Proxemic Mobile Collocated Interactions

Martin Porcheron
The Mixed Reality Laboratory
School of Computer Science
University of Nottingham, UK
porcheron@acm.org

Andrés Lucero
Mads Clausen Institute
University of Southern Denmark
Kolding, Denmark
lucero@acm.org

Aaron Quigley
SACHI
School of Computer Science
University of St Andrews, UK
aquigley@acm.org

Nicolai Marquardt
UCL Interaction Centre
University College London
London, UK
n.marquardt@ucl.ac.uk

James Clawson
School of Interactive Computing
Georgia Institute of Technology
Atlanta, GA, USA
jamer@gatech.edu

Kenton O'Hara
Microsoft Research
Cambridge, UK
keohar@microsoft.com

Abstract

Recent research on *mobile collocated interactions* has been looking at situations in which collocated users engage in collaborative activities using their mobile devices. However, existing practices fail to fully account for the culturally-dependent spatial relationships between people and their digital devices (i.e. the *proxemic* relationships). Building on the ideas of *proxemic interactions*, this workshop is motivated by the concept of 'proxemic mobile collocated interactions', to harness new or existing technologies to create engaging and interactionally relevant experiences. Such approaches would allow devices to not only react to presence and interaction, but also other indicators, such as the interpersonal distance people naturally use in everyday life. The aim of this one-day workshop is to bring together a community of researchers, designers and practitioners who are interested in exploring *proxemics* and *mobile collocated interactions*.

Author Keywords

co-located interaction; proxemics; collaboration; handheld devices; multi-device; multi-user.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Figure 1: Ethnographic research has studied the use of mobiles in natural collocated settings.

Figure 2: Mobiphos allows group of people to simultaneously capture and share photos.

Figure 3: MobiComics allows collocated groups to curate and share comic strip panels.

Introduction

Mobile Collocated Interactions

Research on mobile collocated interactions has sought to push the boundaries of how mobile devices are perceived by users and designers, attempting to evolve them from devices purposed for distributed interactions solitarily performed by individuals to communicate, to devices which can be be used to encourage engaging collocated interactions [7,18]. This work has supported the evolving nature of interacting with mobile devices from personal/individual toward shared/multiuser experiences and interactions [12], allowing people to use their mobile devices as artefacts in their everyday activities and interactions [15].

Research on mobile collocated interactions has broadly focused on either ethnographic work to understand the use of various mobile devices in collocated interactions (e.g. talk in pubs [19] (Figure 1) and TV watching in living rooms [20]), or the creating of novel collective experiences for individuals, with the goal to promote a broad range of collaborative activities. Examples of this include mobile devices being purposed for image curation and sharing in theme parks [3], photo capture and sharing whilst mobile [2] (Figure 2), location based mobile disaster response games [4], and comic strip curation in pubs [11] (Figure 3).

However, while existing approaches have been broad in their design and context, there remains a pressing need to understand the importance of spatial relationships between people and the digital devices in space. Adopting ideas of proxemics could allow for designers to better shape each individual's personal motivations and perceptions of their interactions with both devices and others, to better support their experiences.

Proxemic Interactions

Proxemics, as defined by anthropologist Edward Hall, is research area focused on the culturally-dependent use of space and physical measures (e.g. distance, orientation, and posture) to mediate and comprehend interpersonal interactions [7]. The knowledge of proxemics has long been employed in other disciplines such as architecture, although its use in HCI is a relatively recent addition (e.g. [5,8,17]). One particularly pertinent aspect of the theory is that of proxemic 'zones', which are essentially boundaries of people's interpretations of interpersonal distance defined as intimate (less than 1.5 feet), personal (1.5–4 feet), social (4–12 feet), and public (12–25 feet).

Greenberg et al. [6], in highlighting the importance of adopting proxemics to help realise the ubicomp vision of technologies that are indistinguishable from everyday life, state that *"[people] naturally expect increasing connectivity and interaction possibilities as they bring their devices in close proximity to one another"*. This vision drives the idea that as we move through space, the ways in which we understand and interact with our devices should change also, essentially adopting Hall's idea of proxemic zones.

Proxemic Mobile Collocated Interactions

As HCI moves towards embracing and actualising the ideas of proxemics in design [16], for example, to create proxemic-aware digital devices in living rooms [9] (see Figure 4), we are also motivated by the idea of proxemics being used to support mobile collocated interactions, to allow our devices to not only react to presence and interaction, but also other indicators, such as the interpersonal distance people naturally use in their everyday interactions.
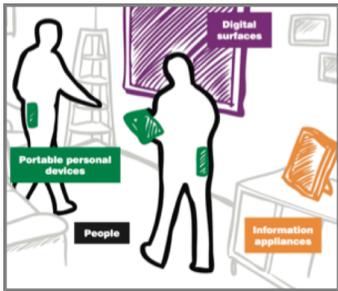
Figure 4: A proxemic ecology based in a living room with multiple interconnected devices.
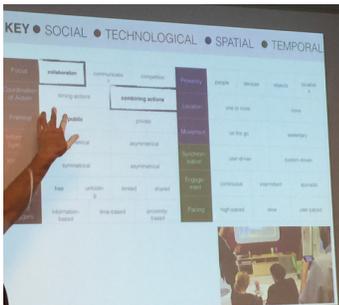

Figure 5: MobileHCI '15 workshop (morning session): Following presentations of accepted position papers, attendees worked together in small groups on tasks oriented toward acquainting themselves with the mobile experiences for collocated interactions framework [14].

In this workshop we will use a number of interactive activities, such as bodystorming, to explore ideas relating to the workshop goals to frame later tasks.

Workshop Background and Goals

Early workshops on the subject of mobile collocated interactions (e.g. at MobileHCI '11 [18]) identified a number of core related areas for research including group size, physical distance, device-binding, operating systems privacy, extending to public displays and tabletops, and conducting in-the-wild evaluations. More recent workshops, such as at CHI '15 [10], have examined the use of technology, gadgets and prototyping ideas for mobile collocated interactions. Another workshop, at MobileHCI '15 [13], focused on the body, materials, and bodily exploration with wearable devices, essentially harnessing the trend of technology to become evermore personal and closer to the body.

However, a question that, as yet, remains still unanswered through these workshops, is of how to incorporate the untapped value of proxemics in designing for face-to-face interactions with mobile devices. Whereas some previous workshops have focused on specific interactive technologies, such as interactive tables [1], smartphones, or wearable devices [10], with this workshop we wish to explore the implications of introducing a potentially more theoretical approach to mobile collocated interactions, to help promote research in the overall domain and to ground existing design practices further.

In order to answer this question, we must first better understand the implications of designing experiences that account for and mediate the intricate proxemic relationships that naturally exist between people and their personal objects. Furthermore, this means we must account for the non-uniform interactional abilities of both people and their devices, mobile or stationary

(e.g. wearable, tablet, interactive table), and the ecological implications of the space in which individuals co-inhabit and interact. The impact of such complexities involves exploring the details of how devices can sense, and act as one unified ecosystem to support the proxemic relationships people share.

Specifically, in this workshop, we will focus on pursing ideas around the curation of proxemic mobile collocated interactions, to create a deeper understanding of designing and evaluating such systems, in order to create richer and more engaging experiences. We have the following goals for the workshop:

- Identify key opportunities for including proxemic interactions in the design and implementation of mobile collocated experiences
- Investigate the ecological implications of both multi-user and multi-device interactions
- Consider the intricacies of sensing in complex environments
- Explore interaction paradigms that can be (re-)appropriated for such interactions
- Examine adequate ways of prototyping and evaluating such systems

Organisers

The workshop organisers are all active researchers in the area of mobile collocated interactions and proxemics, focusing on both novel interaction techniques and communicative elements of interaction. Collectively, the organisers have considerable experience organising workshops on related topics.

Martin Porcheron is the main contact for the workshop.

Figure 6. MobileHCI '15 workshop (afternoon, 'hands on', session): In teams, attendees used different materials consisting of fabrics, conductive fabrics, and assortments of various artefacts, to provoke thought and explore ideas around embodied and tangible interactions.

Martin Porcheron is a PhD student in the Mixed Reality Laboratory at the University of Nottingham. His work has focused on the use of mobile devices within collocated groups. His research includes examining the social implications of mobile device use and the positioning of mobile devices as resources that people can draw upon in conversations.

Andrés Lucero is an Associate Professor of Interaction Design at the University of Southern Denmark in Kolding. His recent work at Nokia focused on the design and evaluation of novel interaction techniques for mobile collocated interactions. He has recently co-organised successful workshops on 'Collaboration Meets Interactive Surfaces' at ITS '13, and two workshops examining ideas around the development and implications of wearables on mobile collocated interactions at CHI '15 and MobileHCI '15.

Professor **Aaron Quigley** is the Chair of Human Computer Interaction and deputy Head of School in Computer Science at the University of St Andrews in Scotland. He is co-founder and director of SACHI, the St Andrews Computer Human Interaction research group. His research interests include surface and multi-display computing, HCI, pervasive and ubiquitous computing and information visualisation. He has published over 150 internationally peer-reviewed publications during his time holding academic and industry appointments in Australia, Japan, USA, Germany, Ireland and the UK.

Nicolai Marquardt is a Lecturer in Physical Computing at University College London. At the UCL Interaction Centre he works on projects in the research areas of ubiquitous computing, proxemic interactions,

prototyping toolkits, and physical user interfaces. He has experience running workshops at ACM conferences.

James Clawson is a Post-Doc in the GVU Center and the School of Interactive Computing at the Georgia Institute of Technology. He is an active mobile HCI researcher, studying how collocated groups of people use mobile devices to augment their face-to-face experiences. He co-organised the first mobile collocated interactions workshop at MobileHCI '11 and successive workshops at CHI '15 and MobileHCI '15.

Kenton O'Hara works in the Human Experience and Design Group at Microsoft Research Cambridge and is also a Visiting Professor in the Computer Science Department at the University of Bristol. His research explores everyday social and collaborative practices with technology with a view to informing design and innovation. His most recent research has focused on user experiences and practices with "touchless" gestural interaction technology in a variety of areas such as surgery, urban displays and everyday desktop computing.

Website
We will use a website to promote the workshop by publishing the call for participation and submission details online. We will also use this as a way of distributing news and updates relating to the workshop, and to maintain a list of all accepted position papers.

The website for the workshop is at https://proxemicmci.wordpress.com/.

Workshop Plan

This workshop will bring together practitioners and researchers in disciplines such as interaction design, human factors, computer science, art, and HCI who are interested in exploring proxemics and mobile collocated interactions. This workshop will build upon the strengths and outcomes of previous workshops and existing research to help foster and develop future research ideas in the field.

Pre-Workshop Plan

We will set up a dedicated website for announcements, communication, related work and accepted contributions. The call for participation will be distributed in relevant academic mailing lists related to HCI and through social media. In addition, we will actively solicit submissions (via personal contacts and targeted invitations) from a broad range of researchers whose work relates to the workshop topic or who can make a significant contribution to the workshop.

Potential workshop participants should submit a 3–6 page position paper (including references) describing their interest and/or previous work related to the workshop topic. We will select papers based on: a) relevance to the workshop, b) quality of the submission, and c) the diversity of the participants. We will limit the size of the workshop to 15-20 people to ensure effective discussion in the second part of the workshop.

All selected papers will be available online on the website prior to the workshop, and participants will be required to read all accepted submissions ahead of the workshop to help ground the discussion.

Workshop Structure

The first half of the workshop (the morning) will be dedicated to introducing both proxemic interactions work and also emerging forms of mobile collocated interactions. Initially, in order to acquaint themselves, all attendees will be asked to briefly present their position paper to each other (e.g. through a form of speed dating). We will then combine the background of the workshop and attendee's submissions into an interactive session on the implications of proxemic interactions on mobile collocated interactions. This will consist of exploring different spaces within the room, bodystorming or role play between small groups of attendees.

Activities during this time will be designed in such a way to invite and encourage attendees to keep an active attitude, and to explore various different ideas. We will use this to help participants engage with theoretical areas arising from proxemics, such as spatiality and territoriality, both to encourage provocative thought and to support later activities. We will use the outcomes of these activities to prepare a list of topics for the afternoon's activities, to allow for a diverse and relevant afternoon session.

The second half of the workshop (the afternoon) will consist of group-oriented ideation and exploration of the workshop topic and ideas around it. In order to allow for flexibility and account for a desire to support ideation, the session will consist of practical activities and discussions in three small teams (attendee number dependent) to explore and generate prototypical ideas on the workshop topic. We will use activities designed to support inspiration, for example, giving roles to individuals in each team to perform or act out, to

support experimentation and reflection within teams. Each team will be provided with low-fidelity materials such as paper, Post-It® notes, and flipcharts as needed. As the organisers and attendees at the workshop will have a broad variety of backgrounds, we will use prior knowledge as a springboard during the session to help explore a variety of topics and encourage activity.

Following this ideation and exploration session, we will use the generated ideas and outcomes of the group work to stimulate an active discussion and reflection. The purpose of this will be to answer the workshop's goals, including how we could, or should, interact with future technologies, and how researchers should evaluate such concepts both from an interaction design perspective and that of HCI. This will be recorded (with consent from participants) to allow for use in a post-workshop report.

Post-Workshop Plan
The results of the workshop will be summarised and published in a report on the workshop's website. Depending on the maturity of the submissions and the outcome of the workshop, we intend to write a special journal issue with an appropriate publisher to promote this research area. All workshop participants will be invited to submit extended versions of their 3–6 page position papers following the workshop.

We are also interested in using the workshop as a venue to nurture the community and any potential future collaborations, including research and potential publications (e.g. a book), between attendees related to the workshop.

Call for Participation
Recent research on *mobile collocated interactions* has been looking at situations in which collocated users engage in collaborative activities using their mobile devices. However, existing practices fail to fully account for the culturally-dependent spatial relationships between people and their digital devices (i.e. the *proxemic* relationships). Building on the ideas of *proxemic interactions*, this workshop is motivated by the concept of 'proxemic mobile collocated interactions', to harness new or existing technologies to create engaging and interactionally relevant experiences. Such approaches would allow devices to not only react to presence and interaction, but also other indicators, such as the interpersonal distance people naturally use in everyday life. The aim of this one-day workshop is to bring together a community of researchers, designers and practitioners who are interested in exploring proxemics and mobile collocated interactions.

Workshop Goals
- Identify key opportunities for including proxemic interactions in the design and implementation of mobile collocated experiences
- Investigate the ecological implications of both multi-user and multi-device interactions
- Consider the intricacies of dealing with varied sensing in complex environments
- Explore interaction paradigms that can be (re-) appropriated for such interactions
- Examine adequate ways of prototyping and evaluating such systems

Acknowledgements

References

1. Pedro Campos, Alfredo Ferreira, and Andrés Lucero. 2013. Collaboration meets interactive surfaces: walls, tables, tablets, and phones. In *Proceedings of the 2013 ACM international conference on Interactive tabletops and surfaces* (ITS '13). ACM, 481-482. http://doi.acm.org/10.1145/2512349.2512350

2. James Clawson, Amy Voida, Nirmal Patel, and Kent Lyons. 2008. Mobiphos: a collocated-synchronous mobile photo sharing application. In *Proceedings of the 10th international conference on Human computer interaction with mobile devices and services* (MobileHCI '08). ACM, 187-195. http://doi.acm.org/10.1145/1409240.1409261

3. Abigail Durrant, Duncan Rowland, David S. Kirk, Steve Benford, Joel E. Fischer, and Derek McAuley. 2011. Automics: souvenir generating photoware for theme parks. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11). ACM, 1767-1776. http://doi.acm.org/10.1145/1978942.1979199

4. Joel E. Fischer, Wenchao Jiang, Andruid Kerne, Chris Greenhalgh, Sarvapali D. Ramchurn, Steven Reece, Nadia Pantidim and Tom Rodden. 2014. Supporting team coordination on the ground: requirements from a mixed reality game. *Proceedings of the 11th International Conference on the Design of Cooperative Systems* (COOP '14). Springer, Switzerland, 46-67. http://dx.doi.org/10.1007/978-3-319-06498-7_4

5. Saul Greenberg, Kasper Honbaek, Aaron Quigley, Harald Reiterer, and Roman Rädle. 2014. Proxemics in Human-Computer Interaction. *Dagstuhl Reports*, *3* (11), 29-57. http://dx.doi.org/10.4230/DagRep.3.11.29

6. Saul Greenberg, Nicolai Marquardt, Till Ballendat, Rob Diaz-Marino, and Miaosen Wang. 2011. Proxemic Interactions: The New Ubicomp?. *interactions* 18, 1 (January 2011), 42-50. http://doi.acm.org/10.1145/1897239.1897250

7. Edward Hall. 1963. A System for the Notation of Proxemic Behavior. In *American Anthropologist* 65 (5) (Oct. 1963), 1003–1026. http://dx.doi.org/10.1525/aa.1963.65.5.02a0002

8. Gerd Kortuem, Christian Kray, and Hans Gellersen. 2005. Sensing and visualizing spatial relations of mobile devices. In *Proceedings of the 18th annual ACM symposium on User interface software and technology* (UIST '05). ACM, 93-102. http://doi.acm.org/10.1145/1095034.1095049

9. David Ledo, Saul Greenberg, Nicolai Marquardt, and Sebastian Boring. 2015. Proxemic-Aware Controls: Designing Remote Controls for Ubiquitous Computing Ecologies. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services* (MobileHCI '15). ACM, 187-198. http://doi.acm.org/10.1145/2785830.2785871

10. Andrés Lucero, James Clawson, Kent Lyons, Joel E. Fischer, Daniel Ashbrook, and Simon Robinson. 2015. Mobile Collocated Interactions: From Smartphones to Wearables. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (CHI EA '15). ACM, 2437-2440. http://doi.acm.org/10.1145/2702613.2702649

11. Andrés Lucero, Jussi Holopainen, and Tero Jokela. 2012. MobiComics: collaborative use of mobile phones and large displays for public expression. In *Proceedings of the 14th international conference on Human-computer interaction with mobile devices and services* (MobileHCI '12). ACM, 383-392. http://doi.acm.org/10.1145/2371574.2371634

12. Andrés Lucero, Matt Jones, Tero Jokela, and Simon Robinson. 2013. Mobile collocated interactions: taking an offline break together. interactions 20, 2 (March 2013), 26-32. http://doi.acm.org/10.1145/2427076.2427083

13. Andrés Lucero, Danielle Wilde, Simon Robinson, Joel E. Fischer, James Clawson, and Oscar Tomico. 2015. Mobile Collocated Interactions With Wearables. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct* (MobileHCI '15). ACM, 1138-1141. http://doi.acm.org/10.1145/2786567.2795401

14. Sus Lundgren, Joel E. Fischer, Stuart Reeves, and Olof Torgersson. 2015. Designing Mobile Experiences for Collocated Interaction. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15). ACM, 496-507. http://doi.acm.org/10.1145/2675133.2675171

15. Paul Luff and Marina Jirotka. 1998. Interactional Resources for the Support of Collaborative Activities: Common Problems in the Design of Technologies to Support Groups and Communities. In *Community Computing and Support Systems*, Toru Ishida (Ed.). Springer, Berlin, Heidelberg, 249–266. http://dx.doi.org/10.1007/3-540-49247-X_17

16. Nicolai Marquardt, Robert Diaz-Marino, Sebastian Boring, and Saul Greenberg. 2011. The proximity toolkit: prototyping proxemic interactions in ubiquitous computing ecologies. In *Proceedings of the 24th annual ACM symposium on User interface software and technology* (UIST '11). ACM, 315-326. http://doi.acm.org/10.1145/2047196.2047238

17. Florian Mueller, Sophie Stellmach, Saul Greenberg, Andreas Dippon, Susanne Boll, Jayden Garner, Rohit Khot, Amani Naseem, and David Altimira. 2014. Proxemics play: understanding proxemics for designing digital play experiences. In *Proceedings of the 2014 conference on Designing interactive systems* (DIS '14). ACM, 533-542. http://doi.acm.org/10.1145/2598510.2598532

18. Nirmal J. Patel and James Clawson. 2011. Designing and evaluating mobile systems for collocated group use. In *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services* (MobileHCI '11). ACM, 765-768. http://doi.acm.org/10.1145/2037373.2037508

19. Martin Porcheron, Joel E. Fischer, and Sarah Sharples. 2016. Using Mobile Phones in Pub Talk. In *Proceedings of the 19th ACM Conference on Computer Supported Cooperative Work & Social Computing* (CSCW '16). http://dx.doi.org/10.1145/2818048.2820014

20. John Rooksby, Timothy E. Smith, Alistair Morrison, Mattias Rost, and Matthew Chalmers. 2015. Configuring Attention in the Multiscreen Living Room. In *ECSCW 2015: Proceedings of the 14th European Conference on Computer Supported Cooperative Work*. Springer, 243–261. http://dx.doi.org/10.1007/978-3-319-20499-4_13