 2 studies how the tool is used in field observations, whether it is easy to use for novices and experts and how the resulting timestamps in videos contribute to the evaluators’ understanding of the users’ emotions. We report an iteration of the design of Proxemo and test its reliability for the documentation of observed emotions. We provide the source code of Proxemo to support future hands-free observations and share insights from its design process.

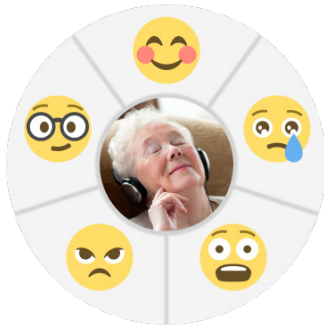


Figure 2: A screenshot of the Proxemo app. Clockwise starting on top, the five emojis represent the emotions pleasure, sadness, anxiety/fear, anger, and general alertness [6] (<http://emojione.com>, CC-BY 4.0).



Figure 3: Setup of the reminiscence intervention: people with dementia sat opposite of a display wall and explored a virtual house together with a caregiver. Here, an individual session is shown, but also group sessions took place.

2 TOOL USE IN THE WILD

In study 1, we explored how novice observers use Proxemo in dementia care facilities during reminiscence sessions in which new technologies were tested. The evaluation took place in a rural dementia care facility in Germany and focused on interventions with an interactive wall of roughly 2.5 x 1.5 meters. Residents could experience multimedia presentations about meaningful topics (e.g. their hometown, farm animals, or seasons) in group interventions or explore a virtual house with a pet avatar in single sessions (Fig. 3, [2]), both moderated by a caregiver. Family members or other spokespersons of all persons with dementia living in this facility had agreed to observations within the scope of the project Interactive Memories (www.intermem.org). Before each evaluation session, the caregiver who moderated the session introduced the observers to the residents, told them they were interested visitors and asked if everyone was comfortable with them watching the session.

Observers were one caregiver with administrative responsibilities and three undergraduate students of health sciences. They had few prior experience in observations but were familiar with reminiscence technology in the dementia context and took turns in observing over nine sessions. Each observer signed a consent form and received a short introduction about the functionality and handling of the watch. We asked observers to document the emotions of residents while using the technology – as soon as they were detected to ensure a high data quality. Observers sat orthogonally to the residents and the displays, so that they could see both, the users’ facial expressions and the content of the interactive wall triggering the emotions. They were equipped with a smartwatch (Gear S2, Samsung Electronics, Seoul South Korea) running the Proxemo app and an optional clipboard for note-taking on paper. By touching the emojis on the watch face (Fig. 2), observers documented the associated emotion with a timestamp. A wide angled camera recorded videos of users’ profiles and the display wall. After the observations the observers participated in short interviews. All observers had no prior experience with Proxemo.

2.1 Findings – Using Proxemo in the wild

Observers hid the smartwatch in their hand, and only wore it on their wrist, when they planned on note-taking (Fig. 4). For the documentation of observed emotions, observers glanced at the smartwatch for about 1-2 seconds – an interaction they rated hardly distracting and even more efficient compared to taking notes on paper. They said, that Proxemo “contains all the important emotions” (O2), “one simply has to push the right button” (O1) and “during note taking I would miss important emotions” (O4). If residents displayed only few emotions, it was “easily manageable to take notes on the side” (O1). Others found “the watch better as a standalone unit, as taking notes next to it needs too many resources” (O3) or that writing was “not necessary in this situation” (O4). O3 concluded that “the watch was really good in the situation and afterwards – meaning directly after the intervention [I did] the writing. Using paper [during the intervention] would be like in an exam [for the residents]. The watch is more discrete. Wearing the watch is more practical than holding it in the hand.” During group sessions, observers documented the emotions of all three participating residents. O1 reported that she missed emojis for situations when residents were very surprised/astonished by either the presented content on the interactive

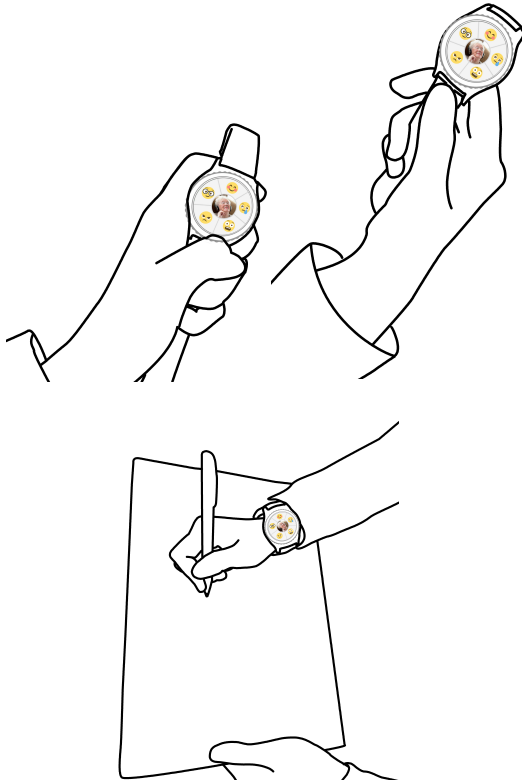


Figure 4: Observers only wore the smartwatch on their wrist, when they intended to take notes. Otherwise, they preferred to hold the watch in their hand. That way they were able to document emotions with a twitch of their thumb or hide the device to avoid distracting residents.

wall or the comments of the moderating caregiver. Observers also pointed out the lack of emojis for “residents falling asleep” (O1), being “disinterested” (O3), or “distracted – as opposite to general alertness” (O2). O4 reported that she “could never observe anxiety [and] that anger and sadness were not always clearly distinguishable in people with dementia”.

2.2 Analysing videos with and without Proxemo data

We synchronized timestamps from Proxemo with the video files and made them available to the observation teams (Proxemo Team, PT). Another team analysed videos from interventions with the interactive wall on observable emotions without being limited to the emotions by the Observed Emotion Rating Scale [6] used in Proxemo (Video-Only Team, VOT). Evaluators who performed the video analysis shared their experiences with us during a short interview. Proxemo data from group sessions had to be manually assigned to one of the observed users. Assigning the documented emotions to one of the residents in the video caused some extra effort but was usually unambiguous. “Mostly [the emotion timestamp] belongs to the person who is either laughing or with whom the caregiver is talking, hence the observer’s focus is on them as well” (PT1). The data from Proxemo gave “additional assurance [and] definitely made the analyses easier” (PT2). Proxemo data became particularly relevant “when residents’ faces [were] not visible on the video because residents moved beyond the captured area, turned away from the camera or caregivers stood between the camera and the resident. Sound alone was sometimes not enough to recognize the emotions, so those would have remained ambiguous without the Proxemo-data” (PT1).

The Video-Only-Team analysed the videos of sessions without data from Proxemo, which gave us ideas for the further development of Proxemo. The VOT did not code each facial expression, but only emotions that occurred in association with autobiographically informed, meaningful moments for the person with dementia. In total the VOT annotated fewer emotions but identified moments of pride or wistfulness – emotions that were not included in the set initially derived from [6], but are important for the context of reminiscence. For example, residents proudly talked about their hometown and the amount of cattle they once owned or they wistfully reminisced over a chapter in their life that had been good but was clearly over. The evaluators also tagged residents’ skills and agency (e.g. singing, reading, remembering something) that became apparent during the intervention and that gave the residents a feeling of pride and joy. We learned from this study, what features to improve and what emotions to include, but also that Proxemo changes the character of an evaluation. Through Proxemo, observers gain more time to actually observe, because they do not need to spend their cognitive resources on note-taking. The predefined set of emotion categories is beneficial for novices but also limits the richness of data noted in context. Consequently, the more detailed interpretation of observed events is shifted towards the video analysis. Proxemo data supported the navigation in video files and facilitated the interpretation of situations, where relevant information was not visible or audible in the video. As one observer stated, the most comprehensive data is generated, when using Proxemo during the observation and writing down important insights subsequently.

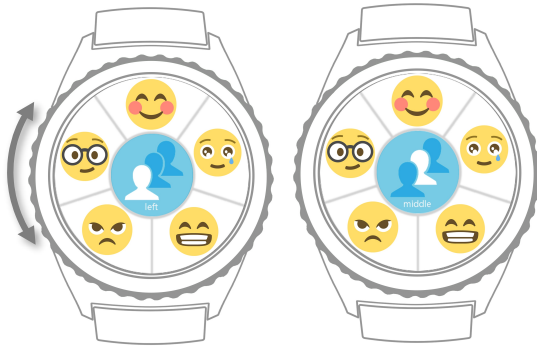


Figure 6: Observers can switch between profiles of different residents by rotating the bezel of the watch in either direction. Tapping the picture in the center documents *agency* of the currently selected resident.

The source code of Proxemo 2.0 for Tizen can be found at: <https://gitlab2.informatik.uni-wuerzburg.de/s347593/Pr0x5m0>



Figure 5: Emojis representing the final set of emotion categories used in Proxemo 2.0 are pleasure, wistfulness, pride, a generic negative emoji and general alertness. Wistfulness has been created based on the sadness emoji, all others were adopted without changes from <http://emojione.com>, CC-BY 4.0.

3 PROXEMO 2.0

Based on our insights from the field study we redesigned Proxemo. We added support for more comfortably documenting group observations. By rotating the haptic bezel of the watch, observers can switch between residents they observed. These can be represented by individual portraits or generic icons (Fig. 5). Tapping the current picture in the centre can now be used to set a timestamp for observed agency. Finally, we collapsed anxiety, sadness and anger to one generic negative emotion and included additional emojis for pride and wistfulness (Fig. 6).

4 INTERRATER RELIABILITY

Case study 1 indicated that Proxemo is easy to use and suitable for documenting observed emotions in smaller groups. Our next step was to find out whether different raters agree on the emotions they choose to document with Proxemo. For ethical reasons and for standardizing the procedure, we decided against deploying multiple observers in a live intervention. Instead, two coders analyzed video material from prior recorded sessions on a large, high-resolution screen (1,65 x 0,93 meters) in a controlled environment. Both were students of health sciences or HCI without prior knowledge of either Proxemo or reminiscing in dementia. We briefed them about the reminiscence project and introduced them to Proxemo. Both coders had the opportunity to familiarize themselves with Proxemo and with coding emotions of people with dementia from video material. Their training involved the coding of one video where they were allowed to pause and discuss observed situations and one video where they were not allowed to pause the video. We then put a visual barrier between the coders and disallowed all conversation. The coders then documented emotions using Proxemo throughout four filmed reminiscence interventions. The material included two interventions for single residents and two interventions with groups of three and lasted 80 minutes in total. For the calculation of interrater reliability, we compared Proxemo timestamps that occurred within intervals of 5 seconds. The agreement between different coders was substantial for videos with one resident ($\kappa = .71$, $p < .001$, $N = 133$) and videos with three residents ($\kappa = .78$ $p < .001$, $N = 116$). Coders perceived Proxemo as easy to use and reported that it did not cause a high workload.

5 DISCUSSION

In this work we presented the evaluation and iteration of Proxemo, a practical tool developed for UX evaluations under difficult conditions (i.e. users cannot speak or remember their emotions). In our first in the wild case study we gave Proxemo to observers and analysts and found, that the predefined set of emotions was beneficial for novices but limits the richness of data in context. Consequently, the more detailed interpretation of observed events is shifted towards the video analysis, where Proxemo data supported the navigation in video files and facilitated the interpretation of ambiguous situations. We evaluated a set of emotions from QoL and contributed a new set of emotions better suited to evaluating interactive technology for people with dementia. After the redesign, participants in an interrater reliability study achieved substantial agreement and rated Proxemo 2.0 as easy to use and non-distractive.

ACKNOWLEDGMENTS

We thank all project partners and especially our participants as well as Jan Erik Fischer for implementing Proximo. We gratefully acknowledge the grants from the German Federal Ministry of Education and Research (project InterMem, 16SV7322).

With *pride* and *wistfulness*, the set of emotions is currently optimized for evaluating reminiscence technology. However, our insights from the first case study are potentially generalizable to observation studies beyond the context of dementia. We learned, that observers gained more time to actually observe when using Proximo, because they did not have to spend their cognitive resources on note-taking. Additionally, the viable form factor of the smartwatch facilitated unobtrusive documentation of observed emotions. We share this tool with the CHI community and encourage them to adapt the set of emotions to new contexts where observers need free hands and less distraction. Our next steps will be to validate the set of emotions with experts in the field and investigate the increase of efficiency between pen and paper and Proximo in lab studies.

Through Proximo, evaluators can document emotions of users with dementia while they are fully immersed in the interaction. However, in ambiguous situations – which are often the most interesting – a timestamped emoji does not cover the complexity of users’ experiences. Evaluators sometimes took notes after the session to express their observations in greater detail. Yet observations may be biased and cannot fully reflect how users experienced their emotions. Future research should work towards enabling people with dementia and other cognitive impairments to directly report their experienced emotions and speak for themselves in a human-centred-design process.

REFERENCES

- [1] Arlene J. Astell, Maggie P. Ellis, Lauren Bernardi, Norman Alm, Richard Dye, Gary Gowans, and Jim Campbell. 2010. Using a touch screen computer to support relationships between people with dementia and caregivers. *Interacting with Computers* 22, 4, 267-275.
- [2] Alexander Bejan, Markus Wieland, Patrizia Murko, and Christophe Kunze. 2018. A Virtual Environment Gesture Interaction System for People with Dementia. In *Proceedings of the Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems* (Hong Kong, China2018), ACM, 3205440, 225-230. DOI= <http://dx.doi.org/10.1145/3197391.3205440>.
- [3] Peter Bennett, Heidi Hinder, and Kirsten Cater. 2016. Rekindling Imagination in Dementia Care with the Resonant Interface Rocking Chair. In *Proceedings of the Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (San Jose, California, USA2016), ACM, 2892505, 2020-2026. DOI= <http://dx.doi.org/10.1145/2851581.2892505>.
- [4] Stephan Huber, Jan Preßler, Nam Ly Tung, and Jörn Hurtienne. 2017. Evaluating Interaction-Triggered Emotions in People with Dementia. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* ACM, Denver, CO, 2659-2667.
- [5] Rose Johnson, Yvonne Rogers, Janet Van Der Linden, and Nadia Bianchi-Berthouze. 2012. Being in the thick of in-the-wild studies: the challenges and insights of researcher participation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* ACM, 1135-1144.
- [6] M. Powell Lawton, Kimberly Van Haitsma, and Jennifer Klapper. 1999. Observed affect and quality of life in dementia: Further affirmations and problems. *Journal of Mental Health and Aging* 5, 1, 69-82.
- [7] Nam Tung Ly, Jan Preßler, Dominik Gall, Jörn Hurtienne, and Stephan Huber. 2016. Tangible interaction drawers for people with dementia: retrieving living experiences from past memories. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct* ACM, 157-160.