Tampere University

SUSANNA PAASOVAARA

Research for Design of Playful Mobile Services for Social Experiences between Nearby Strangers

Tampere University Dissertations 901

Tampere University Dissertations 901

SUSANNA PAASOVAARA

Research for Design of Playful Mobile Services for Social Experiences between Nearby Strangers

ACADEMIC DISSERTATION
To be presented, with the permission of
the Faculty of Information Technology and Communication Sciences
of Tampere University,
for public discussion in the auditorium S2
of the Sähkötalo, Korkeakoulunkatu 3, Tampere,
on 17 November 2023, at 12 o'clock.

ACADEMIC DISSERTATION
Tampere University, Faculty of Information Technology and Communication Sciences
Finland

Responsible supervisor and Custos	Professor Thomas Olsson Tampere University Finland	
Supervisor	Professor Kaisa Väänänen Tampere University Finland	
Pre-examiners	Professor Katherine Isbister University of California, Santa Cruz United States	Professor Elena Márquez Segura Universidad Carlos III de Madrid Spain
Opponent	Professor Mark Perry Brunel University London England	

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

Cover design: Roihu Inc.

ISBN 978-952-03-3149-8 (print)
ISBN 978-952-03-3150-4 (pdf)
ISSN 2489-9860 (print)
ISSN 2490-0028 (pdf)
http://urn.fi/URN:ISBN:978-952-03-3150-4

Carbon dioxide emissions from printing Tampere University dissertations have been compensated.

PunaMusta Oy – Yliopistopaino
Joensuu 2023

ABSTRACT

Having positive interpersonal interactions is a fundamental human need and source of well-being. While fulfilling this need is usually associated with strong ties, research has shown that meaningful social experiences are not limited to those. This research explores the largely untapped social potential of nearby strangers and ways that mobile services can be designed to take advantage of these social opportunities. Play and playfulness appear to be particularly worthwhile ways to achieve this end: play is meaningful in itself (i.e., does not require an external goal) and takes place outside the context of real life. In addition, playful design tends to make digital services more engaging. This research focuses on playfulness as a design quality and explores the social implications of playful mobile services for nearby strangers.

This doctoral thesis asks two research questions: What kind of social experiences emerge between nearby strangers from the use of playful mobile services? How can playful mobile services be designed to encourage social experiences between nearby strangers? The research contributes to the field of human-computer interaction and provides insights into mobile service design through six research articles. Two of the studies charted expected experiences with early-stage mobile application concepts for playful interaction between nearby strangers. One of these concepts was further developed into a fully functional mobile application, and a large-scale, in-the-wild study was arranged to explore the actual social experiences it generated. Two of the studies investigated social experiences between nearby strangers in the context of commercial mobile games. The sixth study explored the design space of playful interactions between nearby strangers through co-design workshops.

The playful mobile services investigated in this research were found to induce various behaviors that resulted in social experiences between nearby strangers. Examples of such behaviors are the active exploration of the outside world, community building, communicating and collaborating with strangers, and interacting in crowds. I found that playful and social experiences such as competition, surprise, curiosity, inspiration, and benevolence motivated individuals to use these services.

PREFACE

"Every shared smile creates a connection" -aphorism in Happy Joe cider bottle cap.

Working towards this doctoral dissertation started in 2014, when I got a researcher position Tampere University of Technology in Device-to-Device research project. I had a pleasure of combining two of my personal interests as my research topic, social interaction between nearby strangers and playful designs. Being a stereotypically introverted Finn, starting to interact with strangers has always had a high threshold for me, but once I get started, I am likely to make friends for life.

I want to thank my supervisors Thomas Olsson and Kaisa Väänänen for first providing me the possibility to make my mark on research, then letting me take my take to finalize this thesis and supporting me whenever I needed it. I am not sure if they believed this day would come, but they never let it show, instead they were always there when I was ready to proceed even a small step. If there weren't my debt for their efforts, this thesis would never have been finished.

I want to sincerely thank my pre-examiners Katherine Isbister and Elena Márquez Segura. The provided feedback allowed me to truly see the value of my work to the whole research community and strengthen my message.

I am grateful for having been funded from two Academy of Finland projects D2D and COBWEB during the first years of my research. This allowed me to complete my studies and much of the thesis writing. I am grateful to Nokia Foundation who provided me with a personal grant that allowed me to devote some additional time for my dissertation.

One does not survive in research without collaboration. I am highly grateful to the following people for doing research and co-authoring publications with me. My first supervisor Thomas Olsson collaborated with me on each of the included publications. Every read-through and iteration of text he made clarified our shared

message. My second supervisor Kaisa Väänänen collaborated with me only on one of the included publications, but I have had the privilege of fruitful co-authoring with her on other publications. Andrés Lucero is an expert on playful design and co-design methods. I am grateful that he invited me on a research visit to SDU (University of Southern Denmark), introduced me into co-design and collaborated with me on one of the included publications. Pradthana Jarusriboonchai was at the time of my research a fellow doctoral student who worked on very similar topics as me. We shared an office, collaborated on three of the included publications and became friends for life once the initial phase of being nearby strangers was over. Ekaterina Karjalainen née Olshannikova, has been beside me as a colleague, a fellow doctoral student and a dear friend ever since 2014. I am happy to have collaborated with her on three of the included publications and for us pushing each other these last steps to defend within a month of each other. My work on Next2You would not have been possible without Aris Malapaschas, who implemented the service and co-authored two of the publications. Jiri Hošek and Pavel Mašek collaborated on arranging Next2You user studies in Czech Republic and co-authored a publication.

My HCI research career started several years before my official doctoral research. From the first moments of learning about HCI in 2001 it was clear to me that my career will somehow be related to human users of computers. I want to thank Jonna Häkkilä for providing me my first UX researcher position in her research group in Nokia Research Center in 2007, thus sparking this whole journey, and Aino Ahtinen for leading my first efforts in the field. Aino has been my inspiration and companion on this quest for doctoral degree over the years. Several colleagues both in NRC and Tampere university positively affected my research career, serving as inspiration and/or companion: Merja Haveri, Arto Puikkonen, Pertti Huuskonen, Marion Boberg, Petri Saarinen, Jukka Holm, Laura Hokkanen, Heli Väätäjä, Jari Varsaluoma, Jarno Ojala, Kati Kuusinen, Elina Hildén, Eeva Andrejeff, Otto Kauhanen, and Chelsea Kelling. A special thanks goes to Ulla Björninen, a colleague who has had a greater impact in my possibilities to finish this thesis than I can put into words.

Spending quite many years either stressing about writing or actually writing, is a big burden for oneself and the loved ones. My biggest thanks go to my husband Arto. He believed in me and supported me in pursuing my career goals, such as completing this thesis and taking a three-month research visit to Denmark. He carried a great

deal of everyday chores as well as took our kids on adventures to provide me possibilities to proceed with the thesis. Without him this would not have been possible! For my two sons Entti and Altti, I want to express my love and regret for being absent so much either physically or mentally over the years. I do not feel too bad as I know there was always someone around instead of me. I am grateful to my mother Sirja for supporting my family. Besides being there for my husband and kids, she supported my writing and believed in me during this process. I am furthermore grateful to my father Esko who has also been an important asset especially during holiday times, taking time to entertain the kids and otherwise supporting my pursues. I am grateful for Luba supporting this. My sister Isa, Jani, Veeti and Sofia have formed a super-family together with my family, which has ensured there is always support and companionship nearby. Beyond this immediate social circle, I want to thank the following people: Merja Jokinen and Tapani Kivelä for making university level studies a baseline career choice. Niina Simone, Paula Lahenius, Kaisa Railomäki, Päivi Harju, Eija Seppälä, Riitta Ilvonen, Anna-Mari Tauriainen, Minna Tauriainen and Tiina Tauriainen for at a point in history making it possible for the introvert me to have social interaction primarily between nearby friends.

CONTENTS

List of Figures

List of Tables

LIST OF PUBLICATIONS

This doctoral thesis includes six original publications that are listed below. The contributions of the candidate are described after the reference details of each publication. The publications, reproduced with the kind permission of the publishers, can be found in the end of this thesis.

P1. **Susanna Paasovaara**, Ekaterina Olshannikova, and Thomas Olsson. 2015. Collaborative Video Challenges: A Playful Concept of Proximity-Based Social Interaction. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15). ACM, New York, NY, USA, 1923-1928.

Paasovaara designed the concept and planned the study in collaboration with Olshannikova and Olsson. She had the main responsibility of the data analysis and producing the publication.

P2. **Susanna Paasovaara** and Thomas Olsson. 2016. Proximity-Based Automatic Exchange of Data in Mobile Gaming: Studying the Experiences of StreetPass Users. In Proceedings of the 9th Nordic Conference on Human-Computer Interaction (NordiCHI '16). ACM, New York, NY, USA, Article 26, 10 pages.

Paasovaara had the main responsibility of planning the study, data analysis and producing the publication.

P3. **Susanna Paasovaara**, Ekaterina Olshannikova, Pradthana Jarusriboonchai, Aris Malapaschas, and Thomas Olsson. 2016. Next2You: a proximity-based social application aiming to encourage interaction between near-by people. In Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia (MUM '16). ACM, New York, NY, USA, 81-90.

Paasovaara shared the responsibility of designing the concept with others, shared main responsibility of data analysis with Olshannikova, and had the main responsibility for planning the study and producing the publication.

P4. **Paasovaara, S**., Väänänen, K., Malapaschas, A., Olshannikova, E., Olsson, T., Jarusriboonchai, P., Hošek, J. and Mašek, P., 2018, September. Playfulness and progression in technology-enhanced social experiences between nearby strangers. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction (pp. 537-548), ACM, New York, NY, USA.

Paasovaara had the main responsibility of planning the study, data analysis and producing the publication.

P5. **Susanna Paasovaara**, Andrés Lucero, and Thomas Olsson. 2016. Outlining the design space of playful interactions between nearby strangers. In Proceedings of the 20th International Academic Mindtrek Conference (AcademicMindtrek '16). ACM, New York, NY, USA, 216-225.

Paasovaara shared the main responsibility of planning the study, data analysis with Lucero, and had the main responsibility for producing the publication.

P6. **Susanna Paasovaara**, Pradthana Jarusriboonchai, and Thomas Olsson. 2017. Understanding collocated social interaction between Pokémon GO players. In Proceedings of the 16th International Conference on Mobile and Ubiquitous Multimedia (MUM '17). ACM, New York, NY, USA, 151-163.

Paasovaara shared the main responsibility of planning the study, data analysis and producing the publication with Jarusriboonchai.

1 INTRODUCTION

This chapter introduces the background and motivation for this research, as well as the research questions and scope of the research. In addition, it outlines the results and contributions of the thesis.

1.1 Background and Motivation

The broad research problem that this thesis addresses is the use of information technology to create positive social experiences between nearby strangers. The topic is controversial as people need social interaction but tend to avoid it with nearby strangers. Belonging to a social group is a basic need for humans (Baumeister & Leary, 1995; Maslow, 1943). Even minimal social interaction with others can lead to a feeling of belonging (Sandstrom & Dunn, 2014). Nearby strangers have underutilized potential to supply social experiences. Yet people have created mechanisms to shield themselves against social interaction with others in urban environments, such as averting their gaze when approaching others to signal unwillingness to engage in social interactions (Goffman, 2008) and using personal media technologies to avoid such interactions and block contact with the world around them (Ito et al., 2017). The tendency to avoid social interaction with strangers has cultural differences, so this may not be true for every culture.

Modern connectivity technologies provide possibilities for technology-mediated social interactions between nearby strangers. Mayer et al. (2015) identified factors that affect mobile social matching. These include social and personal context, such as the sociability and familiarity of a place, involvement in other activities, and mood. There is little knowledge of whether opportune contexts and positive outcomes are the same for technology-mediated social interaction and face-to-face interactions.

Play and playfulness have qualities that make it worthwhile to study whether playful designs could remove the natural obstacles to interactions between nearby strangers and keep users of services for nearby strangers engaged. Play is social activity that is

meaningful, even though it does not have an external goal (Csikszentmihalyi, 2000; Huizinga, 2020; Sutton-Smith, 1997; Tekinbas & Zimmerman, 2003)such as making new friends. Play takes place in a magic circle—a time and place that exists outside of daily life (Huizinga, 2020; Tekinbas & Zimmerman, 2003), i.e., it transcends traditional definitions of context. Playful design makes products and services more engaging (Costello & Edmonds, 2007; Korhonen et al., 2009).

Mobile technologies allow human-computer interaction (HCI) researchers to envision and research new ways of creating social experiences between nearby strangers. Integration of local area connectivity and positioning technologies such as Bluetooth, WLAN, and GPS into mobile devices have inspired research projects implementing social services for nearby strangers (Jung & Blom, 2006; Mcgookin et al., 2014; Persson et al., 2005; Seeburger & Tjondronegoro, 2012; Väänänen-Vainio-Mattila, Saarinen, et al., 2010). Even though scholars have reported on playful experiences, they have not focused on understanding the role of playfulness and designing for it.

This research addresses the research gaps in the understanding and design of social experiences between nearby strangers. What kinds of experiences do playful mobile services elicit? How can mobile services be designed to encourage positive social experiences between nearby strangers through playfulness?

This research was conducted by a Finnish scholar who (originally) fit the stereotype of an introverted Finn who found it challenging to socialize with nearby strangers. To broaden the cultural viewpoint, two of the studies were conducted in Finland but included immigrants as well as Finns as participants. Of the other four studies, one had participants in both the Czech Republic and Finland, another was conducted in Denmark during a research visit, and two were online surveys that included participants from various countries.

1.2 Research Scope and Aims

This research belongs to the field of HCI. The study of HCI typically involves applied research and exists at the intersection of many other fields. HCI research produces distinctive types of knowledge, and the requirements for generalizability

differ from those in other fields. This work follows the conceptualization of Oulasvirta and Hornbaeck (2016) who define HCI as problem-solving to advance our capacity to solve important problems in the human use of computing. To explain the term *problem*, they further define research problems in HCI as a lack of understanding about some phenomenon in the human use of computing or an inability to construct interactive technology to address that phenomenon for desired ends. The importance of solving a problem is measured by its relevance not only to end users but also to other stakeholders: researchers and practitioners.

Another theoretical foundation of this work is Höök and Löwgren's (2012) differentiation between three levels of knowledge: theories, intermediate-level knowledge, and instance-level knowledge in interaction design research. Instance-level knowledge relates to individual cases and interfaces, intermediate-level knowledge is more abstract, and theories have general applicability. Höök and Löwgren consider that design-oriented research practices create opportunities to construct knowledge that is more abstract than instance-based knowledge but is not as generalizable as a theory.

Working from these theoretical foundations, I combine empirical and constructive approaches to advance the capacity of designers and researchers to design and advance the research on playful mobile services for social experiences between nearby strangers. This research will gather instance-level knowledge from constructive design research efforts as well as empirical research on existing commercial services. The knowledge will be abstracted the beyond the instance-level to answer the following two research questions.

RQ1: What kind of social experiences emerge between nearby strangers from the use of playful mobile services? This question addresses the lack of understanding about the social experiences that emerge between nearby strangers who are using playful mobile services. The results describe the experiential qualities of the services studied and the behavioral patterns they generate.

RQ2: How can playful mobile services be designed to encourage social experiences between nearby strangers? This question charts the design space and design considerations for future playful mobile services aimed at encouraging social experiences between nearby strangers.

1.3 Results and Contribution

Wobbrock and Kientz (2016) list seven different types of research contributions in HCI research: empirical research contributions, artifact contributions, methodological contributions, theoretical contributions, dataset contributions, survey contributions, and opinion contributions. In Ways on Knowing in HCI (Olson & Kellogg, 2014), practical contributions, such as design guidelines, are mentioned as one contribution type.

This doctoral research aimed to produce knowledge for researchers and designers of playful mobile services that encourage social experiences between nearby strangers. The research consisted of six separate studies that contributed to answering the research questions. All studies are reported as individual, peer-reviewed, accepted publications that make individual contributions to HCI research and as such are significant elements of this compilation dissertation. The individual studies contribute empirical research and the designs that are included can be viewed as artifact contributions.

The introductory chapters abstract the findings from individual studies to develop intermediate-level knowledge that answers the research questions. The results for RQ1 are organized into two categories: 1) behavioral patterns elicited by playful mobile services for nearby strangers and 2) emotional responses to playful mobile services for nearby strangers. The social behavioral patterns we identified included active exploration of the outside world, community building, communicating and collaborating with strangers, and interacting in crowds. The socially oriented emotional responses included competition, surprise, curiosity, inspiration, and benevolence.

The results for RQ2 are presented as a design space of social experiences between nearby strangers and design considerations for playful mobile services for social experiences between nearby strangers. The design space is presented in terms of levels of interaction, roles of systems, and places of playfulness in services for social experiences between nearby strangers. The design considerations I discuss are designing for engagement with the service, supporting different social contexts, and designing to create a positive atmosphere. Five of the publications (P1, P2, P3, P4 and P6) contribute to answering RQ1. All publications contribute to answering RQ2.

2 CONCEPTUAL FRAMEWORK

This chapter outlines the key terminology used in this doctoral thesis and then explains the conceptual premises of social experiences with nearby strangers and playfulness as a design quality.

2.1 Terminology

In the context of this thesis, the term *mobile services* encompasses mobile and wearable personal devices, applications running on them, features of the applications, enabling technologies, and larger systems comprising such elements. Several alternatives were considered for the term *services*, such as *technologies*, *concepts*, and *applications*. The publications discussed here mostly use the term *technology*, but that term seemed to best apply to enabling technologies. In contrast, *applications* would refer chiefly to the current generation of mobile apps and as such be too narrow to describe the wider scope of this work. The term *concepts* was rejected because, in the field of design, it refers to early and unfinished work. Some of this research included concept-level designs, but most of it treats fully functional and even commercial services. Given the current tendency to use the phrase *service design* in the design methodology of digital services, finding a way to combine the words *designing* and *services* in the thesis title, without intending to discuss service design as such, was not easy either.

Social experiences are defined in this work as people's actions and behaviors that relate to others, including but not restricted to interactions with others, as well as emotional responses to these behaviors and actions. I was interested in understanding what takes place inside and outside playful mobile services when they are used by nearby strangers and how users feel about what occurs. I could have used the term *social interaction*, but restricting the scope of the research to cover only predefined forms of social interaction would limit the picture. The use of the word *experiences* allowed me to look not only at social feelings but also at the full range of emotional responses. Emotional experiences are divided into two dimensions that have positive and negative valences (Watson & Clark, 1994). This research is interested in both positive

and negative social experiences between nearby strangers that result from the use of playful mobile services. It should be possible to differentiate desirable designs and experience goals from those that are meaningless and negative.

There are several close-by definitions to *social experiences*, but they do not fully capture the scope of this research. *User experience* is defined in the ISO standard as "A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service" (ISO 9241-210, 2010). There the focus is on the relationship between the user and the product. Väänänen et al. (2010) define *social user experience* as the user experience of online social activity—that is, how social functionality is experienced by the service users. Even if this definition were extended beyond online social activities, it is still about the relationship between the user and the service. *Co-experience*, as defined by Battarbee and Koskinen (2005), instead addresses the fact that an individual's experience of a product changes as the experience is lifted to focus, reciprocated, rejected, and/or ignored in interaction with others. Ojala's (2017) definition of *social user experience for content-mediated interaction* includes other users as the social context, audience, and content enrichers for the user. Stepanova et al. (2022) discuss *mediated genuine feeling of connection* as something that everyone intuitively understands but finds difficult to define in words. They approach a definition through practice-based knowledge embedded in exemplary systems for creating this feeling, the use of such systems in our daily lives, and the ongoing process of reinterpreting what they mean in terms of theory.

Nearby people, in the context of this work, refers to people who are momentarily near enough to each other that they could easily meet face-to-face. This could mean, for example, a distance of a few hundred meters. The operational ranges of mobile technologies for detecting who is nearby limit the definition of nearby in different ways. Bluetooth can detect users up to approximately 30 m away, and Wi-Fi can detect them up to approximately 100 m away. When GPS positioning is employed, the system can freely decide what is considered nearby. The term *collocated* has a very similar meaning. It can refer to people in close proximity who share the same space (Goffman, 2008), or those near enough to participate in technology-mediated interactions (Olsson et al., 2020).

Strangers refers here not only to people who do not know each other in any way yet but also, from a technological perspective, to people who have not established a formal connection (e.g., a friendship) inside the system. *Familiar strangers* is a term

that refers to people we repeatedly encounter in our daily lives and recognize by face but with whom we never interact (Milgram, 1977). *Strong ties* refers to the opposite: people such as friends, relatives, colleagues, and hobby buddies who we know in real life or are closely connected to online. The term, introduced by Granovetter (1973), denotes two-way connections who invest time, emotional intensity, intimacy, and reciprocal services in each other. His classification includes two other categories: *weak ties* and *absent ties*. Absent ties belong to the *strangers* category. The categorization of weak ties is less clear but irrelevant to this research. A major difference between designing for strong ties and designing for strangers is that some natural willingness to interact can be assumed between people with strong ties. When this work uses the word *between*, it mostly refers to one-to-one connections between two people, as opposed to *among*, which would refer to interactions within a group of people.

2.2 Social Experiences with Nearby Strangers

Social connections are widely recognized as essential for humans. In his famous model, Maslow (1943) lists love and belonging to a social group as basic human needs. Likewise, Baumeister and Leary (1995) conclude after an extensive review that humans have a strong desire to form and maintain positive long-term connections. Maslow and Baumeister and Leary found that people greatly value social connections with those to whom they have strong ties, but later research has shown that strangers, too, can provide feelings of belonging. Research by Sandstrom and Dunn (2014) indicates that even minimal social interactions such as smiles, eye contact, and small talk in customer service situations can generate a sense of belonging. Epley and Schroeder's (2014) research suggests that people could improve their momentary well-being and that of others by being more social with strangers.

Many behavioral norms hinder interaction with nearby strangers, so people tend to keep their distance. Close contact is reserved for intimate interactions and familiar people (Hall, 1963). In crowded urban environments, people make use of certain behaviors to limit interactions with others. *Civil inattention* refers to how strangers approaching each other may first exchange a look and then look away to signal that they are not a threat and have no intention of interacting with the other (Goffman, 2008). Cocooning refers to using mobile media and devices to create a shelter from engagement with co-present others: a private place within the urban space (Ito et al., 2017).

When and how people are willing to interact with nearby strangers varies. For example, exceptional situations and meetings that take place outside of a usual context may provoke interactions between *familiar strangers*—people who encounter each other repeatedly in their daily lives but choose to mutually ignore each other (Milgram, 1977). Work on social matching (Mayer et al., 2015) has identified several social and contextual factors that affect whether someone is interested in meeting new people, including the sociability and familiarity of a place, involvement in other activities, and mood.

Research and commercial efforts have proposed many services for technology-mediated interaction in collocated settings. Some of these services target nearby strangers. However, the evaluations of such services have rarely focused on understanding their social effects (Olsson et al., 2020). Stepanova et al. (2022) discuss strategies for fostering a genuine feeling of connection in technology-mediated systems. Their review of exemplary systems covers many types of connections, from online to collocated and from intimate to those between strangers. Play was one of the nine identified strategies.

To conclude, both face-to-face and technology-mediated interactions between nearby strangers have the potential to make people feel connected.

2.3 Play and Playfulness

This section introduces the concepts of play and playfulness. It explains why play offers an interesting perspective on social experiences between nearby strangers. It discusses why HCI research has been interested in playfulness and introduces the playful experiences (PLEX) framework. In addition, this section briefly explains why this research focuses on playfulness rather than gamification, which is similar to playfulness in many ways.

Play is a basic human activity (Huizinga, 2020) that is born from vital energy not needed for satisfying immediate needs (Caillois, 2001). Play takes many forms. Caillois makes a distinction between free play and rules play. Tekinbas and Zimmerman (2003) define three categories of play: gameplay, ludic activities, and being playful; where being playful includes the other two. The autotelic nature of play—that is, the fact that play is meaningful in itself and does not require an external

goal—is discussed by many scholars (Csikszentmihalyi, 2000; Huizinga, 2020; Sutton-Smith, 1997; Tekinbas & Zimmerman, 2003).

This means that we do not have to make a strict distinction between games and ludic play as being playful includes them both. The autotelic nature of play means that it does not need any pragmatic goals, such as establishing new social connections, to be worth doing. Thus, play could suit the social and temporal context of nearby strangers. Even brief social encounters framed in play may be valuable.

Playing takes place in so-called magic circle—a time and place outside real life (Huizinga, 2020; Tekinbas & Zimmerman, 2003). Players know that the circumstances of the game are not real. The activities in play are re-signified—that is, the meaning of an action in play differs from its meaning outside of play (Bateson, 2006). By entering play, it would be possible, at least in theory, to cross the boundaries of behavioral norms between nearby strangers, as long as both parties are engaged in play and understand the meaning of the activities in the same way.

Games are rule-based forms of play that are further characterized by artificial conflict and quantifiable outcomes (Tekinbas & Zimmerman, 2003). Rules make games repeatable (Huizinga, 2020). Waern (2012) states that rules give meaning to activities that might be meaningless otherwise. She specifies that rules should be explicit but can be negotiated and re-negotiated during a session of play. Playing has also a layer of unwritten, implicit rules that compose the social code that is expected to be followed during play (Tekinbas & Zimmerman, 2003).

From these definitions, we can see that play includes games, but playing can be meaningful without rules and goals as well. Mobile services could potentially set rules for interactions with nearby strangers to remove the need for negotiating the rules and make initiating play with a stranger effortless. Examining play broadly rather than games specifically make sense because a meaningful experience is possible without a conflict and a quantifiable outcome. Forms of play other than games may be better suited for social contexts that do not offer the possibility of engaging in deep and lengthy interactions.

Play and games have strong social aspects, even though it is possible to play alone. Among children developing their playing skills, many forms of social play have been observed (Parten, 1932). They may play their on their own side by side, interact

without full synchronism, play co-operatively in groups, or observe the play of others with or without interacting with the players (ibid.). Stenros et al (2009) discuss various forms of social play and the sociability that exists around games. They note that even single-player gaming has social aspects as play can be, for example, a performance for co-present others or a competition against others whose scores are recorded on lists, and gaming knowledge can be used in other contexts. In multiplayer games, players can form competitive, collaborative, or cooperative relationships. When these multiplayer games are massive, sociability and social play may include online communication and community building. However, the vast number of players can decrease the importance of individual players, even if participants still feel a sense of co-presence (ibid.) The social nature of play and the many roles it allows suggest that play could create social experiences between nearby strangers.

HCI research, particularly user experience research, has been exploring the concept of playfulness as a design quality for some time. Playful design has been seen as a way to create pleasurable, attractive, and engaging products (Costello & Edmonds, 2007; Korhonen et al., 2009). Pleasure forms an important layer on top of functionality and usability in the hierarchy of consumer needs (Jordan, 2000).

The concept of playfulness builds on the concept of play. Korhonen et al (2009) define playfulness as approaching activities with the same attitude that one would take in play—treating them casually and anticipating no real-world consequences. Heljakka (2013), a researcher of adult toy play, found that adult play can be both a state of mind and an activity, in which playfulness may result in play but may not equal play.

Playfulness is not a single experience but rather a wide range of experiences provoked by playing and gaming. Building on earlier work by Costello and Edmonds (2007), Korhonen et al defined 20 categories of playful experiences (2009). The PLEX framework was later appended to 22 categories, such as challenge, fantasy, and thrill (Arrasvuori, Boberg, et al., 2010). Costello and Edmunds' framework includes only pleasurable experiences, whereas the PLEX framework also incorporates negative playful experiences such as suffering and cruelty. Nine of the 22 experience categories in the latter have a strong social aspect: sympathy, nurture, eroticism, submission, fellowship, subversion, competition, expression, and cruelty (Lucero et al., 2014). The PLEX framework helps in the setting of design targets in

the experience-driven design of personal products (Arrasvuori, Korhonen, et al., 2010).

The concept of playfulness contains further complexities. Korhonen et al (2009) found personal differences in what people find pleasurable and fun. In game studies, these different motivations to play are often defined as player types. Hamari and Tuunanen (2014) summarized research on player types and found that there are five main motivations for play: achievement, exploration, sociability, domination, and immersion.

Gamification has been defined as the use of game elements in non-game contexts (Deterding et al., 2011). It can have desirable psychological and behavioral outcomes (Hamari et al., 2014). This research has a connection to gamification—I have looked at why people are not interacting with nearby strangers and how playful mobile services can be designed to change that. But I investigated playful designs, which include but are not restricted to game elements, in a context of social experiences between nearby strangers, which is a non-game context. Also, there is another reason why gamification did not feel like a proper term to describe this research. There is not yet enough information on the kinds of psychological and behavioral outcomes that would be desirable in the context of nearby strangers. This research will be able to guide future work on gamification by providing insight into suitable outcomes.

3 OVERVIEW OF EARLIER RESEARCH ON DESIGNING SOCIAL EXPERIENCES FOR NEARBY STRANGERS

This chapter presents an overview of HCI research that relates to designing social experiences for nearby strangers. Most of the included research are related to technological artifacts that are designed specifically for research purposes, but some looks also into commercial services. This chapter concludes by highlighting the research gap on designing playful mobile services for social experiences between nearby strangers motivating this research.

The topic of designing social experiences for nearby strangers overlaps with research on technologies for enhancing collocated social interaction. Such research covers both strong ties and strangers, including supporting existing relationships and interactions in addition to creating new social experiences between strangers. An extensive literature review by my colleagues and I found that majority of research prototypes for enhancing collocated social interaction have been evaluated with users, but only rarely the focus of the evaluation has been on the social effects of the prototype (Olsson et al., 2020).

This overview covers several veins of research that are relevant to the topic. The focus is on mobile services including the sub-categories of proximity-based services, proximity-based games, wearables, location-based services, and location-based games. Interactive installations are discussed as another topic because they have been found to induce social experiences between nearby strangers. Where possible, the included research evaluated, reported and/or discussed the social potential of, user experiences or user behavior with such technology. Some example concepts and prototypes without significant insights on the social experiences are nevertheless included to depict the existing design space.

My original publications list related work that was familiar to me at the time of writing them. This overview includes also older and contemporary work that were

discovered only at a later phase when writing this thesis, as well as work that were published after my last publication.

3.1 Mobile Services for Nearby People

Mobile services for nearby people allow interactions to happen wherever the users reside compared to fixed installations, which will be discussed later in this overview. Research efforts on designing mobile technology for social experiences between nearby people stretch back two decades. The focus of this review is on work that was published before and around the research for this thesis was conducted in 2014-2016 but tries to capture the most notable more recent publications relevant to this topic as well.

This review covers five subtopics: proximity-based social services, proximity-based games, wearables, location-based services, and location-based games. The interest of HCI research follows often novel technologies. This can also be seen in research related to mobile services for nearby people. The interest in proximity-based technologies shifted to location-based technologies in both services and games. The interest in mobile services has been replaced by focus on wearables. In wearables research there is further shift from wearable displays to playful wearables of various form factors, and to brain-to-brain interfaces.

Most of the found research has constructive design research approach, and the reported findings stay at the level of specific instances. Abstracting beyond instances to produce intermediate-level knowledge or theories has been rare but growing in recent years. Lundgren et al. (2015) developed a design framework to guide design of mobile interactive systems that support, enable or augment face-to-face group interactions in collocated settings. The framework includes four perspectives (social, technological, spatial, and temporal) to be considered in the design, and several properties to each perspective. The framework guides the designer for example to think about what the users do together (collaborate, compete, communicate); does everyone have access to same information and same interaction abilities; and how does the pacing and engagement required by the activity afford for social interaction. While their framework might provide value when designing for nearby strangers, this aspect is not discussed at all. More recently Dagan et al. (2019) defined a design framework for social wearables, and Buruk et al. (2019) synthesized the current

design space around wearables for play. Mitchell and Olsson (2019) draw inspiration from art installation, but generalize design patterns that may be relevant for facilitating the first move between nearby strangers with mobile technologies as well.

3.1.1 Proximity-Based Social Services

Proximity-Based Social Services detect nearby users with help of short-range wireless radios (e.g., Bluetooth and WiFi) of mobile devices, and may use the wireless radio to transfer data directly between devices instead of using internet connection. The device may automatically perform scans of nearby others periodically or it may be up to the user to start the scan. As an alternative approach to detecting nearby users, GPS locations can be used to infer the distance between users.

I will first introduce the design of most notable studied services shortly and then summarize the findings relevant to the topic of this thesis.

Hummingbird (Holmquist et al., 1999) supported awareness of nearby group members by making humming sound while others were discovered within its operation range. *LoveBomb* (Hansson & Skog, 2001) was a concept for emotional communication between nearby strangers. Users could broadcast their emotion (happy or sad), and each device would provide tactile feedback aggregated from emotions of nearby others. *HocMan* (Esbjörnsson et al., 2003) was a social application for stranger motorbikers. Upon encounter, it played a sound and exchanged personal information, including information about their bikes, to be browsed after the trip. *Jabberwockie*s (Paulos & Goodman, 2004) logged similar nearby devices and lit LEDs based on how many familiar strangers were or had been nearby in order to provide social comfort in urban public places. *Serendipity* (Eagle & Pentland, 2005) combined Bluetooth discovery and a centralized server for social matching of profile information and alerting users of found match. *Scent* (Jung & Blom, 2006) was a social application that allowed sharing self-created profile over Bluetooth connection with nearby users as well as communicating with them. Sharing was done by scanning the environment for nearby users and requesting data from them. Scent performed social matching based on users' phonebook entries, i.e. showed the shared contacts of the users. Users could either chat with nearby users or comment their profiles. *DigiDress* (Persson et al., 2005) was a follow-up project to Scent. Users could either actively or automatically scan the environment for nearby users and view

the found profiles in detail. Similar to Scent, DigiDress provided two modes of communication, chatting and commenting profiles. *tunA* (Bassoli et al., 2006) users could connect to a nearby mobile device to listen to the music the other user was listening. TunA listed nearby users and the song they were playing at that moment. *Push!Music* (Håkansson et al., 2007; Hakansson et al., 2007) allowed user to explicitly push songs to nearby other's play lists. The application itself could push songs autonomously to nearby users, when it found songs that would fit the target user's song collection. The application would show a list of nearby usernames. *Capital Music* (Seeburger & Tjondronegoro, 2012)shared information about what music nearby others were listening and allowed commenting their songs. Lee et al. (Lee et al., 2008) implemented a social proximity application for sharing photos over Bluetooth connection to nearby strangers. *TWIN* (Väänänen-Vainio-Mattila, Saarinen, et al., 2010) featured profile and file sharing, searching for files on nearby devices, public and private communication, automatic notifications of nearby friends, and viewing nearby users through a radar-like visualization. It operated over multi-hop data transfer between devices independently of any online server.

The featured research efforts on proximity-based services are already old. They mostly precede the worldwide spread and adoption of smartphones, mobile social media, and mobile games. Furthermore, many of the evaluations are early stage and small scale. This means that actual findings on social experiences between nearby strangers using proximity-based mobile services are few, vague and speculative. Given their age, they may be of limited applicability for today's world.

There are more recent publications on proximity-based services, for example on application concept *Talk2Me* (Shu et al., 2018) that combines device-to-device communication as well as augmented reality and face recognition with camera-enabled wearable glasses; and a system description of *MuLink* (Sou et al., 2019), a service for retrieving music tastes of nearby users and streaming according to it. Research on *Talk2Me* features a user study of 5-10 minutes of use followed by four questions about the acceptance of such technology. Proximity-based services, based both on Bluetooth and GPS, were also very much of interest during COVID-19 pandemic, when these technologies were used for tracing the contacts of infected people (Dar et al., 2020). These publications do not however offer relevant findings for the viewpoint of my research. Research on wearables, which will be covered later, includes proximity-based features as well (e.g (Chen & Abouzied, 2016; Epp et al., 2022)), however the latter publication mentions that due to staging events for

participants to encounter and incentivising trading between participants findings on proximity feature are scarce.

The featured studies include three large-scale in-the-wild studies (Jung & Blom, 2006; Persson et al., 2005; Väänänen-Vainio-Mattila, Saarinen, et al., 2010), while others were evaluated shortly and/or with a small number of participants. Some of the explained research efforts are pre-studies to inform the design, but the prototype evaluation is non-existent or small scale (Bassoli et al., 2006; Paulos & Goodman, 2004). The reported results often include participants' or researchers' speculations of potential use for the service rather than report actual behavior with the service (Eagle & Pentland, 2005; Hansson & Skog, 2001; Kostakos et al., 2006). The reports of large-scale in-the-wild studies do not describe user behavior in much detail either. More than one fifth of TWIN participants reported to have got at least one new friend because of using it, but details on how the application contributed to this are not reported (Väänänen-Vainio-Mattila, Saarinen, et al., 2010).

Play, curiosity and entertainment purposes are present in the reported experiences even without added gamification in the application design. Push!Music users would push humorous songs as pranks to their friends, tried to game the system to push certain songs automatically, and found the automatic pushing of songs a fun and magical aspect of the experience. Participants found it exciting to monitor automatic sharing in group setting, to whom a song will transfer. (Håkansson et al., 2007) Hocman (Esbjörnsson et al., 2003) and CapitalMusic (Seeburger & Tjondronegoro, 2012) users were curious about encountered users. DigiDress (Persson et al., 2005) study reported some users making funny profiles. Lee reports that users tried to find locations that were sent to them as photos from nearby. This could be seen as an ad hoc hide and seek play (Lee et al., 2008). Participants reported using TWIN more for entertainment than for practical purposes (Väänänen-Vainio-Mattila, Saarinen, et al., 2010).

When looking at social experiences with the featured services, several cases show how interaction among strong ties is in the center of the use, and interaction between nearby strangers grows as a side-track to this (Håkansson et al., 2007; Lee et al., 2008; Persson et al., 2005). The delicate nature of interactions between nearby strangers is revealed by the finding that automatic (rather than explicit) pushing of songs to strangers felt less intrusive from the perspective of the sharer. Songs were explicitly

pushed to strangers to let them know that another user was around (Håkansson et al., 2007).

Benevolent motivations were apparent in Push!Music use. Explicit sharing was based on two motivations, sharing a song they liked themselves, and sharing a song they thought the other one would like. New received songs in Push!Music were appreciated as surprise gifts. Some valued songs that were personally selected by other user, while others valued songs despite the origin if the song was good. Sharing created repeated interactions as participants would reciprocate. (Håkansson et al., 2007)

Awareness of nearby others is a recurrent theme in the featured research. The focus group participants evaluating LoveBomb discussed how such application could affect the aura of public places (Hansson & Skog, 2001). The design of Jabbewockies focuses strongly on providing feeling of social comfort, a need that emerged from the conducted preliminary user research (Paulos & Goodman, 2004). The findings on Hummingbird described how the user's social experiences change according to otherwise invisible social context. When the device didn't inform about nearby friends, users would mingle among strangers. When nearby group members were detected around, it provided an instant feeling of not being alone, and made users seek them (Holmquist et al., 1999).

Communication between nearby strangers is discussed on several occasions. Hocman was found to encourage users to greet each other by waving, which is already a habit between bikers (Esbjörnsson et al., 2003). Research shows mixed feelings towards communication channel between nearby strangers. LoveBomb study found anonymous communication too limited to maintain interest of users (Hansson & Skog, 2001). Improvement ideas for Hocman included opening a discussion channel between users, but whether this sort of information exchange could lead to further communication received mixed feedback (Esbjörnsson et al., 2003). Participants of tunA hoped for messaging between users (Bassoli et al., 2006). CapitalMusic had the possibility to comment other users' song choices which was used by the study participants (Seeburger & Tjondronegoro, 2012). Viewing others' profiles in DigiDress was the most common usage pattern while communication was rarer (Persson et al., 2005). The participants of Kostakos's study saw that a Bluetooth based feature for exchanging information about common contacts could be useful

for getting to meet strangers, but there was a reluctance to respond requests from unknown people (Kostakos et al., 2006).

3.1.2 Proximity-Based Games

Proximity-based games utilize connectivity technologies to identify and/or connect to nearby devices. Research on co-located interaction in local multiplayer games that have been specially arranged to a group of players (e.g., Savannah (Benford et al., 2004) and Pirates (Falk et al., 2001)) was excluded from this review. Instead, this review focuses on examples from proximity-based mobile gaming that could take place intertwined in daily life, thus being more applicable to creating social experiences between everyday nearby strangers. Research on social experiences between nearby people and gaming has since shifted to location-based technologies and wearables, which will be covered later.

The rather limited findings indicate that proximity-based gaming could encourage players to gather around known places (Licoppe & Inada, 2012) and in gaming events (Szentgyorgyi et al., 2008), but there would be awkwardness to initiating gaming with strangers (Szentgyorgyi et al., 2008), and if the game permits, players might keep their distance (Licoppe & Inada, 2012). Furthermore, it has been speculated that automatic exchanges between nearby strangers might lead to players viewing each other as in-game currency instead of creating true interaction between them (Briceño, 2014).

Botfighters was an early commercial mobile game that allowed text message based social play between proximate players using cell ID positions. Players gained points by destroying nearby players' robots. Players could run away from the attack by physically moving away from the area. Players could interact with each other by sending SMSs through the game as well as via an online forum. The game was found to suffer from the problem of critical mass to some extent and the costs for playing it actively were very high, limiting the participation. The problem of critical mass was solved later with Long Distance Missiles, that removed the need to be in the proximity of another player. As the positioning was based on cell ID, being in proximity had a different meaning in different areas. (Bjerver, 2006)

Insectopia (Peitz et al., 2007) and *Blowtooth* (Kirman et al., 2011) took advantage of other people's mobile devices in creating content for one's own play. These games relied on discovering the unique Bluetooth identification number visible to others, but did not establish a real connection with the other devices. In Insectopia, every active Bluetooth device generated an insect which could be collected by the players. In Blowtooth, the players attached virtual drugs to active Bluetooth devices before airport security check and tried to find and reclaim them after the security check. These games did not by default create social interaction between nearby strangers, as the other person did not necessarily know of being part of the play. Playing these games would require an active effort from the user, exploring the surroundings and using game features to discover other devices. Insectopia allowed teamwork between proximate players. Both games included online features that allowed comparison between players. Publications on these games reported user evaluations but the focus and scope of the evaluations did not cover user experience aspects and social phenomena around this type of gaming.

Szentgyorgyi et al. looked at the social gaming practices of *Nintendo DS* users. They found out that even though ad-hoc, collocated pick-up games with strangers were made possible with wireless technology, there were social and technical barriers limiting this. Multiplayer gaming took place mostly between familiar people or in gaming events. The found barriers include finding gaming opponents, social awkwardness of initiating a game with a stranger, problems related to joining and exiting an ongoing game. Design implication from the research included mechanisms on the device that would allow locating other players easily, invite them to play, join existing games, and exit from games gracefully. (Szentgyorgyi et al., 2008)

The most notable piece of research for this field is Licoppe and Inada's research on Nintendo DS game *Dragon Quest IX* players' behavior, especially their gathering on public places. The game had two proximity-based features, Tag mode for exchanges between nearby players and Co-Op mode for local multiplayer gaming. The research reveals how players set up encounters on public places through mobile internet, how they appropriated public places for gaming and how they behaved on the encounters. The game was found to motivate players to gather around in the proximity, within 20-30 meters to be connected through the game console's Wi-Fi connection in order to gain benefits in the game. Some engaged in face-to-face interaction, while others kept some anonymity by keeping more distant. (Licoppe & Inada, 2012)

Whereas Licoppe and Inada's approach was ethnographic, Briceño analyzed the proximity-based feature *StreetPass* running on Nintendo 3DS handheld gaming devices. Such a research approach is less common in HCI, but Briceño's work was in fact published in a games research conference. StreetPass automatically exchanges game content between stranger players within WiFi range. She compared the characteristics of StreetPass with online social networks and social network games. In her analysis, she concentrates on looking at a central subset of StreetPass, the Mii Plaza games. She saw StreetPass as something preventing true social interaction between 3DS users and leading players to view each other as in-game currency. However, she also admitted that the physical proximity might convey a sense of intimacy. (Briceño, 2014)

3.1.3 Wearables

I will first introduce work on wearable displays, and then work on defining design frameworks for social and playful wearables.

While the information on traditional mobile devices is targeted for the users themselves, the research on wearable displays often features information targeted for nearby others. The research prototypes for wearable displays have come in various form factors, for example wristband, backside display for a mobile phone, coffee mug, and information on heads-mounted display. The content of the display may depend on the nearby others through proximity-based features. I will first introduce the covered concepts and then summarize the take-aways.

Meme Tags (Borovoy et al., 1998) were wearable displays aimed at engaging the attention of users already facing each other at a normal conversation distance by showing the name of the other user and a meme for them. Meme Tags operated reciprocally i.e. both user's displays would light at the same time with each other's names. The concept was evaluated in a conference, where popular memes were shown additionally on public displays. *MugShots* (Kao & Schmandt, 2015) were coffee mugs with a display intended to invite interaction from nearby others. In private context the mug would show messages from selected contacts, while in public context it would show user selected content. Pearson et al. (2015) explored the possibility of using smartwatches as public displays. Their research consisted of four different types of user research activities (noticeability of other person looking

at your watch, social acceptability of looking at other person's watch, observing the visibility and deportment of watch in face-to-face discussions, perceived usefulness of design options, and deployment of three different probes) and a formalization of public smart watch display design space. *CommonTies* (Chen & Abouzied, 2016) was a wristband that lit one LED on nearby devices when it discovered a match in their users' profiles. Seeing the color of the LED was aimed to serve both the wearer and a glancer. User profiles were automatically extracted from existing social media accounts. *CueSense* (Jarusriboonchai et al., 2015) was a wearable display that showed textual content from user's social media accounts based on the level of proximity to another used and matchmaking between their contents. *Social Display* (Jarusriboonchai et al., 2016) was a display attached to the back side of a mobile device to provide awareness of user's activities on the device to nearby others. *Digital Self* (Kytö & McGookin, 2017) was a system for providing self-curated digital profiles through head-mounted displays studied to support face-to-face interactions in multi-party events. *Digimerkki* (Epp et al., 2022) is a wearable display, with customizable picture. It is meant to be a digital version of clothing patches that Finnish students use for decorating their student boilersuits. DigiMerkki features detection of nearby stranger users within Wi-Fi range, and trading pictures over Wi-Fi when users press buttons simultaneously.

When looking at the social implications of wearable displays for nearby strangers, the findings seem often twofold. Large-scale user studies in events where people are already expected to network have been successful in creating social interaction between nearby strangers (Borovoy et al., 1998; Chen & Abouzied, 2016). However, the user research in other contexts did not report social interaction between nearby strangers. While the research by Pearson el al (2015) revealed that people already look at each other's watches in collocated setting, Jarusriboonchai et al (2016) found that looking at other's wearable display was not socially desirable. Smartwatch showing personal content was discovered to be potentially uncomfortable in external meetings with strangers (Pearson et al., 2015). Then again, some CueSense (Jarusriboonchai et al., 2015) study participants felt self-conscious about wearing a display but did not have privacy concerns with showing their social media content. Even though the mobile phone display used in the study was big, the participants reported difficulty of noticing matches when walking by someone. Even with strong ties, the communication sparked by a wearable display was found cursory and sparked by the novelty of the concept (Jarusriboonchai et al., 2016).

Traces of playful behavior and playful motivations were found in four of the mentioned research. The public displays listing most popular memes (Borovoy et al., 1998) gamified the system. Users were trying to author memes that would make it to the list. Content analysis of the created memes found two categories that clearly relate to playful motivations: "attempt at humor" and "self-referential" (memes about memes). The content creation for Digital Self (Kytö & McGookin, 2017) was found to favour images and ambiguity over text and facts about oneself. The design of CommonTies (Chen & Abouzied, 2016) emphasized ambiguity and minimized computer mediated interactions. The wristband had a problem of not being noticed by the wearers themselves, and the crowd made it difficult to locate the match. This encouraged some users to explore the physical space while holding their hand high, which is not everyday behavior, indicating they had entered a magic circle of play. User's strong ties would even join the effort of finding the match. This and the sense of mystery created by the minimalistic design were perceived as playful. *DigiMerkki* study (Epp et al., 2022) revealed emergent playful practices, for example using funny memes as content, dare challenges before trading, and spamming i.e intervening others' trade attempt with own content.

Dagan et al. (2019) defined a design framework for social wearables. The framework guides designers and researchers to think about wearables from a prosocial perspective; how these mediate, or interfere with social encounters, as they are part of people's social context. Their viewpoints include both the wearer and the others. In addition to considering the inputs and outputs of the designed wearable, they point to considering the social requirements as well as social acceptability of the usage.

Buruk et al. (2019) draws knowledge from game research projects incorporating wearables, synthesizing the current design space around wearables for play. Their framework proposes three high-level categories: the performative, the social and the interactive. The performative category draws attention to potential to increase immersion in the game world. The social category focuses on how wearables invite players to socially interact with each other, for example through inviting interdependence. The interactivity category relates to different input and output modalities. Social category is further divided into three topics, how distant or close the interaction is, how interdependent or independent the interactions are and if the interactions are verbal or bodily.

An interesting vision of where playful wearables might be heading is presented by Fang et al. (2021). They studied user experiences of PsiNet, a wearable device for brain-to-brain interaction. The study was conducted with people who live together, so it doesn't provide any direct finding regarding social experiences between nearby strangers. The findings highlight potential of such technology for playful experiences through creating feeling of connectedness, mind guessing and controlling others.

3.1.4 Location-Based Mobile Services

Research has investigated (mainly commercial) applications for social experiences between strangers that integrate user's location information. The location can for example be used to tag user's photos, user's current or hometown can be mentioned on a city level, or the distance between users can be inferred. Even though certain types of have been termed people-nearby-applications (Hsiao & Dillahunt, 2017), the research does not provide much knowledge on ad hoc encounters between nearby strangers. Instead, it has been found that location check-ins are used to purposefully curate a *spatial self*, profile information of visited places that the user wants to be associated with, even in the eye of friends (Guha & Birnholtz, 2013). Viewing a profile with location check-ins affects the impression one gets of a stranger user and helps decide whether one is interested in connecting with them (Fitzpatrick et al., 2016).

Mobile dating and befriending applications are usually centred around user profiles with photos. Profiles often have discrepancies with the reality, and they are constructed rather as a promise of what the person is at their best (Ellison et al., 2012). Location information can be part of the profile, but the concept of nearby strangers is not necessarily central to the concept as the location is not necessarily updated in real-time or the location precision is too sparse for such purposes. Research (Hsiao & Dillahunt, 2017) has shown that users of existing commercial people-nearby-applications have an inherent motivation to meet others offline and have different strategies to building trust before taking these online connections with strangers to offline meetings. Profile pictures and online discussions as well as crosschecking other online profiles play a role in that.

Dodgeball was an early location-based service, where the location check-ins by users were broadcasted as text messages to their network of Dodgeball friends in the same

city. Check-ins served multiple purposes: they were used to coordinate social gatherings among friends, they were used to show off visiting cool places and they were used to catalogue one's life. By building on user-defined network of friends, this service does not seem to have potential to create social experiences between nearby strangers. For many users, the network consisted of a core group of friends, but for some the network included also more casual connections who were usually similar by demographic. (Humphreys, 2007)

Foursquare was a location-based social network that gamified visiting places with two features: mayorship and badges. Frith (2013) found that while mayorships encouraged people to repeatedly visit same location, badges encouraged visiting new places. The publication does not specifically discuss interactions between nearby strangers, but findings on mayorships indicated that when users compete over a mayorship of a place, they frequently visit the place. Places-worth-defending were found such where the user had easy access, for example they were in the neighborhood. Such competition might result in social experiences between nearby strangers, but according to findings the friendly competition seemed to mostly take place between people who already were friends.

McGookin et al. (2014) studied enriching places with a digital layer. Their application integrated digital content back to the location of its creation in the form of digital graffiti to enhance the users' understanding of their current location. Users were able to view the graffiti on the mobile device screen or as projected to the environment with a pico-projector. The findings provide several interesting insights on interactions between strangers, even though the design doesn't emphasize the temporal aspect of nearby. The user study showed that the graffiti were created with many motivations, which related to self-expression, communication with friends as well as interactions with strangers. Graffiti were modified by others as light-weight interaction, to let the creator know that one has viewed it, and as a form of playful interaction. Using the pico-projector to project graffiti in public places showed to create curiosity in and interactions with nearby strangers. Some users preferred not to use the projector in public, while others liked the way it was something different and drew attention from others.

3.1.5 Location-Based Games

Location-based games create virtual world on top of the real world. The actions of users may leave traces that are visible to other users in the game interface. While location-based games can create social experiences between strangers, they are not necessarily focusing strongly on the temporal aspect of nearby. For this reason, my research didn't even originally extend to location-based games. It was only when witnessing Pokémon GO and various co-located social phenomena around it, that it became obvious that research on location-based games could in fact reveals various interesting insight regarding designing for social experiences between nearby strangers.

This review excludes research on location-based games that have been played as arranged events and concentrates in experiences from in-the-wild research of following prototypes or commercial games. Research on Pokémon GO is reviewed in the end of this subsection.

Feeding Yoshi was a location-based game for PDA, which had two types of game locations that were constructed based on the security characteristics of WiFi networks. The icon of a nearby player could be seen on the game map and a nearby player could be invited to swap items. (Bell et al., 2006) *Geocaching* is a location-based treasure hunt, where the locations of the user created physical caches are published online, and players search them in the real world with help of GPS devices. Final search must be done with keen eyes, as the coordinates only give an approximate location. O'Hara (2008) studied the practices and motivations of geocachers. *Hitchers* (Drozd et al., 2006)was an early location-based game. Players created and carried virtual hitchhikers from one cellular tower location to another one. Each hitcher had a name, a destination where it wanted to go, and a question it asked from each player carrying it. Carrying hither to its destination was a collaborative effort between very likely stranger players. Even though hitchers only travelled with players, they were essentially left to locations, where other players could pick them up whenever. *Ingress* is a location-based game that integrates game content to user's environment and is thus also called an augmented reality game. The game map is built on top of the real world map, and the game locations are attached to real world objects such as landmarks. Interacting with the game locations requires player to be physically close to them. The game has two opposing teams. In-game channels for team and cross team communications show messages and actions from players in a chosen range.

Hunzaker's (2016) study on the disruptive behaviors of Ingress players, and Blasiola et al. (2015) study on experiences on privacy and safety while playing Ingress reveal also the negative real-world consequences of interactions between nearby strangers.

The research on location-based gaming proposes that players seek opportune places to play and thus may be drawn to same locations. Users of *Hitchers* found metro stations suitable places to drop and pick up hitchhikers, while *Feeding Yoshi* players were looking for places where several game locations could be reached from one spot. *Ingress* players typically try to locate areas that are conducive to farms. Viable farming locations consist of a large number of portals that are close together. (Blasiola et al., 2015) Being in the same location allows identifying others as players. One *Feeding Yoshi* player reported to have identified another player based on holding a PDA. *ingress* players have commonly identified other players while playing.

Players have shown interest towards other players. *Ingress* players use external online communication platforms to arrange meetings with members of the same team, and even try to learn more about the members of the opposing team to be able to play more efficiently. *Feeding Yoshi* and *Hitchers* players reported being curious about other players.

The social competitive and collaborative features have been found to motivate user activity. *Feeding Yoshi*, *Geocaching* and *Ingress* feature competitive elements. Collaborative efforts were found from *Hitchers* and *Geocaching*, where physical travel bugs or virtual hitchhikers are moved towards their intended destination, while *Ingress* has team-based collaboration.

Being social is not only about competition and collaboration. Reciprocity, giving back to the community, was reported as a motivation to create caches in *geocaching*. Furthermore, playing together in a group of friends was found to happen in *Feeding Yoshi* and *Geocaching*. Playing took place both along the normal life and when players dedicated time to it.

The release of the location-based augmented reality game Pokémon GO in 2016 and its unforeseen global success generated various veins of research around the game. Our own research of the social effects of the game (Paasovaara et al., 2017), included as one of the thesis publications, was conducted in the first wave of such research, within few months of the release. Years after the release, the game has still inspired

research for example on the health effects of the game (Wang, 2021), how social distancing caused by COVID-19 changed experiences with the game (Saaty et al., 2022), and how the game has affected the life satisfaction and social functioning of users with self-reported diagnoses of mental disorders (Wingenbach & Zana, 2022). I have selected to review here in more detail three publications that address the social effects of the game.

Koskinen et al. (2019) surveyed memorable experiences of players. Social experiences were one of the common categories, featuring experiences of playing with familiar people, encounters with strangers and gatherings of many players in one place. The game was found to create a sense of community and togetherness. The game was found to facilitate encounters and exchanges with strangers that would not have taken place without the game. The game provided something in common to talk about with strangers, and possibility to help other players with the game. Helping others often involved people telling others where they had seen some rare Pokémon the other players were after. Many of these stranger encounters were with children or youth who were eager to discuss about the game, i.e cross-generation communication. The publication however also reports instances in which players avoided social interaction or deliberately chose not to communicate with others, as well as co-present play, in that they were playing in the same space with few people but did not have any interaction with them despite knowing that they were doing the exact same thing.

Vella et al. (2019) used interviews and online forum reports of gameplay to determine social outcomes of playing Pokemon GO, and mechanisms that facilitate social connectedness. Their analysis revealed that playing the game produced a sense of belonging, linked to a sense of place, as well as facilitated conversations with strangers, and strengthened social ties. They found that the game mechanics encouraged players out of their homes. Players reported that the game acted as an Icebreaker, facilitating conversations and interactions with strangers. Players formed a sense of belonging via gameplay that was expressed in terms of feeling part of a community of players inhabiting both online and offline spaces. Within public spaces, this was expressed as an enjoyment of sharing the game with large numbers of other players. For some players, this created altruistic play behaviors and a sense of social cohesion and social goal.

Evans and Saker (2019) examined the effects of locative play on spatiality and sociability with Pokemon GO. They look at the topic through a concept of *playeur*, an engaged actor who develops relationships with space and place through intentional playful activities. The research found that players of locative games that integrate their game-playing into everyday routines are more likely to alter routes, visit novel places and understand their environment differently thanks to the mediation of location by the game. Playing of Pokémon Go was found to have subsidiary social benefits that move beyond changes in mobility but are the result of this modification. Benefits of this kind of play were found not simply revolve around the physical benefits of spending more time outside, but equally involve a genuine pleasure in the game itself. Impact of Pokémon Go was found more enduring than that of other previous similar games. Engagement with the game was found to be far stronger in Pokémon Go than in the more-limited gaming experience of earlier location-based games, thus the effects of the game on mobility, spatiality and social mobility appeared stronger in the use of this game.

3.2 Interactive Installations for nearby strangers

The research related to physical interactive installations in public or semi-public places is relevant to designing mobile services for social experiences between nearby strangers in at least two ways. First, the behaviors and interactions around physical objects may extend to those around augmented interaction spaces that mobile services could create. Second, design strategies for creating social experiences around physical objects may be applicable to mobile services as well.

Interactive installations exhibit examples at the intersection of art and HCI. Interactive installations have been studied in contexts where people are commonly surrounded by nearby stranger: in public places, such as parks and shopping malls, as well as in the semi-public places, such as art galleries and common areas of office buildings. Playful qualities can be used in interactive art to draw user engagement (Costello & Edmonds, 2007).

The most notable work on interactive installations (from the perspective of nearby strangers) includes the research on the following concepts. *iFloor* (Krogh et al., 2004) was a floor display installed in a library. It had a single cursor to navigate the content on the floor that required multiple users to work together. *coMotion* (Kinch et al.,

2013) a shape-changing bench would move in ways that either push people closer to each other, or make more room between them to allow others to fit in. *Proactive Displays* (McCarthy et al., 2004) revealed information on a public display about nearby people whose profile was read from an RFID tag attached to their conference badge. *Jokebox* (Balestrini et al., 2016) was a set of two interconnected installations that required two nearby people to coordinate their actions and interact with the devices simultaneously in order to hear a joke as a reward. *MoodSqueezer* (Gallacher et al., 2015) was a public installation that consisted of custom-made input devices in form of six squeezable balls of different colors and digital floor displays. An aggregate output of all squeezes by different users was mirrored on the floor displays. *Encounters* (Wouters et al., 2016) translated nearby people's bodily movements into visual and sonic output. *Traces* (Monastero & McGookin, 2018) displayed walking trajectories of people with floor projection. Traces of a person faded away after one hour. The system it was powered with implicit interactions, people walking through the area as part of their regular activities.

Concerning encouragement of social interaction, interactive installations create a fixed place interaction space around them, whereas mobile devices are carried along by their users. This fixed place nature has made observational user research possible. The research field exhibits several rigorous studies with insights on human behavior around and with interactive installations, also in relation to strangers (e.g (Balestrini et al., 2016; Kinch et al., 2013; Monastero & McGookin, 2018; Wouters et al., 2016). This section is appended with an interesting piece of research, Heinemann and Mitchell's work (2014) analyzing a set of breaching experiments, social interventions with the intention of encouraging and supporting collocated strangers to collaborate. Similar to interactive installations, the analyzed experiments take place in public and semi-public places, revealing insights about the social rules and behavior on the encounters between nearby strangers.

As a rare example of producing intermediate level knowledge, Mitchell, and Olsson (2019) identified five design patterns for facilitating the first move between nearby strangers from art installations. These patterns (permission to engage, orient towards, highlight the in between, aggregating inputs, isolate to focus) and example designs were further assessed regarding their perceived applicability and social acceptance with focus groups and expert interviews. This phase produced three design principles (automation ambiguity and deflecting), concerned with either reducing or removing the saliency or responsibility for initiating an interaction.

The design space of playful characteristics included for example *bodily movements as a form of input* (dancing) (Wouters et al., 2016), *rewarding* interaction with visual or audible feedback (Balestrini et al., 2016; Gallacher et al., 2015; Wouters et al., 2016), *ambiguity* of interaction and feedback (Gallacher et al., 2015; Monastero & McGookin, 2018; Wouters et al., 2016), and forced *collaboration* (Balestrini et al., 2016; Krogh et al., 2004). In addition to these, the FishPong (Yoon et al., 2004) was in fact a tabletop game, and art gallery visitors seemed to regard playful contraptions as some kind of toys or the whole situation as some kind of a game (Mitchell, 2009).

Even when the design has not been particularly playful, the users have been reported to appropriate the systems in playful ways. *Traces* users were observed to make drawings with their footprints. Funny fake profiles were made for *Proactive Displays*. People were trying to overpower others to get certain color on all displays in *MoodSqueezer*.

The ambiguity of interaction with the system and the feedback it provides seems to have potential to create social interaction. Uncertain people may discuss how a system works; those that have figured it out may teach it forward to others; and social norms on how a system should be used may be established through discussions. (Gallacher et al., 2015; Monastero & McGookin, 2018; Wouters et al., 2016)

It has been discovered that only a small percentage of people who visit the proximity of an interactive installation actively engage in interaction with it (Monastero & McGookin, 2018). People are more likely to interact with installations when they are in already established groups than when they are alone (Balestrini et al., 2016; Heinemann & Mitchell, 2014). There is a barrier to start using an interactive installation, but seeing other people involved legitimizes usage (Heinemann & Mitchell, 2014). Researchers have actually staged people as users to lessen the barrier to engage with the system (Heinemann & Mitchell, 2014; Wouters et al., 2016). In addition to legitimizing use, people learn how to interact with the system by observing others (Wouters et al., 2016). The effect of interactive installation surpasses those who explicitly interact with it by including bystanders and audience roles (Wouters et al., 2016).

Context plays an important role in how people perceive interactive installations and whether they are willing to engage with them. People are more likely to interact with

installations in a leisurely context, such as a park or an art gallery (Balestrini et al., 2016; Kinch et al., 2013; Mitchell, 2009) than in serious context, such as an airport; where the purpose of interactivity may even be misunderstood(Kinch et al., 2013).

General rules of politeness seem to guide the social interactions around interactive installations. Smiles and nods were exchanged between people when connecting the profile with a person around coffee table in a conference (McCarthy et al., 2004). People who understand how the installation works share their knowledge with others (Wouters et al., 2016) and even start championing it i.e., encouraging new people to try it (Balestrini et al., 2016; Heinemann & Mitchell, 2014; Monastero & McGookin, 2018). When only a limited number of people can interact at the same time, people drop out to give room for others (Wouters et al., 2016). Obstacles preventing ordinary life in public place have been found to cause polite behavior as people accept help from others, pay it forward, and even collaborate to remove the obstacle. Such polite acts have been found to be complemented with verbal interaction (Heinemann & Mitchell, 2014). However, the communication around interactive installations has been found to often stay at a cursory level (Heinemann & Mitchell, 2014; Kinch et al., 2013).

Interactive installations can provide social experiences between nearby strangers in other forms beyond direct communication. The research on *Traces* showed that people who spent regularly time in the building learned to interpret the visualizations and what they meant in terms of who else were in the building, creating an additional social information layer, awareness of others.

Negative social effects of interactive installations have been rarely discussed. McCarthy et al. (2004) make an exception by reporting that fake profiles created unwanted behavior in a form of people asking questions in a conference just to get their funny profile visible to others, disrupting the purpose of the Q&A session and being disrespectful to the researchers presenting their work.

3.3 Summary and Research Gaps

Several mobile technology concepts that are believed to have potential to create social experiences between nearby strangers have been proposed and implemented over two decades. There are three main approaches to these: proximity-based

services, location-based services, and wearable devices. The user evaluations on such concepts have often been lightweight (e.g., (Bassoli et al., 2006; Esbjörnsson et al., 2003; Seeburger & Tjondronegoro, 2012)), arranged in short events (e.g., (Chen & Abouzied, 2016; Epp et al., 2022)) or non-existent (e.g., (Paulos & Goodman, 2004)), leaving their true potential in creating social experiences between nearby strangers concealed. The few large-scale studies (e.g., (Jung & Blom, 2006; Persson et al., 2005; Väänänen-Vainio-Mattila, Saarinen, et al., 2010)) do not have a strong focus on understanding the social experiences between nearby strangers. Therefore, this thesis research focuses on unveiling social experiences between nearby strangers of services in large-scale use, and understanding how the design has contributed to them.

Another division can be seen in the purpose of the services, as they can be divided to regular (serious) applications and games. Even though playful experiences have appeared in the user study findings, understanding the role of playful design has not been in the focus of the research. Therefore, this thesis research examines both the playful experiences created by the services and playful qualities of the services, and how they contribute to the social experiences between nearby strangers.

Previous research predicted that automatic content exchanges could create positive social experiences between nearby strangers (Håkansson et al., 2007; Hakansson et al., 2007), but further research on the topic remains scarce. Location-based gaming has been seen to have potential in creating social experiences, but research reports on experiences between nearby strangers are scarce there as well.

Research on inducing social experiences between nearby strangers has also been done in the domain of interactive installations. Research on both domains reports mostly empirical findings on the level of specific instances rather than trying to abstract to intermediate-level knowledge and looking beyond domain boundaries.

In the light of this extensive review and the research gap, this doctoral research focuses on mapping out and making sense of the vast design space, on large-scale user research and co-design of playful mobile services, as well as design implications gained during the course of this work.

4 RESEARCH APPROACH, METHODS AND PROCESS

This thesis contributes to the research field of Human-Computer Interaction. Research in the field of HCI has expanded in the past decades from studying the usability of personal productivity application in the context of computer science to cover studying technology development for a wide spectrum of human experiences and activities inside various academic disciplines such as psychology, design, communication studies, cognitive science, and information science (John M. Carroll). The research conducted for this dissertation is design research where empirical research methods typical to the field were used. The aim of this research was to contribute to the knowledge of designing mobile services that create social experiences between nearby strangers.

This section presents the research approach and process, introduces the studied mobile services, describes the methodology, and describes how research ethics were considered.

4.1 Research Approach

At the level of the whole thesis process, the research is best characterized as Research for Design. According to Zimmerman, Stolterman, and Forlizzi (2010) Research for Design represents a type of research that focuses on improving design practice and that may yield outcomes such as frameworks, philosophies, design recommendations, design methods, and design implications. The intended audience of this knowledge includes both designers and researchers.

The individual studies included in this thesis followed both Research for Design and Research through Design approaches. This research explores the topic by designing novel concepts and services, and evaluates them with users, as well as studies the experiences of users of existing commercial services.

Research through Design is a research approach that employs methods and processes from design practice as a legitimate method of inquiry (Zimmerman et al., 2010). According to Horvath (2008) including design in research creates new opportunities for generating knowledge, which cannot be derived otherwise. This fits the context of this relatively little researched topic well: to study what kind of social experiences emerge between nearby stranger from the use of playful mobile services and to understand how to design such services, design efforts are needed.

HCI is among other things about understanding practices and activity as requirements and design possibilities for new technology, and about exploring design spaces, and realizing new systems through the co-evolution of activity and artifacts. In this task-artifact cycle, the human activities implicitly articulate needs, preferences, and design visions; and the artifacts designed in response do more than merely respond. Through the course of their adoption and appropriation, new designs provide new possibilities for action and interaction. (John M. Carroll) The task-artifact cycle motivates this research in two ways. Firstly, some of the findings from previous research on mobile services for nearby strangers, stretching over two decades, may have become obsolete. Secondly, research on existing services provides valuable input for the design of future services.

4.2 Research Process

This research comprises six studies that were conducted with qualitative user research methods. The studies had altogether 481 participants. Instead of knowing beforehand exactly what to research, the previous studies guided the next steps of the process and fortunate events allowed studying the topic from unexpected viewpoints. The reviews of the first publication pointed us to study Nintendo StreetPass. That research informed the design of our own application Next2You. A research visit encouraged using co-design as research method, where the earlier studied services Challenz, Next2You and StreetPass were introduced as concepts to prime the co-design workshop participants. The first-hand experiences following the release of Pokémon GO pointed us to study social experiences around it. This thesis summary synthesizes knowledge from the conducted research to answer the two thesis level research questions.

The following table gives an overview of the publications (P) and research questions (RQ) they contribute to. It also summarizes the goal of each study, the study method and, the study participants. The numbering of the studies and related publications follows the order in which the studies were conducted.

Table 1. Summary of publications, research questions and studies

P, RQ	Goal of the study	Method	Participants
P1, RQ1+RQ2	Understanding the expected user experiences of proximity-based application concept for creating and sharing video stories	Focus groups	16; technical university students or staff in Finland; 5 females and 11 males
P2, RQ1+RQ2	Understanding the experiences of Nintendo StreetPass users	Online survey	105; active users of StreetPass, mainly North American or European; 24 females, 81 males
P3, RQ1+RQ2	Understanding the expected user experiences of a playful social mobile application concept for nearby strangers	Focus groups	18; technical university students in Finland; 10 females, 8 males
P4, RQ1+RQ2	Understanding the user experiences of a playful social mobile application for nearby strangers	Field trial	162; technical university students or staff in Finland and Czech Republic; 34 females and 128 males
P5, RQ2	Exploring the design space for playful interactions between nearby strangers	Co-design	14, design students or staff in a Danish university including 2 of the authors; 6 females, 8 males
P6, RQ1+RQ2	Understanding the social experiences of Pokémon GO players	Online survey	166; several nationalities (main nationalities Finland, Thailand, USA); 52 females, 114 males

4.3 Research methods and the studied services

This research utilized several different methods typical to HCI research. As the research gap highlighted in chapter 3 shows, research related to this topic is still scarce. Lazar et al. state that when a research topic is new, it is important to start with research methods that can be utilized in an exploratory way. Surveys and focus groups, that were used in this research, are introduced as such generally accepted empirical research methods. (Lazar et al., 2017) So called in-the-wild or field studies, that we used with our own fully implemented mobile service, are considered particularly suitable for studying mobile technologies and how technology fits in to people's daily lives (Kjeldskov & Skov, 2014). The last of the used methods, dialogue-labs, is a co-design workshop (Lucero et al., 2012). This and other similar

methods are less mainstream but used to growing extent in HCI design research explorations (Goguey et al., 2019; Hildén et al., 2017).

The data gathering methods produced mainly qualitative data, which was analyzed with qualitative content analysis method (Elo & Kyngäs, 2008). Quantitative data was not heavily analyzed as the explorative study design and non-probabilistic sampling do not allow for generalization. The role of the quantitative data was to describe the participants and support the qualitative data by reporting frequencies of findings. The synthesis over the included publications for this thesis summary concentrated on answering the thesis level research questions instead of repeating details of each individual study.

The following describes the service in question and methodology of each study. Further details can be found in the related publications.

4.3.1 Study 1 – Focus Groups about Challenz

The first study utilized focus groups as the data collection method for understanding the expected user experiences of Challenz, a proximity-based application concept for creating and sharing video stories. According to the concept, users create video stories in collaboration so that one user starts the story and other users continue it. Each user can only view the addition by the previous user before adding their own contribution, not the whole story. This increases the likelihood of funny twists in the plot. The opportunity to continue the video stories is automatically offered when users encounter each other in WiFi Direct proximity. WiFi Direct is furthermore used to transfer the videos from one user to another. New clips are automatically passed to earlier contributors upon real-world encounters. The concept was designed in a context of a research project exploring social uses for device-to-device connectivity and data transfer.

The focus group sessions included an introductory part, where the concept was introduced with help of a storyboard and an experience prototype. Experience prototype is a simulation that aims at creating the same experience as the real product would create without the actual implementation (Buchenau & Suri, 2000). The

experience prototype simulated creating collaborative videos in a similar manner than the concept suggested, thus revealing the potential of and possible pitfalls of the concept more realistically than a mere concept description. A group-based method was considered to be more suitable in exploring technology-mediated interaction between people than one-on-one methods, as it allowed simulating the intended social interaction as well as allowed participants to build on each other's answers.

4.3.2 Study 2 – Online Survey about StreetPass

The second study was a (mainly) qualitative online survey for active users of Nintendo StreetPass. Nintendo StreetPass is a commercial proximity-based playful mobile feature on Nintendo 3DS handheld gaming console. The feature is designed for social experiences between nearby strangers. It performs automatic exchange of chunks of data between StreetPass users encountering each other within WiFi range. StreetPass exchanges data only between games that the encountering users have in common making it reciprocal. Different games utilize this feature in different ways to create social experiences and technology-mediated interaction between the users, and to reward them for using the feature. Some of the exchanged data is more social, revealing something about the user, while in some games the outcome of an encounter resembles impersonal virtual currency.

An online survey was used for data gathering because it makes possible to reach more participants than one-on-one methods like interviews. Qualitative, open-ended questions are suitable for exploratory research, where the range of answers in still unknown. We chose to study the user experiences of a commercial service because the wide and active user base makes it possible to gather information and experiences that may not appear with smaller scale research prototypes.

With StreetPass we needed to reach also outside Finland to find active users from more densely populated areas. Participants were recruited by advertising the survey in StreetPass users' Facebook groups and online discussion board. This self-selected sampling resulted in 105 respondents. Self-selected, non-probability-based surveys

are considered suitable for investigating such new user populations or new phenomena of usage (Lazar et al., 2017).

The survey questions included open-ended questions, such as "What is your best or most memorable experience with StreetPass?" and "What is the biggest effort you have made in order to get StreetPasses?". It also included close-ended questions, such as "How long have you been using StreetPass?" and statements like "I am curious to know who is the person I StreetPass with" where participants would choose their stance on a 7-step Likert scale. Open-ended questions were analyzed with qualitative content analysis. The analysis of close-ended questions included averages or frequencies depending on the question type.

4.3.3 Study 3 – Focus Groups about Next2You

Study 3 was arranged as a focus group evaluation of our new service concept Next2You. The aim of the evaluation was to get early constructive feedback for the service and to establish an understanding of the user expectations for such services.

Next2You is a proximity-based mobile service that uses Bluetooth to detect nearby users and internet connection to exchange data between them. Next2You automatically exchanges user defined text-based notes, whispers, upon real-world proximity encounters. The exchanges are progressive and reciprocal, i.e., one new whisper from both users is exchanged upon each encounter, and the exchange can happen only if there are still new whispers to exchange from both users. User can like received whispers. After encountering each other, the users can send personal messages to each other. Meeting each other face-to-face and registering it to the service provides users gamified achievements and reveals the actual profile pictures of each other.

The concept follows the design of StreetPass with regards automatic exchanges and technology-mediated interaction, but Next2You is a social service rather than a game. We wanted to see if such concept is desirable without the additional benefits of games. The user interface for Next2You is implemented as an Android application, which makes it available for a wider and more heterogenous audience

than StreetPass that runs on a specific gaming device used by long time Nintendo game fans.

The service concept was introduced to the participants with help of a concept video and experience prototype with limited functionality. The participants used the prototype to create their profile of whispers for this proximity-based social service. The prototype exchanged one whisper between participants in five-minute intervals. Different aspects, such as strengths of the service and views on gamifying face-to-face meetings, were covered in the group discussion. The participants filled an end-questionnaire to sum up their views on the concept.

Participants of the study were 18 university students. With the intention to organize a field trial on the service also on the university campus, this seemed a proper choice.

Group discussions were transcribed and analyzed with qualitative content analysis. Frequencies for end-questionnaire answer options were calculated.

4.3.4 Study 4 – Field Trial with Next2You

Study 4 was a field trial on Next2You service. Field trial or in-the-wild study means deploying a service so that participants can use it as part of their daily lives (Kjeldskov & Skov, 2014). Whereas focus groups are based on participants' opinions and assumptions, field trials provide more realistic data of users' behaviors and experiences. Field trials are costly to arrange and there is little control over the participants. The requirements for the prototype fidelity are high as the application should function smoothly on participants' own phones. If technical problems prevent using the application, the results become unreliable. Aiming to create social experiences and encourage social interaction between nearby strangers, a long-term and large-scale field trial was a better option than a laboratory study.

Study 4 was conducted as a seven-week field trial of a fully functional mobile application running on participants' personal phones. The participants were 162 self-selected students and staff members from two different university campuses. The application had technical restrictions for the phone models where it could be

installed. Focusing the participant recruitment to people who spend time on the same campus was intentional, as we tried to ensure the possibility to encounter other users, which was in the core of the concept. Data gathering methods for the field trial were two voluntary online surveys for the participants at different times during the trial, and analysis of server-side logs of users' activities and user-created content. The open-ended questions included for example "What did you do to collect Whispers?" and "What kind of Whispers from others did you find interesting?" The close-ended questions queried for example participants experiences of playfulness and surprise with Next2You in Likert-scale. Server-side logs provided information about the use of different features. Similarly to previous studies, qualitative content analysis was performed as well as simple calculations of the quantitative data.

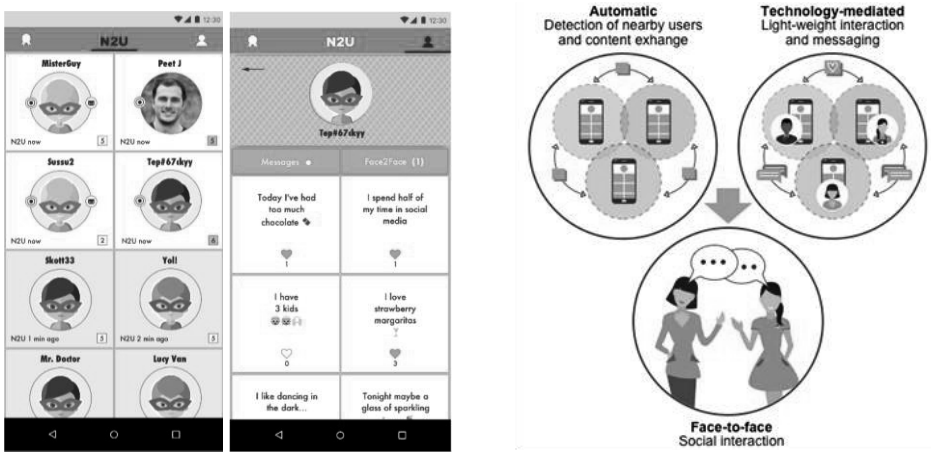

Figure 1. Design of Next2You application - user interface and main features

4.3.5 Study 5 – Co-design Workshops about Playful Experiences between Nearby Strangers

The research method for study 5 was dialogue-labs (Lucero et al., 2012). Dialogue-labs provides a structured way of generating ideas through a sequence of co-design activities. The method has three key structuring characteristics: the process by which the method unfolds in time, the space in which it is set, and the materials available in the lab setting. Each workshop session consists of an idea-generation part, where

small groups consisting of designers and other topic experts generate ideas to predefined topics with help of inspiration material. After generating ideas for several topics, each group presents their ideas to other groups. These ideas are then elaborated on as a group activity, and finally ideas selected by the group are rated as an individual activity. Qualitative analysis of the resulting ideas and discussion around them is used to reveal more about the researched topic.

This method was chosen to allow exploration of the design space beyond the closest and most obvious solutions. From a practical perspective, a research visit to a design-oriented university and collaboration with one of the developers of this methodology, Dr. Andres Lucero encouraged me to use this previously unfamiliar methodology. What made this particularly interesting method for me as a researcher, was that we researchers were considered equal participants in the activities instead of just facilitating or observing.

We organized three workshops of six participants. As two of the researchers took part in all sessions, there were altogether 14 individual participants. The workshops started with a short sensitizing part where the concepts of StreetPass, Next2You and Challenz were presented. After this, pairs of participants ideated around playful ways to encourage interaction between nearby strangers. Ideation was supported by tasks that draw attention to different angles of the topic. Each task was accompanied with different inspiration materials, such as design cards (Lucero et al., 2016). Ideation was followed by sharing the best ideas with the whole group and elaborating them as a group activity. The best ideas from the workshop were rated in the end regarding their overall quality for the goal of encouraging interaction between nearby strangers.

The group discussions were transcribed and altogether 60 ideas were identified from there. The bottom-up analysis of the ideas revealed aspect relevant to this design space and different design options therein. The essence of the highest rated ideas was illustrated as vision sketches. I summarize these ideas below.

Shadows projects fake shadows of people interacting with each other. The aim is to direct attention to a nearby stranger and create a weird moment that serves as something to talk about with each other (Fig 2.a). *Dancing* projects the moves of one dancer on the dance floor for others to follow (Fig 2.b). The aim is to create group

interactions between nearby strangers. *Hotter hotter* informs about the presence of a nearby player with thermoceptive signal. To score points in the game, players are supposed to seek each other and stay in a close proximity for a required time (Fig 2.c). *Honk Honk* is about obeying controls from a nearby strangers. The concept requires funny behavior as a response to specific gesture (Fig 2.d). *Stories of the World* reveals destinations of nearby travelers and allows subscribing to photos from their journey. Destination information can be used as a ticket-to-talk (Fig2.e). *Changing Other's Avatar* gives nearby strangers a possibility to modify owner's avatar in funny ways (Fig 2.f). *Collective Discounts* connects nearby strangers to perform an act together. They will receive a discount to a shared meal (Fig 2.g).

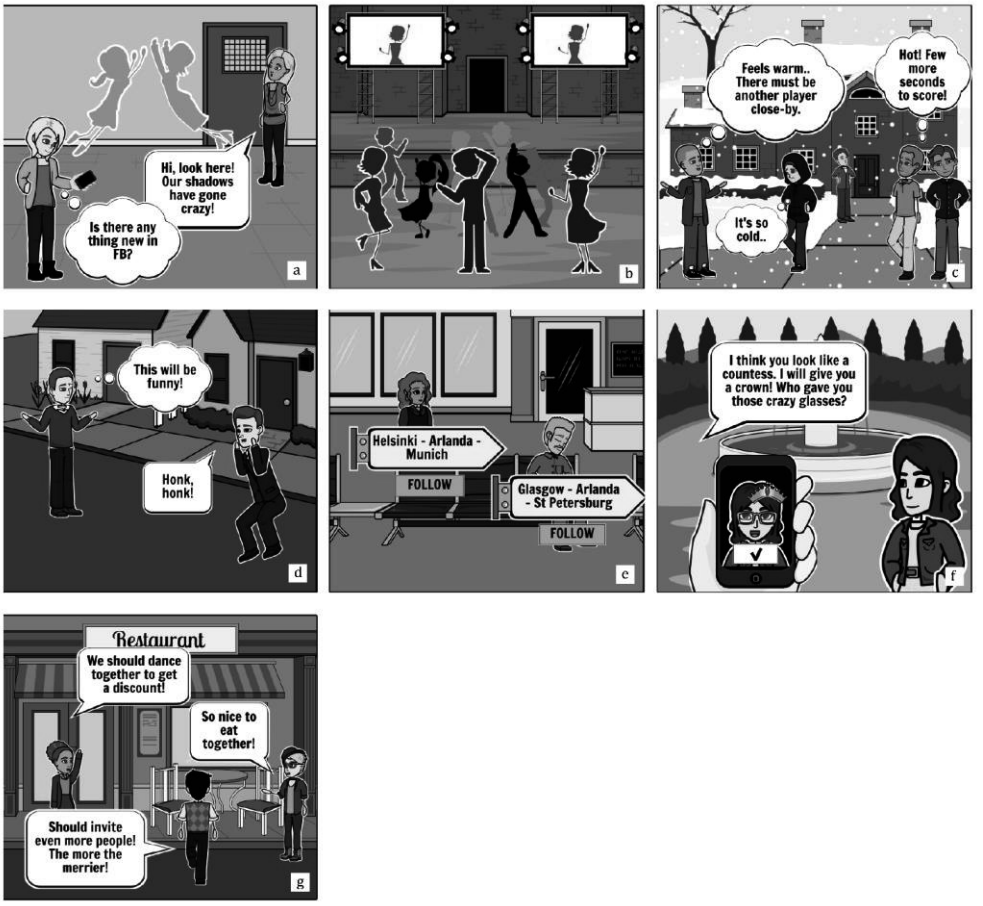

Figure 2. Concept vision sketches for playful experiences between nearby strangers

4.3.6 Study 6 – Online Survey about Pokémon GO

Study 6 was an online survey for users of a then (fall 2016) recently launched location-based mobile game *Pokémon GO*. So far, I had not found location-based services that were well suited for addressing social experiences between nearby strangers. Our first-hand experiences with the game, such as the game sparking discussion with strangers and people gathering in parks to play, however pointed to the direction that the design of game has qualities that create positive social experiences between nearby strangers, which need to be studied.

Pokémon GO is a location-based mobile game, where players explore the physical world catching virtual creatures, Pokémon; gathering items that help with it; and battling. Pokèmon appear at random locations but do it more often around PokéStops. Usually, all nearby players can catch their own copy of a spawned Pokèmon. The spawn rate can be increased for a fixed period by two items. One item increases the rate for the player, while the other item increases the rate for all nearby players. These and other items are received by visiting PokéStops that are located at real-world landmarks. Pokèmon can be furthermore hatched from eggs. Hatching proceeds when the player walks in the real world. Collecting at least one of all the available Pokèmon species is a central theme in the game. Battling happens at Pokèmon Gyms, which are located at real-world landmarks. The Pokèmon defending the Gym belong to other players, but the battling does not require owner's real-time involvement. The studied first release of Pokémon GO lacked many traditional multiplayer elements such as real-time player vs player battling and trading between players. Since then, the game design has been updated numerous times.

The reasons for using a mainly qualitative online survey as the method were similar to those that led us to using the method with StreetPass, exploring a new and unknown topic widely. Our first-hand experiences with the game guided the question setting and interpretation of the results. Open-ended questions left room for new aspects to arise. Close-ended questions allowed charting frequencies of phenomena that we had already come across. Examples of the open ended questions include: "Please share with us one or more of your positive experiences with Pokémon GO" and "Why did you initiate conversation with stranger players?".

With Pokémon GO, we could have easily found enough active players in Finland but wanted to keep the international focus so that the exploration would not be limited to behavior and experiences that might be specific to Finns only. The analysis covered responses from 166 participants from 13 countries. The analysis of qualitative data from open questions was performed by open coding and inductive reasoning, resulting in bottom-up hierarchy of themes. For close-ended questions frequencies were reported to support qualitative data.

4.4 Research Ethics

This research followed the guidelines of Finnish Advisory Board on Research Integrity that were in place at the time of conducting the research in 2014-2016. The guidelines define three ethical principles: participants' self-determination, avoiding harm to participants and protecting participants' privacy. When the research in the field of Human-Computer Interaction follows these guidelines and there is no specific reason for it, there is no requirement for seeking study-specific approvals from the local research ethics committee. General Data Protection Regulation (GDPR) entered into application later than the studies were conducted (2016 vs. 2018). I will next outline how the guidelines were followed.

Taking part in each of the studies was voluntary. The participants were informed about the purpose of the research and gave their consent to it. Taking part in focus group sessions and answering online surveys was considered to have very low potential of harming participants. Survey data was accessed only by the researchers, and answers were reported as anonymized. Next2You field trial participants could freely choose how much and what kind of information they share. The application did not require sharing personal information, only some thoughts as 'whispers'. They were free to stop using the application at any time during the trial. They could also block another user in a case of unwanted interaction. Participant's privacy was maintained when handling and storing data, and reporting results as anonymized in publications. Regarding GDPR (even though it was not applicable before 2018, when the original research was conducted) the data recording was done under user consent. Each research queried e-mail address for the purposes of identifying individual respondents and for the potential need of asking further questions. Age and nationality were queried to describe the data. Occupation was queried in the

studies conducted in university context to make a distinction between students and faculty members.

5 RESULTS

This chapter presents the results of the research, answering the two research questions, RQ1 and RQ2 listed below. The results presented here have been synthesized from the included studies bottom up, looking for larger themes therein.

RQ1: What kind of social experiences emerge between nearby strangers from the use of playful mobile services?

RQ2: How can playful mobile services be designed to encourage social experiences between nearby strangers?

Section 5.1 presents the results relating to the first research question, looking at the social experiences of the users of three examples of playful mobile services: StreetPass feature on Nintendo 3DS handheld gaming device, location-based game Pokémon GO and social mobile application Next2You designed during this research, as well as to the concept evaluation results for a mobile application Challenz. Sections 5.2 and 5.3 look into the second research question, design of playful mobile services for social experiences between nearby strangers, first outlining the design space and then presenting design considerations identified throughout this research. Most of related research is presented in more detail in chapter 3, and is discussed here along with the results or referred to.

The original publications address the frequency of certain findings. With self-reported answers to open questions the actual frequency of a phenomena is likely different of what is mentioned when querying peak experiences. In these synthesized results, I wanted to illustrate the breadth of results, including also the less frequent findings where they might provide interesting topics for further inquiries.

5.1 Social Experiences with Playful Mobile Services

This research identified various kinds of social experiences resulting from the use of playful mobile services. These experiences are presented in the next two subsections. First, I present the identified behavioral patterns with these services. Second, I describe the emotional responses related to using playful mobile services for nearby strangers. This division into two themes (behavior and emotional responses) is a reflection of our research asking for peak experiences as well as what users did as a result of using the service. The responses would often cover these both themes. Overall, the empirical findings reported in P1, P2, P3, P4 and P6 show that playful mobile services can create positive social experiences between nearby strangers.

This section describes these experiences and builds an understanding that can be used when designing new services or researching this topic further.

5.1.1 Behavioral Patterns with Playful Mobile Services for Nearby Strangers

People have different motivations for and ways of using or refusing to use playful mobile services for nearby strangers. The synthesis of the publications identified different behavioral patterns and divided them under three main categories: Play and life, Play and others, and Misbehaving. Table 2 summarizes these patterns and their connection social experiences between nearby strangers described in more detail below.

Table 2. Behavioral patterns with playful mobile services for nearby strangers

PLAY AND LIFE	
Interweaving with life	Finding ways to use the technology without changing normal routines
Active exploring	Creating new routines and attending new events to be more efficient
Non-use	Not using such technology or having stopped using
PLAY AND OTHERS	
Single play	Using technology for the playful rewards

Anonymity keeping	Not revealing being a user to others
Collaboration	Working together towards common goal
Bonding with strong ties	Using technology among strong ties
Community building	Teaming up and communicating with others to be more efficient
Communicating with strangers	Communicating with other users
Interacting in crowd	Interacting as part of a crowd clearly doing the same thing
Companion seeking	Using technology to find people with matching qualities
MISBEHAVING	
Sharing vulgar content	Taking advantage of automatic and anonymous exchanges to disgust others
Grief play	Taking advantage of the anonymity of the game to inflict negative experiences to others
Cheating	Using external technology to gain advantage in game
Testing	Short term usage with potentially nonsensical content

Interweaving with life refers to active users adopting playful mobile services as part of their normal life. They grab opportunities to play as they come along without requiring much active effort. This pattern can happen in parallel with other more active patterns. Many StreetPass users carried their 3DS device always along, with the StreetPass feature activated (P2). Pokémon GO players reported playing while doing things they would anyway be doing (P6). Next2You users had the application activated but did not take more active measures to encounter others (P4). Earlier research on location-based services and gaming has showed similar behavior (Bell et al., 2006; Blasiola et al., 2015; Drozd et al., 2006; Frith, 2013; O'Hara, 2008).

There are people who make changes to their daily routines as well as make bigger arrangements to maximize their experiences with the services through *active exploring*. This was seen with both Pokémon GO and StreetPass. StreetPass users would make detours and trips to crowded places, special events and location based StreetPass Relays (P2). Pokémon GO users would go to and stay in places where the likelihood of finding Pokémon is bigger and walk or run around to hatch Pokémon Eggs (P6). Only a small portion of Next2You respondents reported active exploration (P4). Earlier research on location-based services and gaming has showed similar behavior (Bell et al., 2006; Blasiola et al., 2015; Drozd et al., 2006; Frith, 2013; Hunzaker, 2016; O'Hara, 2008). In smaller scale, similar behavior was also seen with wearable display for social matching in an event (Chen & Abouzied, 2016).

Non-use refers to the behavior where many people are not willing to use these kinds of services at all, or they have stopped using them. This research identified for example privacy and security concerns related mobile services for nearby strangers. Some participants felt that such services are not needed in making new connections, and even slow the process down unnecessarily. Some stated that they do not actually need any new social contacts. These hindrances were discovered among the participants of the early stage design explorations (P1, P3, P4). It seems that one hindrance is considering using playful technology somehow childish. This group was discovered indirectly, as Pokémon GO users reported having faced non-players openly mocking them for playing it (P6). Disappointments with the lack of encounters led people to stop using the technology (P2, P4). Some StreetPass users reported stopping to use it after completing a major collecting task (P2). The importance of paying attention also to non-use has been acknowledged in general HCI literature (Satchell & Dourish, 2009). Some related work examples mentioned users becoming demotivated from lack of other users, also referred as lack of critical mass users (Bjerver, 2006; Drozd et al., 2006; Väänänen-Vainio-Mattila, Saarinen, et al., 2010).

The single-user or single-player aspects are important to most users. When following the pattern of *single-play*, people may interact with others, but their main interest is in the playful rewards it brings to oneself, not in socializing with other people. As reasons for playing alone, some Pokémon GO players reported that playing alone frees them from being restricted by other's availability. Some also reported a wish to be better than others, and single play gave them an advantage (P6). This kind of motivation to play as contrasted with social motivations to play is not especially

discussed in the related work. Stenros et al (Stenros et al., 2009) emphasized that there are many aspects of sociability to be found from single-play. Similarly examining the motivations for single-play in these findings, we can clearly see social aspects, being better than others and being independent of others' schedules.

Anonymity keeping was possible as the researched services had clearly been designed to allow users good control over what they reveal about themselves to strangers. Some people reported taking additional measures to maintain their anonymity and even their usage a secret. Some StreetPass users intentionally created avatars that cannot be linked to their own looks (P2). Some Pokémon GO players reported to keep their phones in pocket if they recognized nearby players (P6). In related work, some users preferred not to use pico-projector in public as it would draw attention from others (Mcgookin et al., 2014). In related work Licoppe and Inada (2012) identified those that kept distance to other players. The findings from the team-based competitive game Ingress (Blasiola et al., 2015; Hunzaker, 2016) showed that players took the privacy trade-off as part of choosing to play, but generally considered inacceptable behavior to follow another player. Still their findings showed that teams sometimes even kept records of other team's players' car license plates, and incidents where players would follow others by car for long distances or confront and threaten them physically; which conforms the need to take the measures to protect the players seriously.

Collaboration refers to working together towards a common goal. Pokémon GO users would take down a Gym together with strong ties or stranger players (P6). Familiar StreetPass users would for example collaborate in large events to make sure that as many different puzzle pieces as possible are collected (P2). The entire concept of Challenz was based on collaboration to finish funny videos (P1). Ingress players would collaborate within teams (Blasiola et al., 2015; Hunzaker, 2016). Geocachers would move travel bugs as a collaborative effort (O'Hara, 2008). Jokebox required timed collaboration to work (Balestrini et al., 2016).

People who adopt playful services for nearby strangers use it often also among already existing connections, such as family and friends, i.e., *bond with strong ties*. Pokémon GO was heavily played among strong ties. This happened with friends, with partners, with parents and their kids, but also interestingly with adult players and their own parents (P6). Some StreetPass users reported using the feature with their strong ties, mostly siblings or friends (P2). Some participants in Challenz focus

groups stated that they would only use the application among strong ties (P1). The early evaluation on Next2You concept revealed that people might use it for discovering their nearby friends (P3). Some of the Next2You use during the trial also happened between strong ties (P4). The role of use between strong ties leading to social experiences between nearby strangers can be found from related work as well. People engage with installation more easily when they are together with strong ties (Balestrini et al., 2016; Heinemann & Mitchell, 2014). In proximity- and location-based mobile services interaction among strong ties was often in the center of the use, and interaction between nearby strangers grew as a side-track to this (Frith, 2013; Håkansson et al., 2007; Koskinen et al., 2019; Lee et al., 2008; Mcgookin et al., 2014; Persson et al., 2005; Vella et al., 2019).

Community building: This research revealed that people embrace the social aspects and maximize the playful rewards by getting organized. StreetPass users reported taking part in regular meetups with local users, and even visiting meetups in different cities. These meetups were organized for example through Facebook groups. For StreetPass users this was a way to ensure the otherwise scarce chances of encountering others (P2). It was common for Pokémon GO players as well to join online communities (P6). Related work revealed building online communities in external services among Dragon Quest IX players (Licoppe & Inada, 2012), Geocachers (O'Hara, 2008), Ingress players (Hunzaker, 2016), and Pokémon GO players (Koskinen et al., 2019; Vella et al., 2019).

Both Pokémon GO and StreetPass, studies revealed various examples of *communicating with nearby strangers* in person. With StreetPass this was for example initiated by seeing someone holding their 3DS device (P2). Pokémon GO players could identify other players based on their behavior, movement patterns and hand gestures. Next2You users communicated with nearby strangers by sending messages to them (P4). Pokémon GO provided reasons (locating Pokémon, learning playing tricks etc.) as well as chances for communication (new Pokémon do not appear constantly, user can spin the same PokéStop every five minutes). Pokémon GO players reported also that sharing the physical place with strangers doing the same thing forced them to communicate as it would have been too awkward otherwise (P6). Communication with nearby strangers has been found also in other Pokémon GO studies (e.g., (Koskinen et al., 2019; Vella et al., 2019)). Various reasons for communicating with nearby strangers came up in related work. Interactive installations required communication to support collaborative efforts (Balestrini et

al., 2016; Heinemann & Mitchell, 2014), people would also pay acquired knowledge forward (Heinemann & Mitchell, 2014; Wouters et al., 2016) and even start championing experiences to nearby strangers (Balestrini et al., 2016). Technology-mediated and content-mediated communication between nearby strangers happened with mobile games and services (Esbjörnsson et al., 2003; Håkansson et al., 2007; Hunzaker, 2016; Jung & Blom, 2006; Lee et al., 2008; Persson et al., 2005; Seeburger & Tjondronegoro, 2012; Väänänen-Vainio-Mattila, Saarinen, et al., 2010). Wearable displays have been creating in person communication between nearby strangers in conference setting (Borovoy et al., 1998; Chen & Abouzied, 2016).

Interacting in crowd was identified as behavior from P2 and P6. Crowds create room for interaction between nearby strangers in many ways while at the same time providing certain anonymity. For StreetPass users, crowds provided a better likelihood of encountering other users (P2). Pokémon GO players would gather in places with high density of PokéStops and locate the rare Pokémon in collaboration (P6). This has been found by other Pokémon GO research as well (e.g., (Koskinen et al., 2019; Vella et al., 2019)). Otherwise, the concept of crowd interactions is not heavily discussed in related work, but some services can for example reveal hidden information about the social context (Chen & Abouzied, 2016; Holmquist et al., 1999; Monastero & McGookin, 2018) and (Wouters et al., 2016) builds a model about how people take different roles in relation to an interactive installation and others at the site.

Some people see services for nearby strangers as a tool for finding new friends or romantic partners. The motivation of *companion seeking* was identified during the focus group study with Next2You concept (P3). Some Pokémon GO players mentioned using LureModule to lure or impress potential partners (P6). Next2You whispers often contained some type of profile information, and some even dating oriented messages (P4). Mobile social matching was discussed by Mayer et al (2015), and some of the introduced concepts relate to mobile social matching (Chen & Abouzied, 2016; Eagle & Pentland, 2005; Jarusriboonchai et al., 2015; Kostakos et al., 2006). As mentioned, there are numerous commercial mobile online dating and befriending services, but they were kept out of the scope of this work.

Sharing vulgar content was identified from P2 and P4. StreetPass users reported having received vulgar greetings (P2). When classifying Next2You whispers, we encountered a set of vulgar content (P4). However, the intention behind these is

unclear; they might have been intended as jokes. This would stem with the findings of memetic expressions on wearable displays in the context of student culture (Epp et al., 2022). Hunzaker instead found that players coming from massively multiplayer online games often had to tone down their communication style when starting to play Ingress; the etiquette in a game that can have real-world encounters is different from the anonymous online worlds (2016). Communication intended as playful fun may be interpreted as serious.

Grief play is a term for players intentionally disrupting the gaming experience of other players (Foo & Koivisto, 2004). During the time of our research on Pokémon GO, it was possible to steal the reward of other persons Gym battle. After the Gym was defeated, there was a short period of time, when any nearby player could place their own Pokémon inside the Gym to collect the reward. This type of grief play was called Gym sniping by our respondents. It was encountered by several of our respondents, and we even had one respondent confessing enjoying doing it to annoy others. (P6) DigiMerkki users were discovered to practice playful spamming i.e intervening others' trade attempt with own content (Epp et al., 2022). Various types of disruptive behaviors among Ingress players was discussed by Hunzaker. Some of the behavior that seemed disruptive was classified as gamesmanship, playing by dubious means but according to rules, which was clearly the case also with gymsniping. In Hunzakers's findings the more senior players and (external online) community leaders would manage disruptive behavior, but there the seriousness of reported events was up to the scale of pointing another player with a gun (Hunzaker, 2016).

Cheating was last of the identified behaviors. StreetPass users were able to exchange content with users from all over the world with a hack called HomePass (P2). Hunzaker discusses GPS spoofing, faking GPS location to prevent the need to really visit a place and granting access to restricted places. Her findings also showed something in the borderline of cheating, using an aircraft to access the GPS location of restricted place from above without trespassing in ground level(Hunzaker, 2016).

The field trial with Next2You application discovered people who were just *testing* the service but not committed to using it properly. Many participants provided nonsensical test content, which was demotivating to those receiving it (P4). This behavior was not found in related work.

5.1.2 Emotional Responses to Using Playful Mobile Services for Nearby Strangers

This research found various emotional responses to using playful mobile services for nearby strangers, both positive and negative. Some of the positive emotions seem to have a clearer connection to the social aspects of the services, some have a clearer connection to the playful aspects; and some seem to arise from the combination of these. This subsection divides the experiences in positive and negative experiences, and groups similar or connected experiences. The experiences were identified bottom up from included research and are here discussed in relation to the PLEX (Lucero et al., 2014) categories where applicable, and related work showing similar experiences.

Positive experiences

Entertainment and fun: The single-player or single-user features provide entertainment, but it is even more fun to play together and share the positive experiences. (P1, P2, P3, P4, P6). In related work for example the long term studies with TWIN (Väänänen-Vainio-Mattila, Saarinen, et al., 2010) and Push!Music (Håkansson et al., 2007) mention entertainment and fun as the motivation for use.

Fellowship between strong ties: Both StreetPass and Pokémon GO seemed to inflict experiences of fellowship as it was used among family, across generations and with friends. (P2, P6) This covers part of PLEX category *Fellowship*. The finding on Geocaching (O'Hara, 2008) and Foursquare (Frith, 2013) showed playing with strong ties.

Sense of community with nearby strangers seemed to arise from various situations. Pokékon GO players and StreetPass users experienced this while being among other players in gatherings or when they recognized other players by behavior. This also happened when chasing rare Pokémon as part of a group. (P6) The invisible community of StreetPass players become visible through automatic exchanges. StreetPass use also enabled discovering people with similar interests by exchanging data with a StreetPass user playing the same games. (P2) Finding people with similar interest was also one of the expected uses for Next2You (P3). PLEX category *Fellowship* includes also community related experiences. After some time, the workers in the building where Traces (Monastero & McGookin, 2018) visualized footsteps in the lobby,

learned to interpret the visualizations, what kinds of people have entered the building recently.

Achievement, completion, competition: All the services seemed to be built around some form of collecting. The mere act of collecting as well as the completion of a collection provided feelings of achievement. (P2, P6) Some Pokémon GO players reported feeling competitive and trying to keep their collection better that their friends' collections. Competition in Pokémon GO was also apparent in rivalry between teams. (P6) In the case of Next2You, some participants questioned the idea of collecting people, and saw the point of using the application more in making new social connection (P3). PLEX has separate categories for *competition* and *completion*. In related work Insectopia (Peitz et al., 2007), FourSquare (Frith, 2013), FeedingYoshi (Bell et al., 2006) and DigiMerkki (Epp et al., 2022) build heavily on collecting.

Anticipation, discovery, surprise: When using these services people started expecting positive surprises. Especially with StreetPass you would never know when and what content you might discover. (P2) PLEX has a category for *discovery*. In related work the automatic pushed music in Push!Music was appreciated as a surprise gift (Håkansson et al., 2007).

Curiosity: StreetPass users reported to be interested in who and what kind of person the other one is (P2). Next2You users reported a general interest towards other users (P3, P4). Pokémon GO playing was motivated by some players with curiosity towards such a new type of gaming (P6). None of the PLEX categories fits this. In related work CapitalMusic (Seeburger & Tjondronegoro, 2012) and HocMan (Esbjörnsson et al., 2003) users were reported to be curious about other users.

Inspiration: Some StreetPass games exchanged content that inspired for example character building or decorating a virtual space. (P2) With Next2You, creating interesting content to be shared between nearby strangers was seen challenging, but it was assumed that seeing others' whispers will serve as an inspiration for improving one's own whispers (P3). PLEX category *Expression* relates to this. Digital graffiti (Mcgookin et al., 2014) and services such as Scent (Jung & Blom, 2006), Digidress (Persson et al., 2005) featuring profile creation related to this as well.

Benevolence: The automatic exchanges of content that would be valuable for the receiver in StreetPass provided feeling of benevolence both from the giver and

receiver perspective. (P2) The experience of benevolence was also evident is people sharing information about rare Pokémon, sharing gaming tips, as well as activating or enjoying the effects of a Lure Module that resulted in higher Pokémon appearance rate around the module. (P6) Altruistic play behaviors in the context of Pokémon GO are also mentioned by Vella et al. (Vella et al., 2019). The PLEX category *Nurture* is closest to this. In geocaching (O'Hara, 2008) reciprocity, giving back to community, clearly relates to this. Paying forward the information about free refreshments (Heinemann & Mitchell, 2014) and championing the fun installation to others (Balestrini et al., 2016) seem to relate to benevolence.

Ownership: Challenz study report showed that people anticipated experiences of ownership over the videos they would participate co-creating. They were interested in maintaining the quality of the video and receiving updated on those videos. (P1) Becoming the mayor of a FourSquare location (Frith, 2013), controlling Ingress location (Blasiola et al., 2015), and creating and maintaining geocaches (O'Hara, 2008) relate to ownership as well.

Subversion: Subversion is an experience included in the PLEX. It means breaking social norms and rules. From the perspective of other players griefplay is negative, but the experience of the griefplayer itself seems to be satisfied and relate to subversion and schadenfreude. Our only respondent report from this perspective was from a player repeatedly gymsniping others while hidden from them in a bush. (P6) In addition to *Subversion*, the PLEX category *Cruelty* seems also relevant here. Disruptive behavior was found common among Ingress players (Hunzaker, 2016). Creating funny fake profile and asking irrelevant questions in a conference just to get the profile visible for others (McCarthy et al., 2004) seems to relate to subversion as well. DigiMerkki users interrupting others' trade just for the fun of it fits this category as well (Epp et al., 2022).

Simulation: Simulation, an imitation of everyday life, is also one of the experiences in PLEX framework. Several Pokémon GO players described the game providing them an experience of being a real-life Pokémon trainer, which had been their dream profession since learning about it years earlier through the TV-series or previous Pokémon games. (P6) *Simulation* is one of the PLEX categories. Ingress players seemed to experience spycraft in the spirit of the game (Hunzaker, 2016).

Control, freedom, safety: Automatic exchanges with possibility choose what information is shared in StreetPass and Next2You provided in general experiences of freedom, control, and safety. Most users were not very concerned about using these technologies. (P2, P3, P4) Control is a PLEX category. Ingress players accepted certain trade-off of privacy and security as part of being able to play (Blasiola et al., 2015).

Negative experiences

Uncertainty: Next2You early evaluation showed that people were not sure what kind of content to share in such new medium between nearby strangers. (P3)

Insecurity: The early evaluations on Next2You and Challenz suggested that some people are concerned with new technology. They are concerned if using the application is safe; will it allow access to malicious or illegal content; can someone follow me; and how does it affect the personal mobile device with regards to battery and disk space consumption. (P1, P3) In related work Kostakos et al (2006) reported people's unwillingness to accept Bluetooth requests from unknown sources. Hunzaker's findings on Ingress players disruptive behavior shows that the fear of being followed may be justified (2016).

Disappointment, frustration: With the anticipation for positive surprises comes the downside of disappointment and frustration when such are not gained. StreetPass and Next2You users were sometimes disappointed with the received content, frustrated with the frequency of receiving content and technology issues affecting use (P2, P4). When discussing the anticipated use of Next2You, the study participants had concerns of both receiving too little and too much content depending on the service adoption rate (P3). The PLEX category that relates to this is *Suffering*. In related work Droz et al. (2006) and Bjerver (2006) report negative experiences caused by low adoption rate.

Neglect: Concentrating on playing aside other real life activities would sometimes lead to neglecting one's company (P2, P6).

Annoyance: Experiences of annoyance were reported regarding misbehaving others (P2, P4, P6). As described in previous subsection, people would share improper social content and use a platform for non-game purposes; they would cheat and

griefplay. In addition to Ingress player's disruptive behavior (Hunzaker, 2016), annoyance was also visible when funny fake profiles were used in a conference setting (McCarthy et al., 2004) and when people were not following a similar pattern for reporting their mood with colours than others (Gallacher et al., 2015).

5.2 Design Space for Social Experiences between Nearby Strangers

This section presents a design space for social experiences between nearby strangers. The design space is described in terms of types of interaction that can take place between nearby strangers, roles that the systems can take in facilitating such experiences before during and after an encounter; and places where playfulness can be incorporated in the design of such systems. Each of these aspects is described with examples. Figure 3 illustrates the key elements of the design space.

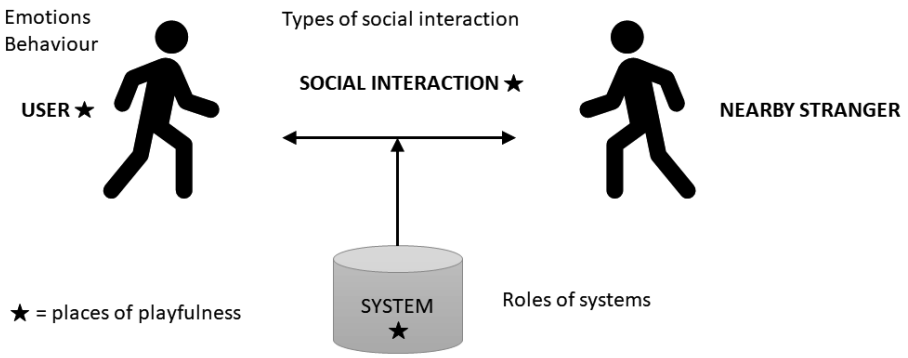

Figure 3. Key elements of the design space for social experiences between nearby strangers

This section is heavily based on the design space exploration reported as P5 where the ideas resulting from co-design activities were analysed. Two of the three themes (types and roles of systems) were directly taken from there. The original terminology was refined, and the scope was changed to the thesis level research questions through a synthesis over all publications. The third theme (places of playfulness) was

introduced as it felt that this main topic of the thesis was not adequately addressed otherwise. The exploration of design space for social experiences between nearby strangers took intentionally a wider scope than mobile services. It was seen that a wider scope could reveal more also about the topic itself and put it in perspective.

The design space can be used as an inspiration for designing new playful mobile services for nearby strangers. It guides designers consider different aspects and possibilities in them. The design space is also aimed at guiding further research efforts by structuring the gathered knowledge and providing vocabulary so that future findings can be reflected against it, and identifying novel aspects becomes easier.

5.2.1 Types of Social Interaction

This research identified six types of social interaction between nearby strangers. The original publication (P5) used term *levels of social interaction*, but it was replaced with types to emphasize the idea that there is no clear hierarchy or preference related to them. Different technologies support different interaction types, different people prefer different interaction types, and different context may be better suited to certain interaction types. Figure 4 illustrates how the types are divided in to direct (human-to-human) and mediated (human-to-machine) interactions.

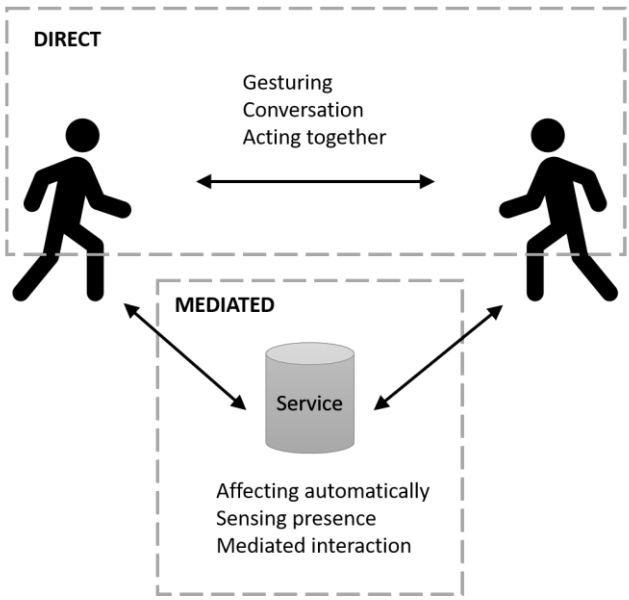

Figure 4. Types of social interaction

With *affecting automatically*, the nearby strangers leave some kind of mark on each other automatically, but no active effort is needed while nearby. Users may notice this on the spot, later, or never. Depending on the exchanged content and the operation range, this type of social interaction can preserve user's privacy quite well. When exchanges happen automatically, and the detection range is wide, user's identity is not revealed likely. Wearing or holding a specific device or sharing revealing content could reveal one as a user. The user's actions related to this interaction type happen prior to and after the actual encounter, preparing content for others and interacting with received content. The automatic exchange of content with StreetPass (P2), Next2You (P3, P4) and Challenz (P1) are clear examples of this interaction type. According to the P5 concept, *Chameleon T-shirts* would modify their appearance based on the content that they collect from nearby users' T-shirts, and *Push-ups* mobile application would execute automatic mini battles between nearby users where the power of the user would be based on their physical activities, for example number of push-ups they have been doing. In earlier work, the service Push!Music (Håkansson et al., 2007; Hakansson et al., 2007) implemented automatic exchanges as well.

With the next type, *sensing presence*, user is made aware of a nearby user. Awareness is a related term commonly used in related work. This choice of terminology aims to remind designers to consider different human senses when wanting to create awareness of others. The idea here is that the user is not expected to actively query their surroundings, but the information is provided to them. The difference to *affecting automatically* is in the temporal aspects. Presence is sensed only when the users are nearby, while the effects of affecting automatically can be observed at own pace. The idea is not to necessarily reveal who and where exactly the other user is, but the design can preserve their chances for privacy. StreetPass users can see a green LED lit when an exchange has happened (P2). Pokémon GO players would recognize others as players based on their movement patterns and hand gestures (P6). According to the concepts ideated in P5, users could for example feel heat when another user was nearby or see the footprints of another user in augmented reality. In related work Hummingbird (Holmquist et al., 1999) is a prime example of sensing presence, even though the feature is not used for sensing the presence of specific strangers, but strong ties. Traces visualizes the footsteps of building visitors for a while, providing awareness of others (Monastero & McGookin, 2018). Jabberwockies aim to visualize information about familiar strangers who were or had been at the user's current location (Paulos & Goodman, 2004). The possibilities for brain-to-brain interaction will take this to new level (Fang et al., 2021).

Mediated interaction relies on a technology-mediated connection established between nearby strangers. Interacting becomes an active action aimed towards the other person. With Next2You, users were able to like each other's whispers and send messages to each other after the first encounter (P3, P4). Mediated interaction was furthermore designed also to support arranging face-to-face meetings. StreetPass exchanged a general greeting during the first exchanges, but after repeated encounters users were able to personalize the message (P2). In Pokémon GO, players can simultaneously battle at the location-based Gyms (P6). This is also technology-mediated interaction between nearby strangers. In earlier work, several of the proximity-based mobile services implemented mediated interaction (Håkansson et al., 2007; Jung & Blom, 2006; Persson et al., 2005; Seeburger & Tjondronegoro, 2012).

In *gesturing*, the interaction is short, bodily and mutual like creating an eye contact, smiling at each other, making gestures and replying to them. The gestures can be symmetrical, like when two motor bikers greet each other on the road by raising their

hand. Alternatively, they can be asymmetrical, like when someone waives their arm in certain way to a truck driver, and they answer back by honking their horn. In our concepts Honk honk referred to the possibility to command other user by gestures (P5). In Pokémon GO, the specific gestures required to throw PokéBalls have helped recognizing others as players (P6). However, those gestures are not aimed at the other player, which is the idea in this interaction type. In earlier work, Hocman (Esbjörnsson et al., 2003) discusses the habit of motorbikers greeting each other with raised hand, Jokebox (Balestrini et al., 2016) users coordinating interaction with gestures, and (McCarthy et al., 2004) nearby people smiling and nodding at a person whose profile they saw in a public display at a coffee table.

In *conversation*, a face-to-face conversation is started between nearby strangers. The conversation can serve a purpose in the play, or it can be small talk that results from noticing another person doing the same activity close by. Pokémon GO was found to create conversation for various purposes, for example to find nearby Pokémon, coordinate use of LureModule and Gym battles, compare collections; or teach and learn to play. Pokémon GO furthermore encouraged people to spend time in specific locations creating an opportune setting for conversations. The operation radius for location-based features allowed some freedom in locating oneself, but if there were many people, or if some parts of the area were more lucrative than others, e.g. the only bench in the park, then people were encouraged to spend time closer to each other than they would normally choose. (P6) In Next2You, the face-to-face registration could not be performed correctly without users being able to see each other's displays (P4). This was expected to create a setting for conversation. One of the ideated concepts was based on encouraging strangers to eat together, as it was assumed to create an opportune setting for conversation (P5). According to the concept of *Shadows*, fake shadows of people would be projected on the wall, when the system would notice that people are not interacting. This was expected to create such a weird moment, that it would lead to actual conversation (P5). The conversation around *Encounters* (Wouters et al., 2016) were related to passing information about how to interact with the installation. The conversations around the shape changing bench were found to be cursory (Kinch et al., 2013).

The last type, *acting together*, is about encouraging nearby strangers to act together also on a physical level. With Pokémon GO people would sometimes explore the surroundings together to discover hidden nearby Pokémon more effectively (P6). These kinds of group actions may be more easily created with different kinds of

interactive installations. The ideated concept of *Dancing*, where people follow the interaction cues provided through a public screen belongs to this type (P5). Interactions around the interactive installation *Encounters* (Wouters et al., 2016) belong to this category.

5.2.2 Roles of Systems

Systems can have different roles in creating social experiences between nearby strangers. The following figure 5 illustrates the time span of an encounter of nearby strangers, and the roles systems can take in it. The figure is divided in three areas, before the encounter takes place, during an encounter, and after the encounter.

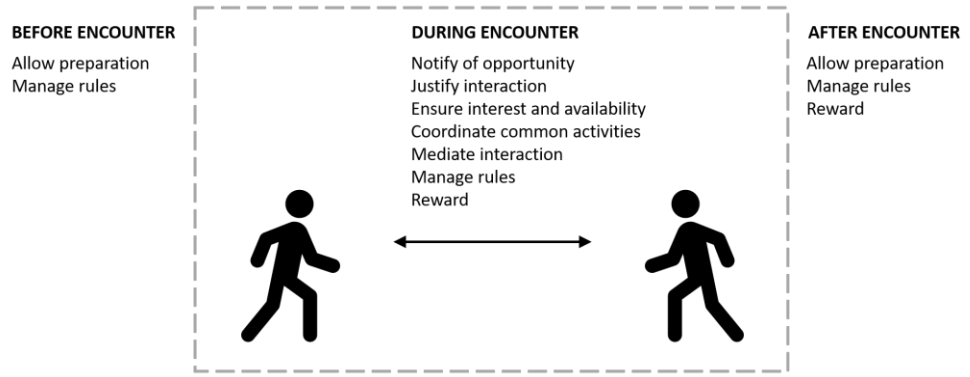

Figure 5. Possible roles of systems before, during and after an encounter between strangers

Systems can be designed to *manage the rules* at any of the phases. In Next2You, the internal rules for example stated that exchanges were always reciprocal. This would at some point prevent further exchanges with a user with less whispers (P4). StreetPass allowed exchanges with the same user once every eight hours. Users were able to personalize their greeting after three encounters (P2). The rules related to collecting Gym battle rewards were changed, as the original rules permitted Gym sniping (P6). The rules of *Hotter hotter* would state for how long the players must stay uncomfortably close to each other to score points (P5). Rules are central to games and gamification (Deterding et al., 2011; Tekinbas & Zimmerman, 2003). In addition to system governed rules, gaming literature discusses *implicit rules*, unwritten rules of accepted behavior (Tekinbas & Zimmerman, 2003). Research on Ingress discusses

how MMO gamers adapt to the different communication etiquette of game that is played in real-world (Hunzaker, 2016). The research on interactive installation *Encounters* (Wouters et al., 2016) showed how the implicit rules on polite behavior affect the way people take different roles and exchange information about interactive installations.

Systems can be designed furthermore to give extrinsic *rewards* to the users at any of these phases. Considering rewarding, in StreetPass the exchanged content could have collectable and playable value (P2). Pokémon GO would reward staying around a PokéStop by letting the user to collect new rewards every five minutes (P6). In Next2You, the received whispers were the reward. Next2You would provide the profile picture of the other user with whom the user had played the face-to-face mini game (P4). According to concept in P5, *Hotter Hotter* would provide a reward for staying very close to another player, while in Collective discounts the users would get a discount of a shared meal after performing together. External rewards, such as badges and points, are one of cornerstones of gamification (Deterding et al., 2011).

Systems can allow user to *prepare for encounters* with others before and after the encounter. This can mean for example generating content to be shared for others or interacting with content received as a result of an encounter. With Next2You, the user can create whispers before the encounter, and view the received whispers afterwards (P3, P4). With StreetPass, most of the content is generated as the user interacts with the games (P2). According to concept Push-ups, the user would prepare to an encounter by doing physical activity which will be registered to the application somehow and compared with other users' activity upon encounter (P5). Ojala (2017) defines content-mediated interaction activities as: content creation, content sharing, content enrichment, following the content and content consumption.

Systems can *notify* both parties *of the presence of other* upon encounter, i.e., of the opportunity for interaction. StreetPass lights a green LED when an exchange has happened (P2). Next2You used standard notification channel for Android phones (P3, P4). Notifying is closely related to the interaction type of sensing presence. According to concepts, Hotter hotter notifies users by heating a personal device, while in Footprints the user can see other users' footprints in augmented reality (P5). CommonTies does this by lighting one LED with the same color in each of the

devices (Chen & Abouzied, 2016). Hummingbird notifies of co-located others by a constant humming noise (Holmquist et al., 1999).

Systems can furthermore *justify interaction* by giving an excuse or reason to interact. Excuse refers here to a playful approach: The rules state that to accomplish a task and get a reward, one must interact with a nearby stranger. The user can either choose or refuse to play. There is no real-world reason, the reason exists in the magic circle of play, which from the real-world perspective can be seen as an excuse. According to the concept of Hotter Hotter, players should seek another player based on increasing feeling of heat and stay very close to the other person in order to score points (P5). Such behavior would be acceptable between nearby strangers who have chosen to play such a game but depending on culture and context it might otherwise be unacceptable. Close physical proximity is usually reserved for intimate connections (Hall, 1963). The hidden Pokémon and unclear game mechanics in Pokémon GO gave actual reasons to interact. A player coming from another direction could have located the Pokémon and save you time from searching. A more knowledgeable player could teach others some gaming tips. Winning a Gym battle might be impossible or at least very time consuming alone, thus require connecting with other players (P6). Several examples of wearable displays in related work provide information that could be used in a conversation (Borovoy et al., 1998; Jarusriboonchai et al., 2016; Kao & Schmandt, 2015), but playful reasons and excuses to interact are still mostly missing. One of the design principles for facilitating the first move between nearby strangers by Mitchell and Olsson (2019) is automating the first move, where the idea is to let the system or artefact take the blame.

System can take the role of *ensuring the encountering strangers' interest and availability* for interaction. It can for example provide information about the other one and ask to confirm before proceeding further. Certain interactions can be limited for occasions where mutual agreement exists. When entering a *Stranger section*, a person signals their willingness to interact with others. The subtle sensation of increasing heat in *Hotter Hotter* provides the user a possibility to ignore or disable the application when playing is not suitable (P5).

Systems can *coordinate common activities*. In Pokémon GO Gym battles, players play against common enemies (P6). In the concept of Dancing, people follow dance moves that are shown on a public screen (P5).

Systems can *mediate interaction* during and after encounter. Automatic exchanges of content in StreetPass and Next2You are asynchronous mediated interaction, even though the respondent is unknown. After a few repeated encounters, StreetPass allows personalizing the greetings to that user (P2). In Next2You the first encounter opened the possibility to send personal messages anytime (P4). Creating and sharing videos in collaboration in Challenz would also be content mediated interaction (P1). In related work mediated interaction was possible in Push!Music (Håkansson et al., 2007), CapitalMusic (Seeburger & Tjondronegoro, 2012), Scent (Jung & Blom, 2006), Digidress (Persson et al., 2005) and TWIN (Väänänen-Vainio-Mattila, Saarinen, et al., 2010).

5.2.3 Places of Playfulness

The previous two subsections may apply to technology that is not playful as well. This chapter explicates where playfulness was identified in and around the studied services and concepts.

Rules are an essential part of play, and it showed in the services and concepts in many ways. User's interactions with others were restricted and guided by rules. Implicit rules or code of conduct reside in user's mind and are not necessarily written anywhere. Pokémon GO players would for example politely take turns on fighting at Gym (P6). In the concept of HonkHonk, the player was allowed to command another with gestures, and the other one should perform accordingly (P5). Services operate according to their internal logic and enforce the explicit rules. Both StreetPass and Next2You have for example rules on how often exchanges can happen and with whom (P2, P4). In related work the rules of Jokebox demand collaboration to operate the service (Balestrini et al., 2016).

Extrinsic *rewards* belong to games and gamification, while the social experiences as themselves were also considered as rewarding. Discovering another StreetPass, Challenz or Next2You user in the real-world result in receiving something (P1, P2, P3, P4). This served as a positive feedback and increased motivation to continue the activity. Unfortunately, Next2You whispers were not always considered rewarding due to their quality and the low frequency of encounters led to discontinuing use (P4). StreetPass instead provided many kinds of rewards. One would receive the playful looking avatar of the other player to their collection. In addition to that, one

might receive many types of collectable items and playable content to different games. (P2) In related work, Foursquare rewards visiting a place more than others with a mayorship of the place (Frith, 2013). Jokebox users hear a joke as a reward (Balestrini et al., 2016). Feeding Yoshi players get points (Bell et al., 2006). Geocachers can compare their number of found caches online (O'Hara, 2008). Ingress players contribute to their personal points as well as team goals (Blasiola et al., 2015).

Playful experiences: Exploring the real world to discover other StreetPass or Next2You users, or Pokémon lead to playful experiences, such as surprise and curiosity (P2, P4, P6). One does not know when another user is encountered and what will be received as a result of that. There is mystery related to automatic exchanges, as they might provide some information about the other user, but not necessarily reveal who that user is. Hotter hotter adds another layer of excitements, locating another player based on sensing increasing or decreasing heat (P5). Push!Music users found automatic pushing of songs to nearby others magical (Håkansson et al., 2007). Blowtooth played with the illusion of smuggling drugs, something that is illegal in real world (Kirman et al., 2011).

The services and concepts encourage or even demanded *playful behavior*. Pokémon GO and StreetPass encouraged people to explore their surrounding actively in order to encounter others or find Pokémon (P2, P6). According to the concept of Honk Honk, player could command another player to behave in a funny way (P5). In related work the location-based games have shown to encourage exploration in the real world. CommonTies users would sometimes explore the crowd with their hand held high to let the others see the lit LED color (Chen & Abouzied, 2016). MoodSqueezer users would sometimes manipulate the system until they got the public displays to display the color of their choice (Gallacher et al., 2015).

Playful content: The studied services and concepts included exchanging content. The content can be playful, for example funny or mysterious. In Challenz concept, the videos created in collaboration were expected to be funny because the user could only view the previous clip, not the whole storyline before shooting their own clip (P1). The exchanged avatars in StreetPass and Next2You were designed to look playful rather than serious. StreetPass users could utilize funny hats to decorate their avatars and Next2You avatars wore masks to emphasize the mystery of the nearby stranger (P2, P4). Related work shows people sharing playful content even when it

is not encouraged in any way. The analysis on meme content on MemeTag showed humorous content (Borovoy et al., 1998). Push!Music users where pushing humorous songs as pranks to their friends (Håkansson et al., 2007). Conference visitors were creating funny fake avatars (McCarthy et al., 2004).

Playful interaction with content: The studied services allowed also playful interaction with exchanged content. Challenz users could enrich the content by continuing it (P1). One of the concepts included decorating the avatar of another user in a funny way (P5). Some StreetPass games allowed users to play with the content (P2). Digital Graffiti users modified others' graffiti as a light weight interaction with them (Mcgookin et al., 2014). New visitors interacting with Traces were often found to draw with their footsteps (Monastero & McGookin, 2018).

Playful interaction with others: The concept of Hotter Hotter demanded players to go uncomfortably close to another player and stay there for uncomfortably long time in to gain a reward in a game (P5). Next2You users could play a mini game face to face to exchange profile pictures (P4). In Pokémon GO, players could simultaneously try to take down a Gym (P6). Push!Music users where pushing humorous songs as pranks to their friends (Håkansson et al., 2007). Geocachers create caches for others (O'Hara, 2008).

5.3 Design Considerations for Playful Mobile Services for Social Experiences between Nearby Strangers

This section discusses design considerations for playful mobile services. These are not a guaranteed key to success but rather a set of things that seemed to increase or decrease motivation to continue using the service and interact with others. The design considerations are organized under three themes: designing for engagement with the service, supporting different social contexts and creating a positive atmosphere. These themes were identified bottom up from findings that were not addressed in the earlier sections, or there was another viewpoint to something that already mentioned. These design considerations can serve as a starting point for designers and researchers aiming to create new concepts or otherwise advance this field. There are many additional aspects that affect the success and failure of any service, such as marketing, competition, and business model; but they are out of the scope of this research.

5.3.1 Design for Engagement with the Service

First challenge is common to any mobile service that aims to stay alive. Active users are needed. This is even more imperative, as we are talking about services that somehow rely on nearby strangers interacting in the real world. An asynchronous online service connecting distant users may survive with less engaged users. This research identified three topics that help to ensure users' engagement with such services. First, the user should trust the technological choices made, otherwise users are likely to refuse or stop using the service. Second, using such services should provide frequent rewards to the user. And third, the rewards should be considered high quality by the user.

Maintain trust with proper technological choices. Two factors regarding technological choices come across as important, trust in the connectivity technology and battery consumption. Suspicion towards Bluetooth and battery consumption peaks were reported as reasons to quit using Next2You (P4). StreetPass users instead reported lower security or privacy concerns with the feature than with technology in general (P2). The slightly increased battery consumption was a price they were ready to pay for the benefits. An observation outside our own research is that playing Pokémon GO increased battery consumption so much that it was common to spot players with power banks. These examples show that failing to make right technological choices puts the service at risk, but if the rewards are high enough users may be ready to accept them. Earlier research suggested for example that users were interested in connecting with nearby strangers, but unwilling to accept Bluetooth connection requests from unknown sources (Kostakos et al., 2006).

Provide frequent rewards. The second topic of engagement is receiving frequent rewards. Rewards here refer to any content or interaction possibilities provided by the service. A common reason for discontinuing use and negative experiences was not discovering others both with StreetPass and Next2You (P2, P4). Challenz study participants were also mentioning receiving content frequently as a key to keep using it (P1). As discussed in P4, there are several ways to design for frequency. First thing is of course to invest effort in gathering enough users, at least in chosen geographic focus areas. The range of proximity-based systems should be wide enough, and it could even be adjustable. This would allow adapting to a low user density at the beginning and in scarcely populated areas, and also to dense areas that might suffer from too frequent encounters to keep using motivating. Automatic exchanges

instead of user-initiated queries for nearby others free the users from active efforts to discover others and decrease (but not prevent) the disappointments of not discovering anyone. If the density of users is low, in addition to actually encountering others, users could be allowed to get some follow-up updates from the encountered users. These would then eventually seize if the users do not encounter repeatedly. Location-based features can support the frequency in different ways. StreetPass users could visit certain locations to pick up the six latest visitors and leave their avatar and content to be picked up by next visitors (P2). Location-based PokéStops, that provide repeated rewards every five minutes, and create a common spawning point for Pokémon, encourage players to spent time around them, thus creating places where players encounter others. (P6) Related work shows users of location-based games seeking places where they get maximal rewards with minimal effort, i.e can reach several locations easily (Bell et al., 2006; Blasiola et al., 2015). During COVID-19 social distancing Pokémon GO received updates that allowed accessing elements from a greater distance, and even participating from home. These updates were enjoyed by players in rural areas and players with disabilities who normally felt having disadvantages in the game, but it changed the gaming from going out to staying at home. (Saaty et al., 2022)

Ensure quality of rewards. Strong single-user experience with high quality rewards is important for the engagement with the service. The studied services provided possibilities for collecting, receiving playable or actionable content, and creating content. Even though the pattern of single play may be associated with a wish to be left alone, this pattern has a social aspect as such users provide technology-mediated interaction and content for others, who may perceive it as social. Challenz study participants mentioned quality of videos as another key aspect beside frequency (P1). StreetPass users appreciated receiving especially unique and playable content instead of in-game currency types of rewards (P2). High share of nonsensical content, created for the purposes of being able to test the application, was perceived as demotivating by Next2You users (P4). Design of the services should aim to ensure the quality of created content and emphasize the uniqueness of each encountered user. Related work on sharing digital profiles to support face-to-face communication showed that basic information was rarely integrated in discussion, and users preferred ambiguous and visual content in the profiles(Kytö & McGookin, 2017).

5.3.2 Support Different Social Contexts

When designed for different social contexts, the services allow interactions to happen between various combinations of people and in various environments. User's personal context is prone to change anytime. Some types of interaction fit easier various contexts, while others have stronger requirement for mutual interest and possibility to invest time in them. Nearby strangers passing by each other on the streets may not have time or wish to interact actively but enjoy an automatic exchange. A ride in congested local transportation may provide chances for technology-mediated interaction, but not a possibility for face-to-face encounter with a specific nearby user. When spending free time at a park, users may have freedom to move, time to spend, and a relaxed mood creating a context suitable for face-to-face encounters as well. While for face-to-face encounters, the contextual requirements may be similar to those discovered by Mayer et al. (2015) with regards to social matching, the more lightweight interactions have less strict requirements. Related work on interactive installations suggests that people are more likely to engage with installations within a group of friends and in leisurely context, while in serious contexts installation may even be misunderstood (Heinemann & Mitchell, 2014; Kinch et al., 2013; Mitchell, 2009).

Design for privacy preserving ways for users to discover each other. Becoming aware of nearby stranger users creates a sense of hidden community (P2). Finding a right balance between revealing and concealing players is important for enabling interactions between nearby strangers, but at the same time providing them feeling of control over their privacy. StreetPass users could personalize their avatars to either look like them or totally different, thus either increasing the chances for real world interactions or decreasing them. The automatic exchanges with wide detection range allowed users to pass each other unnoticed while holding a 3DS device visible would advertise one as a user (P2). Next2You had a shorter detection range, which could reveal users more easily, but on the other hand real avatars were not exchanged along whispers, only as a reward for actually meeting face to face (P4). Pokémon GO gathers players around location-based virtual places, and the hand gestures needed to catch Pokémon and the movement patterns of suddenly stopping to start catching Pokémon reveal people as players. Skipping play when others are at sight or adopting unnoticeable gestures would allow one to go unnoticed, or signal unwillingness to interact with others (P6). Interesting visions of privacy preserving concepts for discovering others from the design space exploration included using thermoception

to track other users and following other user's footprints visible only in augmented reality (P5). In earlier work Push!Music could automatically push music to nearby users, even strangers (Håkansson et al., 2007). Traces visualized only the footprints of building visitors, and they would even fade over time (Monastero & McGookin, 2018). Ingress shows only user's own location on the game map, not other players (Blasiola et al., 2015).

Support interweaving play with life. Single-play oriented users may take every opportunity to advance their virtual collections by keeping their games activated during the day (P2, P6). If playing does not require full attention for long time, it may be done along other activities and among co-located non-players without causing too much distraction. Automatic exchanges allow play to happen even if one cannot be distracted. Even when playing primary single, if previous design consideration is followed, these players are somehow discoverable by or provide rewards to others, thus creating social experiences.

Support play among co-located strong ties. If the technology provides advantage or at least does not penalize it, people may play among co-located strong ties. Players who play among co-located strong ties may be more engaged than if playing alone and thus become long term users. The design can for example benefits from playing together, be positive sum, or have positive local effects. Collecting in both StreetPass and Pokémon GO was positive sum, i.e., catching or receiving something is not away from the nearby player. In Pokémon GO, several players could search hidden Pokémon more effectively by covering different area, and each catch their own copy of it. In StreetPass, players could first team to collect different puzzle pieces and then exchange copies of the missing pieces with each other. Pokémon GO Lure Module would benefit the nearby players and taking turns on activating such would reduce the cost for one player. (P2, P6) In related work Push!Music users were actively pushing content to their friends (Håkansson et al., 2007). Heineman and Mitchell (2014) describe how people were more likely to engage with public instruments in a group of friends. Ingress players, especially female players, found playing in public safer with others (Blasiola et al., 2015).

Support play among co-located strangers. The whole point of this thesis is that playful social experiences between nearby strangers are something special and desired. Nevertheless, there are numerous things to consider when designing for them. Supporting play among co-located strangers is the key, but it doesn't necessarily

survive without the other components. Automatic exchanges are one option to enable play among co-located strangers. Location-based features and persistent world are an option that allows co-located play in the same virtual world. In a persistent world, virtual items or creatures exist in the same locations. Ambiguity related to the exact location of nearby Pokémon promoted co-located communication between strangers as well between familiar players. The same concepts, local effects and positive sum, that were discussed above, promote play among co-located strangers as well. While some of the interactions may be primarily aimed at the strong ties, they may create positive experiences between nearby strangers as well. When strong ties go out to the real world together, they may be more easily discovered than single users. It may also be easier to start face-to-face discussions between nearby groups of people than to address a single person alone.

Design for community building. When the service provides benefits from a bigger group, users start building online and offline communities. StreetPass users belonged to Facebook groups as well as took part in meetups. The meetups allowed them to make many exchanges at the same time, meet with people with similar interest and play 3DS games together (P2). Early Pokémon GO communities included theorycrafting and mentoring, i.e. trying to understand the internal hidden logics of the game and teaching it to others (P6). People in a same Ingress teams were found to collaborate on different online platforms (Blasiola et al., 2015; Hunzaker, 2016).

Design for progression. Progression refers here to moving towards more personal and active involvement between users. It supports privacy and provides the user control over their readiness to interact with others. Technology can support progression by letting users suggest other types of interaction for nearby strangers and providing benefits for doing it. StreetPass allowed personalizing greetings for strangers that are encountered repeatedly, which allows short conversations to take place (P2). Next2You opened a messaging channel between users upon the first encounter (P4). In Ingress senior players would contact newcomers and invite them to online communities (Blasiola et al., 2015; Hunzaker, 2016). Online Ingress communities allowed similar ways of building trust as was found to happen in online dating.

5.3.3 Design for Positive Atmosphere

Positive atmosphere keeps the service welcoming and inclusive for users with different backgrounds. It decreases the likelihood of fierce rivalry between players with different allegiances. This research found three components that contribute to the positive atmosphere: benevolence, playfulness and dealing with misbehavior.

Design for benevolence. If the service is designed with benevolence in mind, other users are a resource rather than a threat and interacting with them makes sense. Pokémon GO creates a location-based persistent world, where the same Pokémon can be found by different players in the same location. It is furthermore a positive-sum game, i.e., each of the nearby players can catch their own copy of the same Pokémon instead of it disappearing after someone catches it. This means that users do not have any reason to hamper other's play, but rather co-operate to find the Pokémon together. Another feature increasing the benevolent atmosphere in Pokémon GO was LureModule, a virtual item that a player activates on a PokéStop, which creates a local positive effect of increased rate of appearing Pokémon visible for all nearby players. Even though Pokémon GO players join one of the three global teams, the team aspect was not especially strong. Members of other teams were not fierce rivals, so helping or mentoring them was not counterproductive. (P6) In StreetPass enounters with others were either beneficial or irrelevant, depending on a game and players state with it. Some games enabled gifting. (P2) This approach is quite the opposite to the competitiveness of Ingress (Hunzaker, 2016) and Botfighters (Bjerver, 2006).

While designing for benevolence, it is important to prepare for *dealing with misbehavior* as well. Misbehavior was encountered in all of these generally positive and benevolent examples (StreetPass, Next2You and Pokémon GO). For Next2You we implemented blocking a user, but no filtering for whispers or messages (P4). StreetPass guided strictly the created profiles by allowing users to choose from predefined options and use only very short greetings (P2). Their other messaging platform was discontinued because of misbehavior. Pokémon GO players could steal other player's battle rewards by placing their Pokémon at a Gym before the winner managed to do it. This loophole was later fixed. (P6) Ingress supports blocking other users. The leaders of Ingress online communities would approach misbehaving players and calm down heated situations (Hunzaker, 2016).

Design for playfulness. A playful design emphasizes that the interactions are done for the sake of play, they are not to be taken seriously and the user does not have any other agenda in mind (or at least they should not have). Taking part in play allows interactions between different genders and generations, that might otherwise be uncommon between nearby strangers. Both StreetPass and Pokémon GO results revealed positive social experiences between different generations, which would not likely have happened, or would have felt more awkward without the frame of play. (P2, P6). Related work has found users appropriating services for playful interactions e.g. (Borovoy et al., 1998; Gallacher et al., 2015; Håkansson et al., 2007). Ingress players were found to take the game sometimes very seriously, up to threatening others with a gun (Hunzaker, 2016). This suggests that fierce rivalry between teams may make one forget it is supposed to be about play.

6 DISCUSSION AND CONCLUSIONS

This chapter discusses the results, quality and limitations of the research and suggests directions for future research and design work. It also presents my conclusions.

6.1 Novelty and Relevance of the Findings

The results chapter reflected individual findings with related work. This section discusses the overall results on a more general level.

The first research question was "What kind of social experiences emerge between nearby strangers from the use of playful mobile services?" The results for this question were categorized into behavioral patterns and emotional responses. Such an extensive set of patterns has not been identified previously, even though many of the patterns are familiar from previous work. The concepts *interweaving with life* and *active exploring* are familiar from research on location-based gaming (Bell et al., 2006; O'Hara, 2008). *Non-use* has received less attention in the context of services for nearby strangers. Regarding that, becoming demotivated from the lack of other users has been identified earlier (Bjerver, 2006; Drozd et al., 2006; Väänänen-Vainio-Mattila, Saarinen, et al., 2010). *Play and others* includes a wide range of social behaviors, including playing alone, playing with strong ties, playing with strangers, and forming communities. Similar behavior has been identified for example in research on the experiences of Pokémon GO players experiences that was conducted contemporaneously or subsequently to my research (e.g., Evans & Saker, 2019; Koskinen et al., 2019; Vella et al., 2019). *Misbehaving* with services for nearby strangers, such as sharing vulgar content, grief play, and cheating has only been discussed once previously, by Hunzaker (2016), with regard to Ingress players. Small and short user studies are probably too limited to create and capture such behavior.

Emotional responses to using playful mobile services for nearby strangers were also discussed relative to RQ1. Most of the experiences that I identified could be linked to the PLEX framework (Korhonen et al., 2009). However, many subtleties

demanded adjustments. For example, *fellowship* had to be divided between fellowship between strong ties and sense of community with nearby strangers. Several experiences had no exact match in the PLEX framework, such as anticipation, surprise, curiosity, and insecurity.

The second research question was "How can playful mobile services be designed to encourage social experiences between nearby strangers?" The results relating to this question were again grouped into two categories that took slightly different perspectives. First, the results were presented as a design space. Second, design considerations were discussed based on the findings.

The design space for social experiences between nearby strangers presented in this work included three elements: types of social interaction, roles of systems, and places of playfulness. No similar categorization has been presented elsewhere.

Types of social interaction resembles the levels of social interaction category in Ludvigsen's (2006) framework. His work explores the design space of co-located social interaction in interactive spaces but also incorporates knowledge from the design of pervasive mobile games. His framework presents four levels of social interaction but excludes mediated interactions. *Distributed attention* refers to people sharing the same space but having a different focus. This level allows the mediated interactions *affecting automatically* and *sensing presence* to take place in the meanwhile. *Shared focus* means that co-located people are focusing on the same thing (for example, an installation) but do not necessarily communicate. It has a connection to *sensing presence* (for example, when players gather around an augmented location). *Dialogue* refers to two-way communication, and *collective action* is defined as working together toward a shared goal. These match the direct interaction types in my categorization: gesturing, conversation, and acting together. *Dialogue* also relates to *mediated interaction*. Similar factors are included in Buruk et al.'s (2019) design framework for playful wearables. Their social category considers the distance or closeness of an interaction, its interdependence or independence, and whether it is verbal or physical as separate subcategories.

Roles of systems overlaps with Jarusriboonchai's model for designing mobile technology for co-located interaction (2016), but the works have slightly different viewpoints. Even though her work includes an ice-breaking game, the focus is not on playfulness. Relevant to this work, Jarusriboonchai's model introduces two roles:

information provider and activity facilitator; and three design objectives: *inviting, encouraging, and enforcing interaction*. The roles described in my work mostly expand what lies inside Jarusriboonchai's role of activity facilitator. The design objective of *inviting interaction* can be seen in the role of *notifying of opportunity*. The design objective of *encouraging interaction* relates to the roles of *justifying interaction* and *rewarding*. From the perspective of taking part in play always being voluntary, *enforcing interaction* does not seem applicable at first. But when considering accepting the magic circle, and the potentially negative playful experiences there, enforcing interaction matches *justifying interaction*, and the concept of providing an excuse for interaction.

The *places of playfulness* category included seven different strategies for incorporating playfulness into the design of services for nearby strangers. For each place of playfulness, some related examples were found in the published literature, but such abstracted knowledge has not been presented before.

Design considerations for playful mobile services for social experiences between nearby strangers included engagement, social context, and atmosphere. This category allowed me to highlight important findings that did not fit my previous categories, as well as clarify why and how some of the findings should be considered in design.

Designing for engagement included *maintaining trust with proper technological choices, providing frequent rewards,* and *ensuring quality of rewards*. Evans and Saker (2019)found that engagement with Pokémon GO was far stronger than engagement in earlier location-based games that offered more limited gaming experiences. Consequently, the effects of the game on mobility, spatiality, and social mobility were stronger. Even though *maintaining trust* would seem to be a very general and common design consideration, the fact that non-use has rarely been discussed in related research makes it worth mentioning. *Providing frequent rewards* relates to the problem of *critical mass*, which previous scholars have highlighted (Bjerver, 2006; Drozd et al., 2006). Rather than emphasizing gaining a critical mass of users, my work suggest that designers should find ways to accommodate existing user numbers and user density. *Quality of rewards*, what is seen as worthy of explorations in the real world, and the connection to or impact of the other user in the reward, are not discussed in related work.

Designing for different social contexts draws attention to the fact that our social context changes over the course of the day, offering different possibilities for playing with

nearby strangers. By implementing features that support different social contexts, the designer can support different types of social interaction between nearby strong ties and strangers. Dagan et al. (2019) prompt designers to consider how wearables might mediate or interfere with social encounters when designing for social contexts. They note the need to consider the social requirements as well as the social acceptability of wearables.

My last design consideration, *designing for positive atmosphere*, incorporates *benevolence, playfulness*, and *dealing with misbehavior*. The HCI literature does not discuss benevolence in great detail, but Martela and Ryan's (2016) research in the field of psychology shows that benevolent acts (beneficence), making positive impact on others, increases well-being. Accentuating playfulness seems especially important, given Hunzaker and Blasiola's finding that Ingress players may take the game too seriously (Blasiola et al., 2015; Hunzaker, 2016).

As HCI research is often performed in laboratory settings or time-limited, the need to understand and deal with misbehavior that intensifies after the flaws in a system are identified does not get enough attention. If we enable benevolent actions in a service, we must understand that it allows for wolves to dress as sheep. My research does not answer whether the gains are greater than the threat.

6.2 Quality of Research and Limitations

This thesis research stretched over nine years. The original research for this thesis was conducted from 2014 to 2016. Finalizing the publications took until 2018. Due to personal reasons, the writing of the thesis summary took until 2023. Still, the findings are timely and relevant. The combination of social experiences between nearby strangers and playfulness remains of interest to the HCI research community as shown by recent publications. Even though some of my findings parallel those of others who have researched the topic, no similar framework has been presented elsewhere. My findings can be used to guide and analyze services that are developed in the future.

Different sources suggest different ways to assess the quality of research. In the introduction, I referred to Oulasvirta and Hornbaek's definition of HCI research as problem-solving (2016). Here I draw on their perspective of research quality as well.

They expect research reports to clearly state the problems addressed and how the results increase our ability to solve those problems. They list five criteria for problem-solving ability. *Significance* means that the solution addresses a problem that is important to the stakeholders of the research. *Effectiveness* considers whether the solution resolves essential aspects of the problem. *Efficiency* assesses the cost of applying the solution compared to the gains from doing so. *Transfer* gauges how well the solution transfers to neighboring problems. *Confidence* evaluates the probability that the solution is correct and relates to *validity* and *reliability*. I will next weigh the research I have done against these criteria.

The *problem* I addressed was the lack of both empirical and constructive intermediate knowledge on the playful mobile services that are designed to facilitate social experiences between nearby strangers. Empirical experiences and behaviors by users of such services have not been considered beyond the level of single studies, and little research has focused on understanding the role of playfulness. Furthermore, a holistic understanding of how to design such services is lacking.

This research increased the *capacity to solve* the empirical problems by presenting abstracted knowledge from explorative studies studying the experiences of users of playful mobile services for nearby strangers. The results describe behavioral patterns and emotional responses that occur during the use of such services. I also presented a design space for playful mobile services for social experiences between nearby strangers and summarized the design considerations that my results showed were most important. Furthermore, the publications that form the backbone of this thesis provide knowledge at the level of the individual studies.

The *significance* of the problem that I addressed is supported by related HCI research stretching over two decades and the fact that numerous commercial applications for social experiences between nearby strangers exist. Regarding *effectiveness* (i.e., resolving essential aspects of the problem), this work identified several factors that rose from the bottom during the analysis as essential to the topic. It is unclear how the *efficiency* (i.e., the cost of applying the solution compared to gains) of this research should be assessed, but if we compare the cost of reading and applying the abstracted knowledge provided in this thesis with that of reading all of the individual studies and drawing similar knowledge from them, this work should provide an efficient starting point for anyone researching the topic or designing services. Some of the results of this work could also *transfer* to the research and design of non-playful

services for social experiences between nearby strangers and services that focus on nearby strong ties. In addition to providing relevant information for HCI research, these results might be used in gamification research—for example, to determine target experiences.

Confidence (reliability and validity) in this qualitative HCI research was supported in the following ways. The methods and participant sets used in this research were typical of those used in explorative HCI research (Lazar et al., 2017) Multiple researchers took part in the qualitative analysis of the individual studies. Triangulation was present in many forms, similar findings were obtained in multiple studies and from multiple participants in those studies and, in most cases, comparable results were recorded in one or more related studies in the literature.

When thinking about the limitations of this research, the biggest weakness is that the usefulness of the intermediate-level knowledge has not been validated. Such validations have become commonplace when presenting intermediate-level contributions. The methodological limitations of the individual studies are discussed in the publications, but I mention here some of the main limitations. The two early-state concept evaluation and the co-design study had only a small set of participants, and as such studies are to great extent relying on participants' anticipation of use rather than true experience of use, the results are more speculative. The two international online surveys and the in-the-wild study instead had more participants and were based on experiences of use of real services. The main limitations there are related to self-selected participants, who often represent enthusiastic users rather than average users. Another methodological limitation was the minimal use of methods inspecting in-person embodied action, such as observations or conversation-analysis. Informal observations were used to help structure Pokémon GO research questionnaire. Observations would have fitted Next2You research well, but there were practical obstacles to arranging them. Using such methods would have most likely yielded richer data and deeper understanding of the topic. Using them would be a natural continuation for the presented research. Furthermore, both question setting and analysis may suffer from bias introduced by researchers.

6.3 Future Work

Future research could strengthen and build on this research in several directions. First, the described design space informs research through design efforts, that is, the design and implementation of novel concepts for the research fields of HCI and gamification.

Second, several location-based augmented reality games have been released since Pokémon GO (for example, Walking Dead: Our World, Minecraft Earth, Harry Potter: Wizards Unite, Jurassic World Alive, and Pikmin Bloom). However, several of these services have been discontinued already, whereas Pokémon GO remains. Empirical research on the users of these services would help to determine if they were able to create social experiences between nearby strangers and, if so, how the designs of the services contributed to that ability. Open-ended interviews with people who have played several of these games as well as Pokémon GO and/or Ingress, would likely yield interesting insights. The results of this thesis could be used for crafting interview questions.

Third, the intermediate-level knowledge presented in this thesis needs to be strengthened through future research. For example, further knowledge is needed on how different designs result in different behaviors and experiences and what types of players participate in playful experiences with nearby strangers. The fact that the PLEX framework did not perfectly match our data suggests that efforts to extend and refine the categorization of playful experiences might be needed. Also, for example the role of benevolence, calls for further HCI research.

When I began this research, it seemed that the widespread use of mobile services for detecting nearby strangers and exchanging data with them was just a small step away (e.g., Wi-Fi Aware). While playful services and longer detection ranges are still lacking, the COVID-19 pandemic brought shorter-range proximity-based technologies into widespread use. For example, in Finland, a government-supported pandemic tracking application, Koronavilkku, was used to collect information on users who were close to one another for more than 15 minutes. This thesis research could motivate further research on implementing mobile enablers for experimenting with awareness and automatic exchanges between nearby strangers.

6.4 Conclusions

Nearby strangers have the potential to offer positive social experiences. The overall goal of this work was to increase knowledge of how to design positive experiences between nearby strangers. The nature of play and playful design, as well as findings from earlier research, suggested the need for research on the kinds of experiences that playful mobile services could create between nearby strangers and ways to design such services.

The results indicated that playful mobile applications can generate positive social experiences between nearby strangers. These experiences range from curiosity about each other, and pleasant surprises produced by automatic content exchanges to the small talk and playful interactions that occur when players recognize each other through their gestures, behavior, location, mobile devices, or avatars with play providing reasons and context for interactions.

This thesis synthesized the results from the six included publications into intermediate-level knowledge. Furthermore, it made empirical contributions through the individual studies and by abstracting behavioral patterns and emotional responses related to the use of playful mobile services for nearby strangers. The six included publications have so far been referred in publications total 99 times which speaks of their impact to the research field. Artifact contributions of this research included the design of a mobile service concept, Challenz, and the design of a mobile service, Next2You. Practical contributions included the description of the design space for social experiences between nearby strangers and the discussion of design considerations for playful mobile services for social experiences between nearby strangers.

My results help structure knowledge on playful mobile services for nearby strangers and serve as a starting point for ideating, evaluating, and researching new service concepts of this type.

REFERENCES

Arrasvuori, J., Boberg, M., & Korhonen, H. (2010). Understanding playfulness-an overview of the revised playful experience (PLEX) framework. *Proc. of Design & Emotion 2010 Conference, Design and Emotion Society*.

Arrasvuori, J., Korhonen, H., & Väänänen-Vainio-Mattila, K. (2010). Exploring playfulness in user experience of personal mobile products. *Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction*, 88–95.

Balestrini, M., Marshall, P., Cornejo, R., Tentori, M., Bird, J., & Rogers, Y. (2016). Jokebox: Coordinating shared encounters in public spaces. *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*, 38–49.

Bassoli, A., Moore, J., & Agamanolis, S. (2006). tunA: Socialising music sharing on the move. *Consuming Music Together: Social and Collaborative Aspects of Music Consumption Technologies*, 151–172.

Bateson, G. (2006). *A theory of play and fantasy*. Cambridge, Mass.: The MIT Press.

Battarbee, K., & Koskinen, I. (2005). Co-experience: user experience as interaction. *CoDesign*, *1*(1), 5–18.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497.

Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., & Benford, S. (2006). Interweaving mobile games with everyday life. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '06*, 417. https://doi.org/10.1145/1124772.1124835

Benford, S., Rowland, D., Flintham, M., Hull, R., Reid, J., Morrison, J., Facer, K., & Clayton, B. (2004). Savannah: Designing a location-based game simulating lion behaviour. *International Conference on Advances in Computer Entertainment Technology*.

Bjerver, M. (2006). *Player Behaviour in Pervasive Games-Using the City as Game Board in Botfighters*. Numerisk analys och datalogi, Kungliga Tekniska högskolan.

Blasiola, S., Feng, M., & Massanari, A. (2015). Riding in cars with strangers: A cross-cultural comparison of privacy and safety in Ingress. *Social, Casual and Mobile Games: The Changing Gaming Landscape (2015)*, 135–148.

Borovoy, R., Martin, F., Vemuri, S., Resnick, M., Silverman, B., & Hancock, C. (1998). Meme tags and community mirrors: moving from conferences to collaboration. *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work*, 159–168.

Briceño, V. (2014). *The Sound of One 3DS Clapping : User Commodification in StreetPass*. https://library.med.utah.edu/e-channel/wp-content/uploads/2016/04/digra2014_submission_109.pdf

Buchenau, M., & Suri, J. F. (2000). Experience prototyping. *Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, 424–433.

Buruk, O., Isbister, K., & Tanenbaum, T. J. (2019). A design framework for playful wearables. *Proceedings of the 14th International Conference on the Foundations of Digital Games*, 1–12.

Caillois, R. (2001). *Man, play, and games*. University of Illinois press.

Chen, J., & Abouzied, A. (2016). One LED is Enough: Catalyzing Face-to-face Interactions at Conferences with a Gentle Nudge. *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing - CSCW '16*, 172–182. https://doi.org/10.1145/2818048.2819969

Costello, B., & Edmonds, E. (2007). A study in play, pleasure and interaction design. *Proceedings of the 2007 Conference on Designing Pleasurable Products and Interfaces*, 76–91.

Csikszentmihalyi, M. (2000). *Beyond boredom and anxiety*. Jossey-bass.

Dagan, E., Márquez Segura, E., Altarriba Bertran, F., Flores, M., Mitchell, R., & Isbister, K. (2019). Design framework for social wearables. *Proceedings of the 2019 on Designing Interactive Systems Conference*, 1001–1015.

Dar, A. B., Lone, A. H., Zahoor, S., Khan, A. A., & Naaz, R. (2020). Applicability of mobile contact tracing in fighting pandemic (COVID-19): Issues, challenges and solutions. *Computer Science Review*, *38*, 100307.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining" gamification". *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9–15.

Drozd, A., Benford, S., Tandavanitj, N., Wright, M., & Chamberlain, A. (2006). Hitchers: Designing for cellular positioning. *UbiComp 2006: Ubiquitous Computing: 8th International Conference, UbiComp 2006 Orange County, CA, USA, September 17-21, 2006 Proceedings 8*, 279–296.

Eagle, N., & Pentland, A. (2005). Social Serendipity: Mobilizing Social Software. *IEEE Pervasive Computing*, *4*(2), 28–34. https://doi.org/10.1109/MPRV.2005.37

Ellison, N. B., Hancock, J. T., & Toma, C. L. (2012). Profile as promise: A framework for conceptualizing veracity in online dating self-presentations. *New Media & Society*, *14*(1), 45–62. https://doi.org/10.1177/1461444811410395

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115.

Epley, N., & Schroeder, J. (2014). Mistakenly seeking solitude. *Journal of Experimental Psychology: General*, *143*(5), 1980.

Epp, F. A., Kantosalo, A., Jain, N., Lucero, A., & Mekler, E. D. (2022). Adorned in Memes: Exploring the Adoption of Social Wearables in Nordic Student Culture. *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–18.

Esbjörnsson, M., Juhlin, O., & Östergren, M. (2003). Motorcyclists using Hocman–Field Trials on mobile interaction. *Human-Computer Interaction with Mobile Devices and Services: 5th International Symposium, Mobile HCI 2003, Udine, Italy, September 2003. Proceedings 5*, 32–44.

Evans, L., & Saker, M. (2019). The playeur and Pokémon Go: Examining the effects of locative play on spatiality and sociability. *Mobile Media & Communication*, *7*(2), 232–247.

Falk, J., Ljungstrand, P., Björk, S., & Hansson, R. (2001). Pirates: proximity-triggered interaction in a multi-player game. *CHI'01 Extended Abstracts on Human Factors in Computing Systems*, 119–120.

Fang, X., Semertzidis, N., Scary, M., Wang, X., Andres, J., Zambetta, F., & Mueller, F. (2021). Telepathic Play: Towards Playful Experiences Based on Brain-to-brain Interfacing. *Extended Abstracts of the 2021 Annual Symposium on Computer-Human Interaction in Play*, 268–273.

Fitzpatrick, C., Birnholtz, J., & Gergle, D. (2016). People, places, and perceptions. *Proceedings of the 18th International Conference on Human-Computer Interaction with*

Mobile Devices and Services - MobileHCI '16, 295–305. https://doi.org/10.1145/2935334.2935369

Foo, C. Y., & Koivisto, E. M. I. (2004). Defining grief play in MMORPGs: player and developer perceptions. *Proceedings of the 2004 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology*, 245–250.

Frith, J. (2013). Turning life into a game: Foursquare, gamification, and personal mobility. *Mobile Media & Communication*, *1*(2), 248–262.

Gallacher, S., O'Connor, J., Bird, J., Rogers, Y., Capra, L., Harrison, D., & Marshall, P. (2015). Mood Squeezer. *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing - CSCW '15*, 891–902. https://doi.org/10.1145/2675133.2675170

Goffman, E. (2008). *Behavior in public places*. Simon and Schuster.

Goguey, A., Steer, C., Lucero, A., Nigay, L., Sahoo, D. R., Coutrix, C., Roudaut, A., Subramanian, S., Tokuda, Y., & Neate, T. (2019). PickCells: A physically reconfigurable cell-composed touchscreen. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–14.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360–1380.

Guha, S., & Birnholtz, J. (2013). Can you see me now? Location, visibility and the management of impressions on foursquare. *Proceedings of the 15th International Conference on Human-Computer Interaction with Mobile Devices and Services*, 183–192.

Håkansson, M., Rost, M., & Holmquist, L. E. (2007). Gifts from friends and strangers: A study of mobile music sharing. *ECSCW 2007: Proceedings of the 10th European Conference on Computer-Supported Cooperative Work, Limerick, Ireland, 24-28 September 2007*, 311–330.

Hakansson, M., Rost, M., Jacobsson, M., & Holmquist, L. E. (2007). Facilitating mobile music sharing and social interaction with Push! Music. *2007 40th Annual Hawaii International Conference on System Sciences (HICSS'07)*, 87.

Hall, E. T. (1963). A system for the notation of proxemic behavior. *American Anthropologist*, *65*(5), 1003–1026.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work?--a literature review of empirical studies on gamification. *2014 47th Hawaii International Conference on System Sciences*, 3025–3034.

Hamari, J., & Tuunanen, J. (2014). *Player types: A meta-synthesis*.

Hansson, R., & Skog, T. (2001). The LoveBomb: Encouraging the communication of emotions in public spaces. *CHI'01 Extended Abstracts on Human Factors in Computing Systems*, 433–434.

Heinemann, T., & Mitchell, R. (2014). Breaching barriers to collaboration in public spaces. *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction*, 213–220.

Heljakka, K. (2013). *Principles of adult play (fulness) in contemporary toy cultures: From wow to flow to glow*. School of Arts, Design and Architecture.

Hildén, E., Ojala, J., & Väänänen, K. (2017). *A Co-design Study of Digital Service Ideas in the Bus Context* (pp. 295–312). https://doi.org/10.1007/978-3-319-67744-6_20

Holmquist, L. E., Falk, J., & Wigström, J. (1999). Supporting group collaboration with interpersonal awareness devices. *Personal Technologies*, *3*(1–2), 13–21. https://doi.org/10.1007/BF01305316

Höök, K., & Löwgren, J. (2012). Strong concepts: Intermediate-level knowledge in interaction design research. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *19*(3), 1–18.

Horváth, I. (2008). Differences between'research in design context'and'design inclusive research'in the domain of industrial design engineering. *Journal of Design Research*, *7*(1), 61–83.

Hsiao, J. C.-Y., & Dillahunt, T. R. (2017). People-Nearby Applications. *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17*, 26–40. https://doi.org/10.1145/2998181.2998280

Huizinga, J. (2020). *Homo ludens*. Editora Perspectiva SA.

Humphreys, L. (2007). Mobile social networks and social practice: A case study of Dodgeball. *Journal of Computer-Mediated Communication*, *13*(1), 341–360.

Hunzaker, M. A. (2016). *Intent or Misinterpretation? Disruptive Behaviors within Ingress*.

ISO 9241-210, J. (2010). Ergonomics of human-system interaction–Part 210: Human-centred design for interactive systems. *Isotopenpraxis*, *2010*, 1–19.

Ito, M., Okabe, D., & Anderson, K. (2017). Portable objects in three global cities: The personalization of urban places. In *The reconstruction of space and time* (pp. 67–87). Routledge.

Jarusriboonchai, P. (2016). *Understanding Roles and User Experience of Mobile Technology in Co-located Interaction*.

Jarusriboonchai, P., Malapaschas, A., Olsson, T., & Väänänen, K. (2016). Increasing collocated people's awareness of the mobile user's activities: A field trial of social displays. *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*, 1691–1702.

Jarusriboonchai, P., Olsson, T., Prabhu, V., & Väänänen-Vainio-Mattila, K. (2015). CueSense. *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '15*, 2127–2132. https://doi.org/10.1145/2702613.2732833

John M. Carroll. (n.d.). Human Computer Interaction - brief intro. In *The Encyclopedia of Human-Computer Interaction* (2nd ed.). Interaction Design Foundation. Retrieved June 3, 2023, from https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/human-computer-interaction-brief-intro

Jordan, P. W. (2000). *Designing pleasurable products: An introduction to the new human factors*. CRC press.

Jung, Y., & Blom, J. (2006). *Scent Field Trial - Understanding Emerging Social Interaction*. 69–76.

Kao, H.-L., & Schmandt, C. (2015). MugShots: A mug display for front and back stage social interaction in the workplace. *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction*, 57–60.

Kinch, S., Grönvall, E., Petersen, M. G., & Rasmussen, M. K. (2013). Encounters on a shape-changing bench. *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction - TEI '14*, 233–240. https://doi.org/10.1145/2540930.2540947

Kirman, B., Linehan, C., & Lawson, S. (2011). Blowtooth: a provocative pervasive game for smuggling virtual drugs through real airport security. *Personal and Ubiquitous Computing*, *16*(6), 767–775. https://doi.org/10.1007/s00779-011-0423-z

Kjeldskov, J., & Skov, M. B. (2014). Was it worth the hassle? Ten years of mobile HCI research discussions on lab and field evaluations. *Proceedings of the 16th International Conference on Human-Computer Interaction with Mobile Devices & Services*, 43–52.

Korhonen, H., Montola, M., & Arrasvuori, J. (2009). Understanding playful user experience through digital games. *International Conference on Designing Pleasurable Products and Interfaces*, *2009*, 13–16.

Koskinen, E., Leorke, D., Alha, K., & Paavilainen, J. (2019). Player experiences in location-based games: Memorable moments with Pokémon GO. *Augmented Reality Games I: Understanding the Pokémon GO Phenomenon*, 95–116.

Kostakos, V., O'Neill, E., & Shahi, A. (2006). *Building Common Ground for Face to Face Interactions by Sharing Mobile Device Context* (pp. 222–238). Springer, Berlin, Heidelberg. https://doi.org/10.1007/11752967_15

Krogh, P., Ludvigsen, M., & Lykke-Olesen, A. (2004). " Help Me Pull That Cursor" A Collaborative Interactive Floor Enhancing Community Interaction. *Australasian Journal of Information Systems*, *11*(2).

Kytö, M., & McGookin, D. (2017). Augmenting Multi-Party Face-to-Face Interactions Amongst Strangers with User Generated Content. *Computer Supported Cooperative Work (CSCW)*, *26*, 527–562.

Lazar, J., Feng, J. H., & Hochheiser, H. (2017). *Research methods in human-computer interaction*. Morgan Kaufmann.

Lee, C., Cheng, Y., Yeh, C., & Chen, L. (2008). *Surfing in the Crowd : Feasibility Study of Experience Sharing in a Taiwanese Night Market*. 239–242.

Licoppe, C., & Inada, Y. (2012). "Timid encounters." *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems - CHI '12*, 2759. https://doi.org/10.1145/2207676.2208675

Lucero, A., Dalsgaard, P., Halskov, K., & Buur, J. (2016). Designing with cards. *Collaboration in Creative Design: Methods and Tools*, 75–95.

Lucero, A., Karapanos, E., Arrasvuori, J., & Korhonen, H. (2014). Playful or gameful? Creating delightful user experiences. *Interactions*, *21*(3), 34–39.

Lucero, A., Vaajakallio, K., & Dalsgaard, P. (2012). The dialogue-labs method: process, space and materials as structuring elements to spark dialogue in co-design events. *CoDesign*, *8*(1), 1–23.

Ludvigsen, M. (2006). Designing for social interaction. *Department of Design. Aarhus School of Architecture*.

Lundgren, S., Fischer, J. E., Reeves, S., & Torgersson, O. (2015). Designing mobile experiences for collocated interaction. *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, 496–507.

Martela, F., & Ryan, R. M. (2016). The benefits of benevolence: Basic psychological needs, beneficence, and the enhancement of well-being. *Journal of Personality*, *84*(6), 750–764.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370.

Mayer, J. M., Jones, Q., & Hiltz, S. R. (2015). Identifying opportunities for valuable encounters: Toward context-aware social matching systems. *ACM Transactions on Information Systems (TOIS)*, *34*(1), 1–32.

McCarthy, J. F., McDonald, D. W., Soroczak, S., Nguyen, D. H., & Rashid, A. M. (2004). Augmenting the social space of an academic conference. *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work*, 39–48.

Mcgookin, D. K., Brewster, S. A., & Christov, G. (2014). *Studying Digital Graffiti as a Location-Based Social Network*. 3269–3278.

Milgram, S. (1977). The familiar stranger: An aspect of urban anonymity. In *The individual in a social world: Essays and experiments* (pp. 51–53). Addison-Wesley Reading, MA.

Mitchell, R. (2009). Physical contraptions as social interaction catalysts. *3rd International Workshop on Physicality*, 37–42.

Mitchell, R., & Olsson, T. (2019). Facilitating the first move: Exploring inspirational design patterns for aiding initiation of social encounters. *Proceedings of the 9th International Conference on Communities & Technologies-Transforming Communities*, 283–294.

Monastero, B., & McGookin, D. K. (2018). Traces: Studying a Public Reactive Floor-Projection of Walking Trajectories to Support Social Awareness. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*. https://doi.org/10.1145/3173574.3174061

O'Hara, K. (2008). Understanding geocaching practices and motivations. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1177–1186.

Ojala, J. (2017). *Studies of Content-Mediated Interaction: Insights into Activities, Motivations and User Experience Design*.

Olson, J. S., & Kellogg, W. A. (2014). *Ways of Knowing in HCI* (Vol. 2). Springer.

Olsson, T., Jarusriboonchai, P., Woźniak, P., Paasovaara, S., Väänänen, K., & Lucero, A. (2020). Technologies for Enhancing Collocated Social Interaction: Review of Design Solutions and Approaches. *Computer Supported Cooperative Work: CSCW: An International Journal*, *29*(1–2). https://doi.org/10.1007/s10606-019-09345-0

Oulasvirta, A., & Hornbæk, K. (2016). HCI research as problem-solving. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 4956–4967.

Parten, M. B. (1932). Social participation among pre-school children. *The Journal of Abnormal and Social Psychology*, *27*(3), 243.

Paulos, E., & Goodman, E. (2004). The familiar stranger. *Proceedings of the 2004 Conference on Human Factors in Computing Systems - CHI '04*, 223–230. https://doi.org/10.1145/985692.985721

Pearson, J., Robinson, S., & Jones, M. (2015). It's About Time: Smartwatches as public displays. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 1257–1266.

Peitz, J., Saarenpaa, H., & Bjork, S. (2007). Insectopia: Exploring pervasive games through technology already pervasively available. *ACM International Conference Proceeding Series*, *203*, 107–114. http://dx.doi.org/10.1145/1255047.1255069

Persson, P., Blom, J., & Jung, Y. (2005). *DigiDress : A Field Trial of an Expressive Social Proximity Application*. 195–212.

Saaty, M., Haqq, D., Beyki, M., Hassan, T., & McCRICKARD, D. S. (2022). Pokémon GO with Social Distancing: Social Media Analysis of Players' Experiences with Location-based Games. *Proceedings of the ACM on Human-Computer Interaction*, *6*(CHI PLAY), 1–22.

Sandstrom, G. M., & Dunn, E. W. (2014). Is efficiency overrated? Minimal social interactions lead to belonging and positive affect. *Social Psychological and Personality Science*, *5*(4), 437–442.

Satchell, C., & Dourish, P. (2009). Beyond the user: use and non-use in HCI. *Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7*, 9–16.

Seeburger, J., & Tjondronegoro, D. (2012). *The Sound of Music : Sharing Song Selections between Collocated Strangers in Public Urban Places*.

Shu, J., Kosta, S., Zheng, R., & Hui, P. (2018). Talk2me: A framework for device-to-device augmented reality social network. *2018 IEEE International Conference on Pervasive Computing and Communications (PerCom)*, 1–10.

Sou, S.-I., Chen, S.-H., Li, H.-W., Yang, P.-L., & Wang, Y.-C. (2019). Nearby x music: A mobile social service in proximity based on youtube hashtag and playlist. *2019 IEEE 8th Global Conference on Consumer Electronics (GCCE)*, 517–518.

Stenros, J., Paavilainen, J., & Mäyrä, F. (2009). The many faces of sociability and social play in games. *Proceedings of the 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era*, 82–89.

Stepanova, E. R., Desnoyers-Stewart, J., Höök, K., & Riecke, B. E. (2022). Strategies for Fostering a Genuine Feeling of Connection in Technologically Mediated

Systems. *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–26.

Sutton-Smith, B. (1997). *The ambiguity of play*.

Szentgyorgyi, C., Terry, M., & Lank, E. (2008). Renegade gaming. *Proceeding of the Twenty-Sixth Annual CHI Conference on Human Factors in Computing Systems - CHI '08*, 1463. https://doi.org/10.1145/1357054.1357283

Tekinbas, K. S., & Zimmerman, E. (2003). *Rules of play: Game design fundamentals*. MIT press.

Väänänen-Vainio-Mattila, K., Saarinen, P., Wäljas, M., Hännikäinen, M., Orsila, H., & Kiukkonen, N. (2010). User experience of social ad hoc networking. *Proceedings of the 9th International Conference on Mobile and Ubiquitous Multimedia - MUM '10*, 1–10. https://doi.org/10.1145/1899475.1899485

Väänänen-Vainio-Mattila, K., Wäljas, M., Ojala, J., & Segerståhl, K. (2010). Identifying drivers and hindrances of social user experience in web services. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2499–2502.

Vella, K., Johnson, D., Cheng, V. W. S., Davenport, T., Mitchell, J., Klarkowski, M., & Phillips, C. (2019). A sense of belonging: Pokémon GO and social connectedness. *Games and Culture*, *14*(6), 583–603.

Waern, A. (2012). Framing games. *Proceedings of Nordic DiGRA*, *2012*.

Wang, A. I. (2021). Systematic literature review on health effects of playing Pokémon Go. *Entertainment Computing*, *38*, 100411.

Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the positive and negative affect schedule-expanded form*.

Wingenbach, T. S. H., & Zana, Y. (2022). Playing Pokemon Go: increased life satisfaction through more (positive) social interactions. *Frontiers in Sports and Active Living*, *4*.

Wobbrock, J. O., & Kientz, J. A. (2016). Research contributions in human-computer interaction. *Interactions*, *23*(3), 38–44.

Wouters, N., Downs, J., Harrop, M., Cox, T., Oliveira, E., Webber, S., Vetere, F., & Moere, A. Vande. (2016). Uncovering the Honeypot Effect: How Audiences Engage with Public Interactive Systems. *DIS '16*. https://doi.org/10.1145/2901790.2901796

Yoon, J., Oishi, J., Nawyn, J., Kobayashi, K., & Gupta, N. (2004). FishPong: Encouraging human-to-human interaction in informal social environments. *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work*, 374–377.

Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An analysis and critique of Research through Design: towards a formalization of a research approach. *Proceedings of the 8th ACM Conference on Designing Interactive Systems*, 310–319.

PUBLICATION 1

Collaborative Video Challenges: A Playful Concept of Proximity-Based Social Interaction

Susanna Paasovaara, Ekaterina Olshannikova, and Thomas Olsson

Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15). ACM, New York, NY, USA, 1923-1928

Collaborative Video Challenges: a Playful Concept of Proximity-Based Social Interaction

Susanna Paasovaara
Tampere Univ. of Technology
Korkeakoulunkatu 1 P.O.Box 553, 33101 Tampere, Finland
susanna.paasovaara@tut.fi

Thomas Olsson
Tampere Univ. of Technology
Korkeakoulunkatu 1 P.O.Box 553, 33101 Tampere, Finland
thomas.olsson@tut.fi

Ekaterina Olshannikova
Tampere Univ. of Technology
Korkeakoulunkatu 1 P.O.Box 553, 33101 Tampere, Finland
ekaterina.olshannikova@tut.fi

Abstract
Mobile proximity-based networking technologies like Wi-Fi Direct enable applications that allow interaction between co-located users and device-to-device transfer of large amounts of data. To explore new ways of utilizing such enablers, we designed a concept that allows users to create collaborative video challenges, and further spread them device-to-device via Wi-Fi direct. The concept offers means for proximity-based playful social interaction, mediated by collaboratively created stories consisting of several clips. We present a preliminary user study to gather early feedback on the concept and to identify main hindrances. Our analysis shows promising results: the concept is considered as fun and playful, and there is high interest to follow how the challenges proceed. We discuss various opportunities and challenges as well as present ideas for further research.

Author Keywords
Proximity-based interaction; collaboration; playfulness; collaborative video; Wi-Fi direct; device-to-device

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g. HCI): Miscellaneous.

Introduction

Most often technology-mediated social interaction happens between familiar people, family and friends. However, social networking applications often consider also friends of a friend as part of one's network. The interaction between co-located strangers has been in the focus of researched recently[1]. In this paper, the focus is on social interaction between any co-located people, covering the whole familiarity continuum between friends and strangers.

Regarding *playful* social interaction, play lies somewhere between work and games. When compared to work, play can be seen as a voluntary action without a serious purpose. When compared to games, play is not as competitive, and it has less strict rules and structure. *Playful social interaction* refers to activities that people do with or for others just for fun and recreation or to, for example, spread goodwill.

Our overall goal is to explore how mobile proximity-based services could enable and foster playful social interaction. As the first step we have designed an application concept that allows users to create and take collaborative mobile video challenges and spread them forward to other users in the proximity over Wi-Fi Direct. This paper presents the overview of the concept and its novelties, briefly reports the results of a preliminary user study, and highlights some of the next steps on our research journey.

Background and Related Work

A famous example of playful social interaction between strangers is the location-based activity of geocaching: people hide and seek containers in public places, based on GPS and optional cues, just for fun. A recent research example of playful social interaction in public places is DigiGraff [6], which investigates re-integrating geo-tagged social media in the physical environment. It allows users to create, leave and search GPS-tagged digital graffiti. As a rare example of interaction between collocated urban strangers, Capital Music [10] supported real-time sharing of song choices, as well as messaging with them. Capital Music is referred as Location-Based Social Network application, but as it connects people who are at the same time in the same place, it is essentially a proximity-based application. In the same manner as in these examples, we want to explore ways in which people can interact with co-located others in a playful and indirect manner.

While location-based applications are tied to fixed locations and suffer from the well-known problems in positioning technologies, our approach, proximity-based applications, allow interaction wherever a device detects another device *nearby* running the same application. As the devices move along with their owners, the possibilities for interaction are highly restricted by duration of the encounter. This is both a challenge and an opportunity. A critical mass of active users is required for interactions to happen often enough for the application to feel relevant. On the other hand, proximity-based applications naturally support *discovery*, finding something new and unknown, one of the categories of Playful Experiences [5].

Already in 2003, before the mobile devices reached their current capabilities, Kortuem and Segall [3] discussed the social potential of proximity-based applications. Paulos and Goodman explored the relationship of urban co-located strangers by creating Bluetooth-enabled devices, *Jabberwockies,* to log

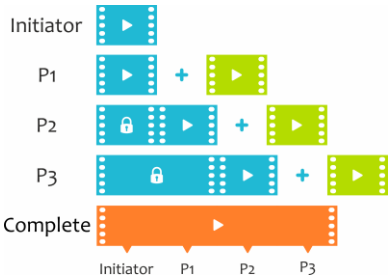

Figure 1. The collaborative video (a Challenge) consists of several clips. Only the most recent clip is viewable when the challenge is forwarded.

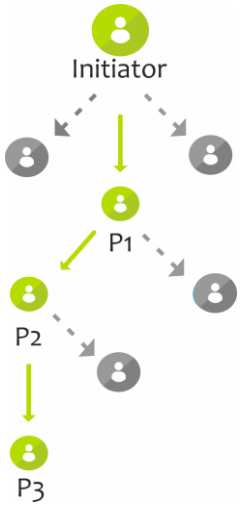

Figure 2. Sending a Challenge forward. After each clip, the challenge is broadcasted to all co-located devices but only one can accept to continue it.

nearby people and places [8]. Early work on Social Proximity Applications (SPA) includes DigiDress [9] and Scent[2]. They both take advantage of Bluetooth technology presenting functionalities like messaging, discovery of proximate users and expressing identity. Also in a later example of SPA, photos from a market place were shared over Bluetooth connectivity [4].

Casual proximity-based pervasive games is a genre close to proximity-based playful social interaction. Insectopia [7] used discovery of nearby Bluetooth devices as a way to get and maintain an insect collection, and it had a public high score list. With some additional rules, also our concept would serve as a game but we believe that proximity-based playful social interaction is valuable already as it is, without excess gamification.

Wi-Fi Direct is a technology that allows creating proximity-based applications, i.e. detecting other devices in the proximity and communicating with them. Compared to Bluetooth, it gives a wider operating range (up to 100m) and a faster data transfer rate. In public places, encounters between unfamiliar users become more probable, and the users have a better chance of maintaining their privacy. With the increased data transfer rate and range, it is possible to transfer large amounts of data even when two users just pass by each other.

Over the last ten years, mobile devices have taken a huge leap, both in technological capabilities they offer and in what kinds of services users are used to expect from them. While many of the findings from the earlier research on social proximity application are probably still valid, we believe it is time to revisit the field with current technological advancements and new concepts.

Concept of Collaborative Video Challenges

Our application concept has two main novelties. First, videos are created as a collaborative and phased process (one clip at a time), representing playful social interaction. Second, the content, i.e. video clips and full compiled videos, is shared directly from device to device. Playfulness of the concept is supported by the fact that new content can only be discovered when another user is in physical proximity. The application is intended to foster sense of community in (semi-)public congested environments like a school campus or a tourist attraction, as well as enable new serendipitous interactions between people who are at the same time in the same place.

We termed the effort of creating a collaborative video story a *Challenge*. One user at a time adds a new video clip to the challenge (Figure 1), making it a collaborative effort. In order to increase the motivation to participate and to provide a rewarding and fun experience, we utilize the technique called "exquisite corpse"[1], where each user can only see what the previous one added. In addition to that, there can be some instructions and restrictions from the initiator of the challenge. Based on that information, a user has to plan and record a new video clip. Only after sending the clip to the challenge, one can view the whole compiled video so far. This is expected to create amusing experiences when seeing how one's clip actually continued the original storyline

[1] http://en.wikipedia.org/wiki/Exquisite_corpse

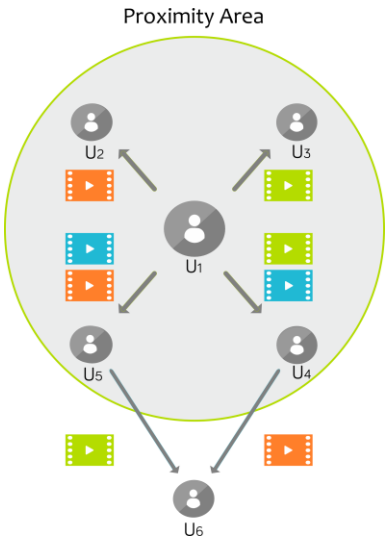

Figure 3. Sharing content (Challenges, Co-op Videos and Updates) with nearby users

Sending the challenge forward actually means that the application will start to look for the next participant (Figure 2). A nearby user will get a notification asking to accept the challenge. After choosing to accept the challenge, the user will receive the related content from the previous participant. The file transfer over Wi-Fi Direct is automatic from the perspective of the previous participant.

Similarly, the users having participated in the same challenge earlier will receive the new clips as automatic updates when they are in proximity of any user that has those data (Figure 3).

The challenge will continue to circulate among the users until it comes to end. The end can be defined by different ways: a preset number of clips is reached, a preset time to participate runs out, no-one takes the challenge anymore, or one of the contributing users declares the video as complete.

The exquisite corpse technique is used in an internet-based service called Folding Story[2], which allows writing collaborative stories with a visibility only to the latest addition. To our knowledge, there are no systems that support the creation of proximity-based collaborative videos using the exquisite corpse technique.

The product of a challenge, Co-op Video, is the compilation of the video clips from a finished challenge. Co-op Video is a viral and public entity that any user can see in full length. Users are notified of and/or can search the Co-op Videos stored on nearby devices running the application. Copies of the chosen videos are then downloaded via Wi-Fi Direct. The owner of the device having a requested Co-op Video does not have to do anything: the file is transferred automatically.

The implementation of our system is currently in progress. In addition to leaning on Wi-Fi direct, it will have a cloud-based coordinator that stores the meta-data of the content as well as performs location-based pre-inquiries if some users could be in the range of each other. That way the light-weight messaging is done in the cloud, and unnecessary Wi-Fi Direct service discoveries are avoided when no-one is around. The Wi-Fi Direct connection is used where it gives the most value: in transferring heavy data between devices in proximity to each other.

As the concept is rather complex and an active user community is needed for meaningful interactions, we wanted to get feedback from potential users. The next section presents our early stage user study.

User Evaluation Study

We arranged four focus groups to get feedback on the concept. The participants (5 females, 11 males) were students and researchers from a university campus with several thousands of people. The 1.5-2h long sessions consisted of three parts: simulation of collaborative video creation, explanation of the concept and group discussion.

We wanted to provide our participants an experience of creating video clips as a response to an ongoing story as well as others responding to their clip. The simulation of collaborative video creation was conducted with help of a regular video camera

[2] http://foldingstory.com/

Figure 4. Anna gets a notification triggered by the fact that she and Paul are close to each other.

Figure 5. Anna plans how the story would continue, and asks her friends to assist as actors.

Figure 6. Anna sends the clip. There aren't any nearby users. So, the video clips stay in her device, and the application tries to pass them forward again later on.

application of a mobile device. At first, the four participants were divided in two pairs and split in two rooms. Each pair recorded one new clip to two collaborative video stories. The beginning of both stories was created by a researcher, because it was witnessed in the pilot session that shooting videos takes easily a lot of time, but that it is faster and easier to continue a story than to start a new one. In order to make the process go fast and smooth, both stories included soft toys and finger puppets as props. After recording the first clip, the pairs changed rooms and recorded another clip to continue also the other story. After this, we gathered back to watch all the video clips in the story so far. That way they all got the experience of both continuing the story and seeing what the others filmed after them.

Next, the application was further explained with the help of a storyboard (see Figures 4-6 for selected individual views). Based on the scenarios and the first-hand experience, the concept was discussed with regard to, e.g. perceived opportunities and risks, and interestingness of the concept.

Our analysis indicates that the concept of creating collaborative videos is very promising. It was considered fun and playful. A few participants said that they would create and share videos only with their friends. At the opposite end, there were people who saw this as a way to create a new type of portfolio and a way to find new real life collaborating opportunities.

Different challenge types envisioned by the participants included trick videos (dance, parkour, skateboarding), music videos, stories acted with toys, horror, and simple acts like merging clips of people's smiles into a video. As long as there is good quality content and new content appears regularly, the participants believed it to be motivating to follow collaboratively created videos.

There is high interest in how the challenge that one has participated in will proceed: what happens in the following clips and especially in the end. The participants wanted to make sure that the quality of the content is maintained. Another requirement was that they can trust that they will receive the updates.

Regarding other concerns and requirements, downloading the content on one's own device faced resistance. There was a common concern of filling up the disk space with the videos and that using the device-to-device communication would open an access also to other files. Another concern was how to prevent trolling and illegal content in such a distributed system.

In addition, the participants thought that the initiator should have possibilities to define the challenge in many ways: write instructions, set maximum length for clips, set requirements for video quality, and choose whether it will be a public challenge of for friends only. To overcome the awkwardness of showing one's face in the videos, the possibility to create audio challenges was suggested in one of the groups. There were also concerns how the different human actors in separate clips could perform the same characters. To overcome that problem, an application with animation creation capabilities was suggested.

Conclusions and Future Work

Based on the related work, there is a yet scarcely explored field of proximity-based playful social

interactions. While the previous application concepts have mainly utilized Bluetooth, the wider operating range of Wi-Fi Direct can more efficiently connect strangers in public places and thus create new forms of local communities and playful interactions.

Based on the preliminary user study, our concept, creating collaborative videos and sharing them device-to-device, shows promise. The application content has good potential to start expanding virally in places like university campuses. However, also design challenges and needs for re-design were identified. For example, in our initial design, the content would reside only on the devices of the users. The feedback encouraged us to think of ways to incorporate cloud-based storage as well.

Overall, without having the real system running and real users producing and consuming content, it is too speculative to draw heavy conclusions about the social impact and user experience. We will continue with implementing a working prototype application and the cloud-based support system. To test the future prototypes we are planning to involve a broad spectrum of different kinds of users – also ensuring that they are able to produce good quality content – to see what kind of social interactions emerge as a result of using the application. The first long-term trial is planned to take place in a university campus where the students form a natural local community of friends and fellow students, and people readily try out new technologies.

Acknowledgements

We thank all the participants of the study for their insightful comments. The research was funded by Academy of Finland (grant 283110).

References

[1] Jarusriboonchai, P., Olsson, T., Ojala, J., Väänänen-Vainio-Mattila, K. (2014) Opportunities and Challenges of Mobile Applications as "Tickets-to-Talk": A Scenario-Based User Study. In Proc. MUM'14, Nov. 25-28 2014, Melbourne, Australia. ACM Press.

[2] Jung, Y., Blom, J., Persson, P. Scent Field Trial – Understanding Emerging Social Interaction. In Proc. MobileHCI'06.

[3] Kortuem, G., Segall, Z. Wearable Communities: Augmenting Social Networks with Wearable Computers, IEEE Pervasive Computing, v.2 n.1, p.71-78, 2003

[4] Lee, C., et al. Surfing in the Crowd: Feasibility Study of Experience Sharing in a Taiwanese Night Market, In Proc. OZCHI 2008.

[5] Lucero, A., Karapanos, E., Arrasvuori, J., Korhonen, H. Playful or Gameful?: Creating Delightful User Experiences, Interactions, v.21 n.3, May-June 2014

[6] McGookin, D.K., Brewster, S.A., Christov, G. Studying Digital Graffiti as a Location-Based Social Network. In Proc. CHI'14, ACM Press (2014).

[7] Peitz, J. , Saarenpää, H. , Björk, S. Insectopia: exploring pervasive games through technology already pervasively available, In Proc. ACE'07, ACM Press.

[8] Paulos, E., Goodman, E. The familiar stranger: anxiety, comfort, and play in public places, In Proc. CHI'04, p.223-230, ACM Press (2004)

[9] Persson, P., Blom, J., Jung, Y. DigiDress: A Field trial of an Expressive Social Proximity Application. In Proc. Ubicomp 2005, 195-212. Springer.

[10] Seeburger, J., Foth, M., Tjondronegoro, D. The Sound of Music: Sharing Song Selections between Collocated Strangers in Public Urban Places. In Proc. MUM'12, ACM Press (2012).

PUBLICATION 2

Proximity-Based Automatic Exchange of Data in Mobile Gaming: Studying the Experiences of StreetPass Users

Susanna Paasovaara and Thomas Olsson

Proceedings of the 9th Nordic Conference on Human-Computer Interaction (NordiCHI '16). ACM, New York, NY, USA, Article 26, 10 pages

Proximity-Based Automatic Exchange of Data in Mobile Gaming: Studying the Experiences of StreetPass Users

Susanna Paasovaara
Tampere University of Technology
Tampere, Finland
susanna.paasovaara@tut.fi

Thomas Olsson
Tampere University of Technology
Tampere, Finland
thomas.olsson@tut.fi

ABSTRACT
Despite the ubiquity of short-range connectivity technologies and their use for pragmatic purposes, the opportunities they provide for playful interaction are not well understood. StreetPass feature on Nintendo 3DS handheld gaming devices is a rare world-wide example of exchanging playful content (e.g. avatars, messages, items) automatically between close-by users over proximity-based technologies. To learn from the user experiences of this pioneer group we conducted an online questionnaire, gathering over 100 responses from active Nintendo 3DS users. The findings indicate that proximity-based automatic exchanges have remarkably enriched the gaming experience with 3DS, increased sense of community, and triggered serendipitous interactions between players. We argue that similar features could bring value also to other application areas and mobile systems; and describe what should be taken into account in their design.

Author Keywords
Proximity-based interaction; proximity sensing; device-to-device; playfulness; social gaming; collaborative gaming; multi-player; social interaction; StreetPass; online survey.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces.

INTRODUCTION

The advances in mobile proximity-based connectivity technologies like Wi-Fi Direct and Bluetooth enable applications that allow the detection of nearby devices and the establishment of direct data transfer over up to 100m distance. The device-to-device connectivity paradigm brings pragmatic benefits, especially when transferring large data files, as the transfer is fast and free of charge compared to using an internet-based service [6].

More interesting for HCI, the device-to-device connectivity with proximal users opens immense new opportunities for diverse applications beyond data transfer efficiency. In particular, social applications and collaborative gaming have been envisioned in the technological communities [4]. Already in 2003, before the mobile devices reached their current capabilities, Kortuem and Segall [9] discussed the social potential of proximity-based applications. Limited by the prevailing technology, they saw that proximity-based interactions could take place mostly beside face-to-face interactions as the operation range of wireless personal area networks was very limited. However, the ranges of current proximity-based technologies like the Wi-Fi Direct allow also interaction between users over such a distance that the user identities are not necessarily revealed. In other words, novel social applications would be possible not only between familiar people but also between strangers.

Our review on related work reveals that various proximity-based systems for gaming and social purposes have been envisioned in research literature. The focus of the work has mainly been technological and the end user evaluations small scale. As a result of that, the user experience of the systems is not well understood. The systems are often based on the users' intentional queries about the people and digital services in their proximity.

As often happens with new technology, also with proximity-based interactions the gaming field has been a pioneer to adopt the new feature. The entertainment company Nintendo has developed a feature called StreetPass[1] to enrich their 3DS handheld game console experience. Users who come within each other's Wi-Fi range will automatically exchange data related to the games they have in common. The users can for example receive gifts from the other players, view their avatars and use them as helpers or as opponents in the games. StreetPass has a long term and worldwide user base, which makes it an interesting case to look at.

Our work digs deeper into the user experience of proximity-based applications as well as into automatic exchanges of data as a form of playful interaction between nearby strangers. Automation, with technology-initiated rather than user-initiated interactions, is a major change of interaction

[1] http://www.nintendo.com/3ds/built-in-software/streetpass

paradigm that affects sense of user control but can also produce experiences of surprise. Consequently, we want to understand what kind of experiences, playful interactions and social phenomena have emerged around this new possibility in mobile gaming. To this end, we conducted an online survey with active users of StreetPass to explore and analyze the users' experiences from various viewpoints. This work contributes to the understanding of the experiential value that proximity-based features bring to mobile gaming and, more broadly, the opportunities for designing mobile systems with proximity-based features.

NINTENDO 3DS AND STREETPASS

Before discussing the related work in more detail, we describe what StreetPass is about and how different games take advantage of that feature.

The 3DS model continues the long line of Nintendo's handheld gaming devices. It introduces a feature called StreetPass. StreetPass automatically connects the nearby 3DS devices that have the feature activated; regardless of if they are in active use or in the battery-saving sleep mode.

StreetPass is based on automatic peer-to-peer Wi-Fi connection, which is used to exchange data related to maximum of 12 games the users have in common. The exchange does not require user's active involvement and is fast enough to happen between people passing by each other on the streets. After the data exchange, a green LED starts to blink to notify the user. Exchanging data again with a same user can happen only after several hours.

Apart from encountering nearby users, there are two other ways to get StreetPasses. They are both based on Wi-Fi but do not require the users to actually be in the proximity of each other. First, Nintendo Zone hotspots in places like fast food restaurants offer a free and automatic Wi-Fi connection to Nintendo 3DS devices and store the information from the six latest StreetPass users that visited the place. A user visiting the zone will receive these and become one of the six for the next visitor. Second, there is an unofficial hack called HomePass that allows getting StreetPasses from all over the world without leaving home. As a result, Nintendo's systems assume the connected 3DS to be collocated and exchange StreetPass between them.

There is no official estimate of the number of StreetPass users. The potential relates to more than 54 million 3DS devices sold by Nintendo worldwide by 2016, but how many of the users have activated StreetPass and are using it actively is not revealed. The local StreetPass communities with Facebook pages from all over the world have up to thousands of members each. Even without the actual numbers, we can be sure that at the moment there are no other equally wide-spread and popular playful proximity-based features in other mobile devices.

StreetPass Games

Mii Plaza is a central application in the StreetPass use. It comes pre-installed in Nintendo 3DS. It allows the user to create an avatar, Mii, which will be automatically exchanged with the other gamers whenever encounters happen (or, as termed in the games, when the users *meet*). The avatar information consists of a visual representation and textual information about things such as likes and place of origin.

Miis received through StreetPass have to be welcomed in Mii Plaza, after which they can be utilized in the games. A conversation between Miis reveals if and how many times the users have met before. It is also possible to rate the other avatar "Fantastic", which will be shown to the user when the users meet each other the next time. This lightweight form of interaction reminds of "Liking" in many social media. After meeting several times, it is possible to personalize the greeting. Mii Plaza saves all the collected Miis, allowing the user to view them later on.

Mii Plaza comes with two pre-installed games and an option for additional downloadable games. In StreetPass Puzzle each encountered Mii shows their puzzle piece collection, and the user can pick one of the available puzzle pieces to extend their own collection. StreetPass Quest utilizes the met Miis to fight ghosts, and proceeding in the game grants funny hats that can be worn by the Miis. Overall, the most central activity in StreetPass is collecting. In Mii Plaza the user collects the number of met Miis, and Miis from different countries or regions. It also has a vast achievements section, including achievements like having met the same person several times.

Other 3DS games have different approaches for utilizing StreetPass. There are games that allow the user to view the creations of others, give and receive gifts, items or money. The met Miis can be presented as by-standers in some games (e.g. in the audience of a tennis match). Additionally, there are different forms of competing against others' Miis, like simply comparing the results and high scores, playing against an AI representation of the other user's character or team, receiving so called ghost data from others which allows the users to race against each other asynchronously. As information is exchanged only between the games that both players have, it naturally reveals common gaming interests.

RELATED WORK

In the following we discuss earlier research on proximity-based systems. We take a look at how proximity-based features have been utilized in mobile gaming and studies relating especially to the social interactions around Nintendo handhelds, as well as at user experience research on mobile proximity-based social applications.

Botfighters, an early commercial location-based mobile game allowed text message based social play between players originally within one kilometer radius, being

essentially a proximity-based game. Bjerver[2] looked into the experiences of Botfighters players, revealing that it suffered from the problem of critical mass to some extent and the costs for playing it actively were very high, limiting the participation. The problem of critical mass was solved later on with Long Distance Missiles, that removed the need to be in the proximity of another player. As the positioning was based on cell ID, being in proximity had a different meaning in different areas. A later example of location-based game, Ingress[2], on the other hand doesn't include such direct play between nearby players. The social play happens through conquering portals associated with a physical location and accessible to players anytime.

Gaming with proximity-based features has been explored in research with different types of concepts. In Feeding Yoshi[1], Insectopia[14] and Blowtooth[8] the players take an active role in exploring their surroundings, whereas StreetPass exchanges game content automatically without users' active involvement. All of the mentioned examples also take advantage of non-player devices as game elements. In Feeding Yoshi local Wi-Fi networks and their different security characteristics generate either creatures or farms to grow food to them. The user needs to collect food from the farm and take it to the creatures, which leads to exploring the surroundings in order to locate the networks and going back and forth to transport the fruits. In Insectopia every active Bluetooth device generated an insect which could be collected. In Blowtooth, the player attaches virtual drugs to an active Bluetooth device before airport security check and tries to find and reclaim them after the security check. Both Feeding Yoshi and Insectopia also allow teamwork between proximate players. All of the mentioned concepts include online features that allow comparison between players. Each study also reports a user evaluation but the focus and scope of the evaluation are rather narrow, not covering various user experience aspects and social phenomena around this type of gaming.

Sensing the distance between players and using that as a resource when designing games is discussed by Mueller et al. [12]. They derive design strategies based on an analysis of four games presented in research literature. Three of the games are essentially local multiplayer games, and the fourth one, WarDriving is based on the discovery of open Wi-Fi networks in the same way as Feeding Yoshi, but there is even less playful utilization of this information.

Some research on the users of Nintendo's handheld gaming consoles has been published before. Szentgyorgyi et al. [16] looked at the social gaming practices of Nintendo DS users. They found out that even though ad-hoc, collocated pick-up games with strangers were made possible with wireless technology, there were social and technical barriers to make this actually happen. Multiplayer gaming took place mostly between familiar people or in gaming events. The found barriers include finding gaming opponents, social awkwardness of initiating a game with a stranger, the problems related to joining, and exiting an ongoing game.

Söderlund [17] discussed the game design aspects and the future of proximity-based gaming in 2010. He saw that proximity-based features would become part of other game genres rather than proximity gaming becoming recognized as a separate genre. He saw entering nearby stranger's game worlds as having social barriers.

Nintendo DS game Dragon Quest IX had two proximity-based features, the Tag mode similar to StreetPass, and Co-Op mode for local multiplayer gaming. Dragon Quest IX players' behavior, especially their gathering on public places were studied by Licoppe and Inada[11]. Their work looks at how players set up encounters on public places through mobile internet, how they appropriate public places for gaming and how they behave on the encounters. The game was found to motivate players to gather around in the proximity, within 20-30 meters to be connected through the game console's Wi-Fi connection in order to gain benefit in the game. Some engaged in face-to-face interaction, while others kept their anonymity. StreetPass has broadened the use cases for the functionality introduced in the Tag Mode, as well as the range of games and the user base.

In a recent work, Briceño [2] analyzed StreetPass and compared its characteristics with online social networks and social network games. In her analysis, she concentrates on looking at the Mii Plaza games, described earlier in this paper. She saw StreetPass as something preventing true social interaction between 3DS users and leading players to view each other as in-game currency but also admits that the physical proximity can convey a sense of intimacy. Our work continues this vein of research but focuses on the experiences and social interactions particularly the active users of StreetPass have had over a long period of use.

Proximity-Based Social Applications

As StreetPass exchanges also some profile information on top of the game content, it is relevant to discuss the research on mobile proximity-based social applications. The research on proximity-based applications with focus on social purposes dates mostly to the early days of Bluetooth. As a part of their research on exploring the relationship between strangers encountering each other frequently on public places, Paulos and Goodman [13] designed a Bluetooth based device as well as a mobile application called Jabberwocky. It would log the encounters and show the user if these frequently encountered strangers, so called Familiar Strangers, are or have been around them. Paulos and Goodman believed that such devices could encourage solidarity in public places. StreetPass continues the idea of Jabberwockies by logging the encounters with people with a similar interest, namely Nintendo 3DS gaming.

[2] https://www.ingress.com/

Kostakos et al. [10] developed a proximity-based system for discovering of common contacts based on a comparison between phonebook entries. The motivation behind this system was assisting users already in face-to-face meeting to establish common ground. The Bluetooth implementation required user to do a discovery of devices in the range and then request data exchange with one of them. The owner of the requested device had to accept it in order to make the exchange happen. The user study participants saw that the Bluetooth based feature could be useful for getting to meet strangers, but there was a reluctance to respond requests from unknown people.

Serendipity [5] combines Bluetooth discovery and a centralized server for facilitating social interaction between proximate people. When it detected a desired amount of similarities in the profiles of two users physically close to each other, it alerted them. The performed user evaluation revealed that the value of Serendipity relates to pragmatic goals like meeting with another employee of the same company or discovering similar business interests.

Other work on social proximity-based applications includes DigiDress [15], Scent [7] and TWIN[17]. They present functionalities like messaging, discovery of proximate users, expressing identity and sharing content with other users. The user trial for TWIN showed that the motivations to use it were mostly related to fun and entertainment, not to any practical goals. Meeting both known and new people was another motivation. The researchers in TWIN saw that in the future proximity-based systems could run in the background of the mobile device and provide alerts of changes in the social environment. StreetPass does exactly that, and our research reveals what kind of behaviors and user experiences this can lead to.

ONLINE SURVEY

We aimed to investigate the user experiences of Nintendo 3DS StreetPass from diverse viewpoints. To be able to extensively study the geographically spread user population, an online survey was conducted. With online surveys it is common to reach mainly active and enthusiastic users.

Survey Design and Dissemination

The survey was designed with the Webropol online tool for creating interactive surveys. The survey was advertised in several StreetPass community pages in Facebook and in Nintendo 3DS online discussion board in gamefaqs.com. To motivate responding, three Nintendo eShop cards worth 50 (€/£/$) were drawn among the respondents. Over a period of 11 days, the survey resulted in 105 relevant responses.

Analysis

The responses to the open questions (qualitative data) were coded; recurring themes were recognized and categorized bottom-up. The distribution of answers to the Likert scale questions are presented as bar charts. The numbers and percentages presented in the results describe our sample; they are not generalizable to the overall population of StreetPass users. As the focus of the work is on qualitative research and surfacing relevant themes, no statistical tests were carried out. The reported user quotes are condensed to the essential parts. The researchers are independent academics with no connection to Nintendo.

Respondents

The average age for the respondents was 27 years (min 14, max 53). 24 of the respondents were female and 81 male. Nationalities of the respondents included mainly North-American (45%) and European (49%).

The average for the respondents' estimation of their weekly gaming hours was 31. Nintendo 3DS was used by all respondents (on average 14h weekly), followed by home consoles (79% reported to play with them, weekly average 8h), smartphones (41%, 6h), tablets (18%, 3h) and other hand held devices (21%, 5h). On average, the respondents reported to have used Nintendo hand consoles already for 16 years (min 1, max 30, St.dev. 6.3 years). The studied population represents active and experienced gamers. They can also be considered as early adopters, as supported by the responses to the statement "I am interested in new technology": 51% fully agreed, 28% mostly agreed, and 15% mildly agreed with it.

Activity of StreetPass Use

The respondents represented long time active StreetPass users. On average, the respondents reported having used StreetPass for 30 months (of about 4 years it had excisted). Figure 1 illustrates our average respondent. The number of games they have played with the StreetPass ranged from 1 to 50. We consider the number of Miis received through StreetPass, i.e encounters with different users, as the main measure of their activity. We present the Mii count along with quotes to contextualize them. Only 14% had received less than 100 Miis, while 45% had received 100-999 and 30% 1000-2999. 10% had received as much as over 3000 Miis. Interestingly, on average about 93 % of these were reported to be from total strangers.

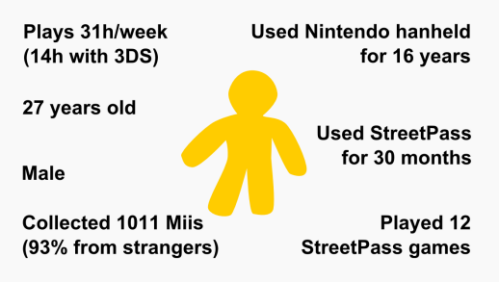

Figure 1. The statistics of an average respondent in the survey.

RESULTS

Overview of the StreetPass User Experiences

To get an overview of the user experience of StreetPass and its effects on the respondents' interactions and lives in general we asked the respondents to choose their stance on different statements on a 7-step Likert scale. Figures 2 and 3 present the distribution of the answers.

Figure 2 shows that the satisfaction with number of received StreetPasses as well as the effects of StreetPass on excitement towards gaming and enjoyment of Nintendo 3DS for this group were generally more agreed with than disagreed with.

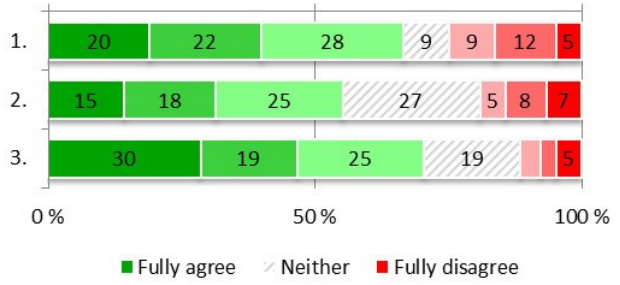

Figure 2. User experience statements (n=105) (1) "I'm in general happy with the number of StreetPass I get"; (2) "Because of SP I feel more excited about gaming than before"; (3) "Because of StreetPass I am enjoying my Nintendo 3DS more than before"

Figure 3 reveals that 92% of the respondents reported to take their 3DS to different places just to get more StreetPasses. The responses to the statements on the social effects and the opposing statement on StreetPassing being done only to get ahead in games both imply that StreetPassing is a hobby in itself. It seems that a major element in the perceived value of StreetPass is related to the social aspects.

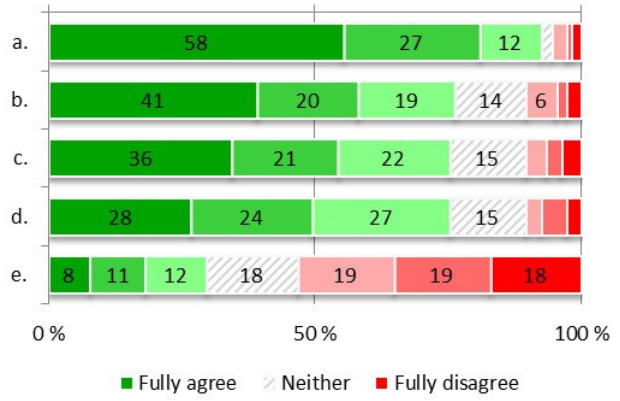

Figure 3. Statements about behavioral and social effects (n=105) (a) "I take 3DS to different places just to get more Streetpasses"; (b) "When I get a StreetPass I feel like part of a 3DS user community"; (c) "Because of StreetPass I feel more connected to other 3DS gamers"; (d) "I am curious to know who is the person I StreetPass with"; (e) "I do StreetPass only for getting ahead in games, other users do not interest at all"

In addition to this quantitative overview, we wanted to understand the effect that automatic proximity-based exchanges can have on a user's life. The following sections describe the qualitative results and try to shed light on the reasons behind the summative assessments above.

The Benefits of StreetPass

To understand what kind of experiences and benefits automatic proximity-based exchanges can bring to their users, we asked two questions: "What is your best or most memorable experience with Streetpass?" and "Overall, what kind of benefit or value do you feel you get from using Streetpass?" Based on the analysis of the answers of both of these questions, we describe what kinds of benefits StreetPass provides to its users, and what aspects seem to contribute them. The benefits fall under two main categories: *Gaming benefits(56)* and *Social Experiences(43)*.

Gaming Benefits

StreetPass was found to enrich gaming in various ways. As expected, receiving *in-game content(21)* was seen as the main benefit by a large group of respondents. Getting a StreetPass can also *help in proceeding with the games(8)*. Interestingly the experienced value of StreetPass seems to go far beyond these.

Feelings of *achievement(17)* are supported by the many types of *collecting(10)* tasks. Utilizing the diversity in the user community provides a rich and dynamic basis that allows continuing the collecting practically endlessly.

> Probably when I hit the 3000+ mark on visitors. It's like "Yeah! I'm big league now!" (Male, 32 years, USA, 3001 Miis gathered)
>
> When I received my first and only Mii with golden pants ("Golden Mii"). It is something special and does not happen a lot in Europe. I was very excited! (M, 35, Denmark, 900)
>
> Looking at my streetpass map, all the countries I've streetpassed and all the different regions. Pretty neat to see how diverse it is, knowing that I got them all legit. (M, 21, USA, 523)

Unlike in modern smartphone gaming, where users are overwhelmed by masses of new free-of-charge games, 3DS mostly relies on the traditional business model. The games are paid up-front and they are expensive, however offering a well-designed experience. StreetPass seems to help in *generating replay value(8)*.

> It's a bonus to my games, keeps me playing them longer. (M20, Canada, 2500)

People already carry a lot of items with them: smartphones, wallet, keys etc. Having space and willingness to take care of yet another item is not self-evident. It seems that StreetPass gives additional motivation for bringing 3DS along, thus making the *bond with the device stronger(6)*.

> Encourages me to take the handheld out and about, the way it was designed to be used. (M, 16, UK, 352)

StreetPass seems to add a social layer to the games. It *inspires(4)* the gaming by allowing the user to view what games others play and even what they have done in the games. A feeling of *benevolence(3)* comes from being able to give something to others and reciprocally receiving something from them.

> always exciting to get a StreetPass for a game you think no one else is playing. (M, 41, USA, 2500)
>
> The biggest benefit is being able to see what other players are doing and interact with what they have built (M, 27, USA, 1600)
>
> There are some games in which you can share an item with other players you streetpass and its nice to give and receive things in a game that would be difficult to get by yourself. (M, 34, USA, 800)

Using StreetPass in fact seemed to turn life in to a playground where the encounters happen by *surprise(14)* and the received content is another positive surprise.

> …excitement, surprise, feels like waiting for christmas in childhood (F, 39, German, 1000)
>
> StreetPass adds a lot of mystery and excitement to a game, who will you meet, what have they accomplished, what will you gain or discover as a result of meeting them? (M, 25, UK, 3000)

StreetPass seems to create a similar motivation to explore the real world as location-based games, even though there is no guarantee of encountering another user. This seems to lead to *attending events(2*4) that the user would otherwise neglect but that can enrich their lives.

> Going to [an event] that doesn't interest me, with some friends, after one of them convinced me that there was a high chance of SPs which I found doubtful. Got around 14 SPs, which is hard to do in Puerto Rico due to general view on handhelds. Talked & played [a game] a bit with some of the other." (M, 25, Puerto Rico, 1195)
>
> I am kinda more motivated to go outside when I don't have anything to do, in order to get more people in the mii lobby. (M, 24, Germany, 1183)

Social Experiences

The new way of interacting with strangers was considered something unlike anything before. Using StreetPass gave the respondents *a feeling that they are actually interacting with the others(13)*, even though the data exchange itself happens automatically.

> I'm not alone, it is nice to meet someone, little play in the daily routine (F, 25, Germany, 942)
>
> A unique feeling which I never experienced before. It feels like you can connect to Nintendo gamer much easier than before, even if you possibly never meet the same stranger on StreetPass ever again (M, 23, Germany, 130)

StreetPassing the same user repeatedly was seen to lead to interaction in deeper level and even initiate *face-to-face interaction(5)*. The users in the same area can become *familiar strangers(6)*, thus the feature helping make new real life connections. Gaming could also be a good conversation starter with old acquaintances as well as strangers.

> In my uni I met a woman nearly every day and we talked with the short messages. Then I saw someone playing who looked like her Mii and I took my 3DS out for her to see. She looked between her 3DS and then me and came to me. We talked a lot then and now we are friends. (F, 24, Germany, 1200)
>
> ...the StreetPass feature would alert me if others in the near vicinity play 3DS games as I do even if their 3DS is not visible. StreetPasses make a good icebreaker and conversation starter about gaming. (M, 31, USA, 800)
>
> One of the best parts is regularly passing people who have the same daily travel route as you, or live in the same local area. It's also wonderful to pass by somebody you haven't passed in ages, like an old acquaintance you only ever knew through StreetPass. (M, 25, UK, 3000)

Using StreetPass also seemed to provide a *feeling of community(20)*. Being a 3DS gamer is not as common as having e.g. a smartphone, which makes the encounters with other 3DS gamers, i.e. *discovering people with similar interests(9)*, feel unique. By finding out about other 3DS users in the same area one can also start *seeing their familiar neighborhood in a totally new way(4)*.

> ... even when you aren't actively playing a game you are still interacting with the 3DS and other 3DS users (F, 22, UK, 930)
>
> …I got 10 in one day in my town, including one from Scotland, one from Japan, and one from Germany. I was excited to realise that people from all over the world had been that close to me and that we shared interests. (M, 19, UK, 264)
>
> I like knowing that there are more gamers in my town; a place I once thought was a ghost-town. (M, 22, UK, 526)

Furthermore, the value of StreetPass seems to not limit to interacting only with strangers. It can bring value to interactions in already existing friendships by providing a *shared activity(6)*, as mentioned in the following quote.

> …we went to the Legend of Zelda Symphony of the Goddesses concert … and then made a joint effort among about 6 of us to collect all of the pink puzzle pieces we were missing among us. (M, 35, USA, 1000)

Negative Experiences

Similarly, we had a question "What is your worst or least motivating experience with Streetpass?" Interestingly, 20 respondents explicitly stated that have not had one. Disappointment in getting expected amount of encounters was the most common reason for negative experiences. Bad context refers here to long term problems with critical mass in certain areas or certain times. Poor game design was another reason. Even though it seems that the major point with StreetPass is to spread positive things and feeling, in a few cases the behavior of other users had caused negative experiences. Table 1 presents these findings in more detail.

Disappointsments with the number of exchanges (52)	Nothing from supposedly good context (28) Technical problems (9) Bad context (8) Own mistakes (2)
Poor game design (18)	No benefit from the encounter (11) Unnecessary limitations (4) Uninteresting design (4) Unrealistic demands (1)
Misbehavior of other users (6)	Offensive greetings (3) Sexual predators (1) Cheating (1) Creepy Mii (1)

Table 1. Negative Experiences with StreetPass

In 18 cases the negative experiences were related to the design of StreetPass or a specific game. Sometimes getting a StreetPass does not give any benefit, for example when the encountered user does not have any new puzzle pieces. The mentioned limitation of fitting maximum of ten Miis waiting in the Plaza had also caused negative experiences. In mass events, where the users could potentially get high numbers of SPs they need to constantly return to the game and clear out the queue before new ones can appear, which affect the event experience. Poor game design, such as too complex design for utilizing the StreetPass or uninteresting games were mentioned too. Given the fact that in some contexts it is very difficult to get StreetPasses, accomplishments that are based on having high numbers of StreetPasses were considered too hard to reach. Although StreetPass apparently gives a lot of replay value, an active player could "finish everything" and become demotivated.

Encounter with misbehaving users were reported to be the worst experiences by 6 respondents. Witnessing offensive greetings, cheating (e.g. using HomePass), and being sexually harassed were examples of such.

> Some stranger sent me the message "ur gay". (M, 30, Canada, 6600)

To get more information about the negative aspects of StreetPass we asked if our respondents had ever stopped using StreetPass, as well as to identify the reason for it. "No" was the most common answer (84%). Reasons for stopping the use either momentary or totally included: frustration for not getting enough StreetPasses, lack of motivation from either becoming bored or being too occupied in other games, real life responsibilities, and stolen or broken device. Deactivating StreetPass for certain games was reported due to the 12 active StreetPass game limit or disappointing features in a game.

Efforts to Get more StreetPasses

We wanted to find out if and how our respondents had changed their behavior, and what kind of habits they had established in order to get StreetPasses. Our question inquired "What is the biggest effort you have made in order to get StreetPasses?" Table 2 presents the recognized main effort types as well as examples of such behavior.

Active Exploring	Visiting Crowded Areas (20) Visiting Locations-based Nintendo Zones (19) Attending Mass Events (14) Visiting Special Locations (8)
Passive Exploring	Carrying the device "always" along (18)
Attending Community Events	StreetPass Meetings (18) Nintendo fan events (5)
Cheating	HomePass (7)
Utilizing Friends	Collect to others (2) Explore together (1)

Table 2. Efforts to get more StreetPasses

Active exploring in the forms of visiting crowded areas or visiting Nintendo Zones was common. This was done by foot or by car.

> I will take different routes if I know there is a Home Depot or McDonald's location on that route - I make a point to stop and get streetpasses if I can. (M, 34, USA, 1500)

The mentions of *attending community events* such as regular StreetPass meetings were not surprising as apparently about 40% of the respondent came to the survey from Facebook StreetPass communities that organize them. Attending these events can sometimes require a big effort as seen in the following quote.

> I googled a local streetpass meeting when I was in Barcelona and went there, abandoning my boyfriend in the hotel. (F, 30, Germany, 1470)

Taking the 3DS to mass events like concerts and conferences; or to special locations like amusement parks was also a common activity. These activities usually resulted in many hits, but even a one hit may have made the

event a memorable one. The latter of the following quotes also shows how users *team up with friends* or family members to get more StreetPasses for all of them.

> …The parade consisted primarily of bagpipers and marching bands. During the parade, I periodically checked my 3DS to see if I was getting any Streetpasses. At the end of the parade, I noticed that the green light was flashing. I received a Mii with the message "I'm in the show!" I thought it was hilarious! (M, 33, Canada, 390)
>
> Me and my sister took 4 3DS systems (mine, hers, my brothers, and his sons) to the Nintendo World Store in NYC for their Animal Crossing: New Leaf event. All four 3DS systems got over 100 StreetPasses that day, so we had to constantly check all 4 of them to clear out the full plazas. (M, 27, USA, 1600)

Passive exploration i.e. carrying 3DS along as a common routine was another common effort. This is a sign of proximity-based play becoming interwoven in daily life.

Finally, *cheating*, meaning using the HomePass described earlier in the section *Nintendo 3DS and StreetPass*, was mentioned by few respondents. It requires computer skills but can provide massive amounts of StreetPasses in return.

Privacy and security

As interaction and automatic exchange of data with strangers are in a central role in StreetPass, we wanted to understand the users' thoughts on privacy and security issues in this context. Figure 5 presents the distribution of the answers to our statements. Surprisingly the privacy and security concerns with technology in general were more common than concerns with StreetPass. Automatic proximity-based exchanges of playful data were clearly not a concern for the studied sample of users.

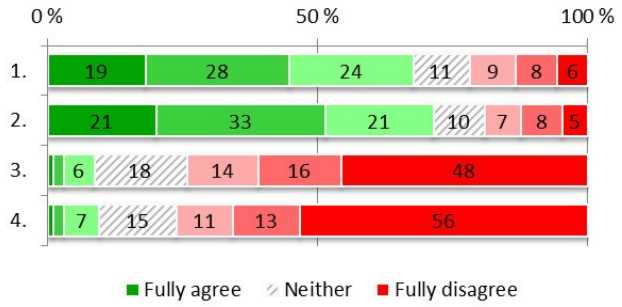

Figure 4. Privacy and security concerns. (1) "I am concerned about privacy issues when using technology"; (2) "I am concerned about security issues when using technology"; (3) "I am concerned about privacy when using StreetPass"; (4) "I am concerned about security when using StreetPass"

We also asked if they would be more or less worried if they were using a similar feature on their smartphones, as well as the reasons for this opinion. 62% agreed that they would be more concerned. The common reasons included smartphones storing more personal information and general distrust to smartphone safety, while Nintendo was seen as a trustworthy company. The mentioned reasons for not being more worried included: having expectations of being able to control the sent data in the same way as in StreetPass; and not worrying about such things in general.

Wishes for Deeper Interaction

73 % of the respondents agreed with a Likert scale statement "It would be interesting if I had more or deeper interaction with nearby StreetPass users". In open answers, there were people who were perfectly happy with the way StreetPass currently works – particularly in the way it preserves the anonymity of the players but has a social aspect. However, there were also many hopes for being able to exchange messages easier as well as engaging in multiplayer gaming easily with nearby players.

> I'm pretty happy with the current amount of interaction. No more, no less. (M, 23, USA, 80)
>
> Let them appear in my game … and help or distract me, they disappear if they get out of range, also give me the ability to communicate out of games with them, we need a better messenegr system where I can chat with people around me no matter which game we have open. (M, 25, Germany, 380)

DISCUSSION

We were positively surprised by the vivid answers we received. The generally very positive attitudes towards and experiences of StreetPass are evident throughout the responses of this sample of active StreetPass users. The numerical data on the usage activity of our respondents shows that proximity-based automatic exchanges of playful data can induce active, long-term (several years) usage where the interaction happens mostly between strangers (thousands of encountered users).

The findings on biggest efforts and best experiences with StreetPass imply that proximity-based play can become a meaningful hobby where people spend time and effort, and receive plenty of value to their gaming and social benefits in return. Apparently the benefits outweigh the drawbacks, such as having to carry an additional device along or the decreased battery life. The device can become a companion carried with oneself where ever opportunities for finding new connections may appear, being interwoven in life but also shaping it by affecting the decisions where one goes.

Whereas location-based games draw players to certain locations and guide them with a map interface, StreetPass users are left guessing where one could encounter like-minded people. Proximity-based automatic exchanges suffer more easily from the lack of critical mass, but can perhaps bring more surprises instead. The long operation ranges of Wi-Fi connection, and the fact that the exchanges happen automatically, are less demanding on the density and activity of users than if the exchanges would require user's explicit input.

Interestingly, our findings imply that the value of proximity-based play can go far beyond the benefits in a game. This is contrary to the analysis by Briceño [2]. The

respondents of our survey reported to have been encouraged to explore their surroundings and attend different kinds of events. Encounters and interactions with other users – strangers, familiar strangers and friends – offer various social experiences and a feeling of belonging in a community, confirming the vision of Paulos and Goodman [13]. Based on the detailed reports by the respondents, StreetPass had created numerous positive experiences of social encounters. The feature seemed to enhance the feeling of community, resulted in discussions between players, and even facilitated making new friends. This happened even though StreetPass does not provide means to easily identify stranger users or messaging with them.

The finding related to respondents' perceptions of privacy and security was surprising. The privacy and security concerns with StreetPass were very low compared to the concerns with technology in general. StreetPass allows choosing how much information one wants to share about oneself. Also, the automatic data transfer and long operation range guarantee that users can easily remain unrecognizable if they carry their devices in their bags and their Miis do not look like them. Besides, 3DS is a device dedicated to gaming and is produced by Nintendo, a company considered trustworthy by them.

There was clearly more suspicion towards something similar (automatic exchange of data) becoming available for mobile phones. At the moment automatic exchange of data between nearby strangers is prevented on mobile phones both through Bluetooth and Wi-Fi Direct, as they both require the receiving party to explicitly accept the proposed connection. Detecting proximity based on GPS position, and using mobile internet and servers to exchange data between players seems at the moment a more feasible option. Even though location-based games at the moment rely heavily on a map interface, a game with a critical mass of users could be powered by encounters only, providing surprises and sense of privacy.

StreetPass doesn't provide similar access to one's games for strangers as Söderlund [17] talks about. Similarly, whereas Botfighters was based on direct competition between players which might invite for negative behavior like stalking [2], taking advantage of a StreetPass encounter is voluntary, and provides usually positive effects. Other players do not present a threat to one's gaming. Still our respondents wished for deeper ways to interact with nearby players. It is interesting to see how the recent location-based hit game Pokemon GO[3] will solve the issue of interaction i.e. trading and fighting between nearby players and what is the user experience of it.

When considering these highly positive findings, we must remember that they come from very active DS3 gamers and Nintendo enthusiasts with a long history with its handheld devices. The long experience and brand loyalty might partially explain the generally very positive experiences and attitudes. At the same time, it is worth noting that experienced gamers are harder to please and surprise; StreetPass seems to have managed to accomplish this.

Design Implications

In order to make our findings more approachable for potential designers of proximity-based playful applications, we describe how they could be taken into account in design.

- The surprise factor related to when and where an encounter happens, and what the user gains based on that is what makes particularly *automatic* proximity-based exchanges unique. The users are willing to explore the world in order to experience more surprising encounters. This surprise factor should not be sacrificed while considering the possibility of including services in fixed locations to facilitate exchanges (e.g. Nintendo Zones).
- The frequency of encounters will vary a lot between individual users and in different contexts. Applications based on serendipitous encounters of other users should be motivating to use in different conditions. Each encounter should provide value and the value should not fade over time. The user should be able to choose whether they access the received content immediately or save it for later.
- With playful data, proximity-based automatic exchanges seem to provide a decent sense of privacy for interaction between strangers. Unnecessary barriers for *automatic* proximity-based exchange of data that is not privacy-sensitive should be avoided.
- Proximity-based automatic exchanges of data should be extended with follow-up interactions like exchanging messages or gaming together. However, this should not compromise the anonymity and privacy provided by automatic exchanges.
- If there is not absolute certainty that the system will automatically detect another user every time, the users should be able to manually trigger the discovery. Despite the fact that strangers can be the main source of encounters and the users will not be able to know if they have collected them all or not, there will be cases when a user encounters other users who are their friends.

CONCLUSIONS

We reported an online survey for active users of the StreetPass feature on Nintendo 3DS hand console. We found that Nintendo's approach to proximity-based interactions, automatic exchanges, had provided our respondents with benefits and delightful experiences both in regard to gaming and social interactions. Based on the encouraging results, we believe that automatic proximity-based exchanges could bring value also in other mobile systems and applications. Such applications could offer further means to engage the users in face-to-face

[3] http://www.pokemongo.com/

interactions as well as provide a feeling of being among people with similar interests.

To summarize the contribution of the paper, we argue that we reported an extensive empirical study as well as design implications related to a phenomenon that is novel and has been studied very little. We focused on the user experiences of pioneer users in the first widely available service that utilizes automatic proximity-based exchanges. We identified a broad variety of interesting UX viewpoints to this user community that have not previously been addressed in research. Based on the results we can argue that automatic proximity-based exchanges can introduce significant additional value to mobile gaming. It not only enriches the gaming experience but also serves as a meaningful activity in itself and creates positive social interactions and phenomena amongst the player community. We expect that the findings from our study will be useful for designers and researchers of proximity-based playful applications on any mobile platform. We hope that our findings will encourage the mobile industry to enable and explore automatic proximity-based exchanges on various mobile platforms.

ACKNOWLEDGMENTS

We thank all the respondents of the study for their insightful comments. The research was funded by Academy of Finland (grants 283110 and 295895).

REFERENCES

1. Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., Benford, S., Capra, M. and Hampshire, A. 2006. Interweaving mobile games with everyday life. *Proc. CHI 2006,* 417-426.

2. Bjerver, M. 2006. Player Behaviour in Pervasive Games-Using the City as Game Board in Botfighters. Numerisk analys och datalogi, Kungliga Tekniska högskolan.

3. Briceño, V. 2014. The Sound of One 3DS Clapping: User Commodification in StreetPass. *Proc. DiGRA* 2014.

4. Corson, M.S., Laroia, R., Li, J., Park, V., Richardson T. and George Tsirtsis. 2010. Towards proximity-aware internetworking. In *Wireless Communications*, IEEE , vol.17, no.6, pp. 26-33, December 2010.

5. Eagle, N. and Pentland, A. 2005. Social Serendipity: Mobilizing Social Software. IEEE *Pervasive Computing*, v.4 n.2, p. 28-34, April 2005.

6. Fodor, G., Dahlman, E., Mildh, G., Parkvall, S., Reider, N., Miklós, G. and Turányi, Z. 2012. Design aspects of network assisted device-to-device communications. *Communications Magazine*, IEEE , vol.50, no.3, pp. 170-177, March 2012.

7. Jung, Y., Blom, J. and Persson, P. 2006. Scent field trial: understanding emerging social interaction. *Proc. MobileHCI 2006,* 69-76.

8. Kirman, B., Linehan, C. and Lawson, S. 2012. Blowtooth: a provocative pervasive game for smuggling virtual drugs through real airport security. *Personal Ubiquitous Comput*. 16, 6 (August 2012), 767-775.

9. Kortuem G. and Segall, Z. 2003. Wearable communities: augmenting social networks with wearable computers. *IEEE Pervasive Computing*, 2(1), 71-78.

10. Kostakos, V., O'Neill, E. and Shahi, A. 2006. Building common ground for face to face interactions by sharing mobile device context. *Proc. Location and Context-Awareness* (LoCA), 222-238.

11. Licoppe, C. and Inada, Y. 2012. 'Timid encounters': a case study in the use of proximity-based mobile technologies. *Proc. CHI 2012,* 2759-2768.

12. Mueller, F., Stellmach, S., Greenberg, S., Dippon, A., Boll, S., Garner, J., Khot, R., Naseem, A. and Altimira, D. 2014. Proxemics play: understanding proxemics for designing digital play experiences. *Proc. DIS 2014,* 533-542.

13. Paulos, E. and Goodman, E. 2004. The familiar stranger: anxiety, comfort, and play in public places. *Proc. CHI 2004,* 223-230.

14. Peitz, J., Saarenpää, H. and Björk, S. 2007. Insectopia: exploring pervasive games through technology already pervasively available. *Proc. ACE 2007,* 107-114.

15. Persson, P., Blom, J. and Jung, Y. 2005. DigiDress: a field trial of an expressive social proximity application. *Proc.* UbiComp 2005. Springer-Verlag, 195-212.

16. Szentgyorgyi, C., Terry, M. and Lank, E. 2008. Renegade gaming: practices surrounding social use of the Nintendo DS handheld gaming system. *Proc. CHI 2008,* 1463-1472.

17. Söderlund. T. 2010. Proximity Gaming: New Forms of Wireless Gaming. Digital Cityscapes. Merging Digital and Urban Playspaces, Peter Lang, New York, USA, 217-230.

18. Väänänen-Vainio-Mattila, K., Saarinen, P., Wäljas, M., Hännikäinen, M., Orsila, H. and Kiukkonen, N. 2010. User experience of social ad hoc networking: findings from a large-scale field trial of TWIN. *Proc. MUM 2010*.

PUBLICATION 3

Next2You: a proximity-based social application aiming to encourage interaction between near-by people

Susanna Paasovaara, Ekaterina Olshannikova, Pradthana Jarusriboonchai, Aris Malapaschas, and Thomas Olsson

Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia (MUM '16). ACM, New York, NY, USA, 81-90

Next2You: a Proximity-Based Social Application Aiming to Encourage Interaction between Nearby People

Susanna Paasovaara, Ekaterina Olshannikova, Pradthana Jarusriboonchai, Aris Malapaschas, Thomas Olsson
Department of Pervasive Computing, Tampere University of Technology
Tampere, Finland
first.last@tut.fi

ABSTRACT
This paper presents the design and concept evaluation of Next2You, a proximity-based social mobile application that uses gamification, progressive disclosure and light-weight interactions to encourage interaction between people who are regularly within a close proximity of each other. The application aims to break the current norm of matching and introducing people based on similar interests or commonalities. We conducted focus groups to evaluate the application concept. We report findings of the user study contributing to the understanding of the potential and challenges of gamified proximity-based social applications.

Author Keywords
Social applications; Proximity-based systems; Social interaction; Progressive disclosure; Gamification.

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

INTRODUCTION
Triggering and encouraging social interaction between collocated people has become an increasingly popular research topic in human-computer interaction and computer-supported collaborative work. Research has shown that collecting game related content from nearby strangers motivates exploring the real world and attending events, provides pleasant surprises, and it can also lead to face-to-face interaction [19]. Proximity-based applications are seen to have potential to serve various domains including both leisure and business [2]. Our research looks at the potential that proximity-based applications have in encouraging social interaction between nearby people.

We argue that the surrounding strangers in urban environments provide an extensive but challenging design space. Especially in large cities, people have lost such connection to each other that might still exist in small villages and communities. This leads to a question whether information technology could encourage people to take the immense social opportunities around them? After all, social interaction is a fundamental source of pleasure and provides feelings of companionship and connectedness. It is the basis of knowledge sharing in societies and development of cultures, and it affects the overall quality of communities [8,12,24]. While modern people are criticized for focusing on interacting with their personal devices in public places, we see that it is the same technology that could also turn their attention towards the surrounding others.

Interactive technology has been involved in facilitating and supporting social interaction with different approaches including social matching, interactive installations and awareness applications. Social matching systems are systems that recommend or match people together [26]. Social matching systems have gained much attention both in academic research and industry, especially as dating services (e.g.,Badoo[1]) and networking tools in professional events (e.g. [1]). However, these systems mostly base their results on matching algorithm of profile attributes and interests. However, we consider this as limiting users to only those who have similar interests, but not provide opportunities to expand their interests further. In contrast, we provide opportunities for people to connect with nearby people in their own community, and learn more about each other. We aim to increase a user's curiosity towards surrounding people as well as increase the awareness of the social possibilities around oneself.

Alternative to social matching, technology can encourage interaction between nearby people by providing them with information hidden beyond people's ordinary senses. Social awareness applications provide information about users' current state or situation to others [22]. The information can be used to bring together people within a community, like neighborhood or office (e.g., [10,17]). Unlike social matching systems that provide matched results between

[1] www.badoo.com

users based on certain algorithms, social awareness applications provide a variety of information about other users or situations. Although this may contain great amount of information, it provides freedom for users to make use or take advantages from systems (e.g., [18]).

In addition to these mobile and personal systems, research has explored the potential of interactive installations and applications on public displays in encouraging interaction between nearby people [3,15]. They create a honey pot effect, i.e. when someone interacts with the system, others are attracted to the site.

In this paper, we take an approach similar to awareness applications, showing information about other users to our users, but letting them decide how they use it. Our system applies gamification to encourage people who are regularly within each other's proximity to become more aware of each other and, possibly, interact face-to-face. We present Next2You, a proximity-based mobile service that supports awareness of nearby people and encourages social interaction with them. Next2You provides awareness information through progressive disclosure of other users' profiles. That is, it gradually reveals new pieces of information from another user's profile every time they are in proximity of each other. This is expected to increase curiosity and sense of playfulness, unlike the approach of displaying the whole profile at once as in traditional profile-based social awareness systems (e.g., [21]).

This paper has two contributions: first, we describe the design and implementation of the Next2You system that has novelties both from the viewpoints of designing for social interaction and building proximity-based systems. Second, we report the initial user evaluation of the acceptability and expected user experience conducted with focus group method.

RELATED WORK

Social Matching Applications

Our research explores technology-mediated interaction between nearby strangers and its potential to encourage them to meet face-to-face. Previous research has explored multiple approaches in bringing people together. One of these is social matching. There are multiple forms of social matching applications. Online social matching can be done via web interfaces with remote users. *Context-aware social matching* can be done with mobile applications and it can take into account for example the physical location or physical proximity of the users. Matching can be done based on different criteria, for example a user defined profile or mutual friends. For example, *Serendipity* matches users who are within proximity using preferences in their profile [24]. *Social Net* is another matchmaking system. Its matching algorithm is based on frequency of encounters over time between users and their mutual friends [25]. Kostakos et al. [11] implemented sharing and matching mobile phone address books over a Bluetooth connection in order to discover mutual friends. Burak and Sharon studied the usage patterns of a mobile location-based application FriendZone, finding out that Anonymous Instant Messenger (AIM) was the most used feature there. AIM provided a possibility to discover users with matching interest and close physical proximity, and exchange messages with them. AIM was appreciated by users because of the anonymity and the potential to lead to face-to-face encounters. [5] Mayer et al. discuss the promises and challenges of context-aware social matching. They consider that opportunistic encounters or unexpected meetings could open variety of opportunities for people in both business and leisure. [13] A challenge in the existing social matching systems is that they mostly promote socialization based on commonalities and familiarities, leading to phenomenon known as *homophily*. Homophily limits people's social connections, attitudes and opinions. This nature of socializing only with similar others, has been addressed in various disciplines including psychology, sociology and social network analytics [9, 14].

Social Awareness and Profile Sharing Applications

Social matching is not the only approach to encouraging nearby people to interact with each other. In addition to actually introducing people to each other, research has explored making them more aware of each other's presence in various ways. The premises for this work are that it will increase solidarity in public places. Paulos and Goodman designed Bluetooth based devices called Jabberwockies[20], which gathered information about *familiar strangers*, people who have been around you before. The way the system presents information to the users was very simplistic. That is, it collects information about nearby users and shows with different colored lights the presence of people the user has or has not encountered before. *DigiDress* is a profile sharing mobile application. Users can view others' profile only if they are nearby each other, without any other matching requirements [21]. The system is reported to instigate curiosity, which then led to face-to-face interaction between users. Our approach doesn't require user´s active effort in scanning the surrounding, but is detects nearby users and makes and exchange with them automatically also saving the collected content. *Meme Tag* is system that swapped users' nametags with each other when they were in close proximity, triggering face-to-face interaction between new people [4]. TWIN was a WLAN based mobile application for with the main purpose of allowing exchanging files between nearby users. It also allowed users to discovering who is around. The researcher envisioned that in the future, social applications could be more proactive. [27] That is something our research is looking into.

Seeburger et al. created a system that shared choices between nearby strangers, and allowed light-weight technology mediated interaction in relation to the songs [23]. It is worth noting that the interaction is based on something that the user does anyway i.e. listens to music. A commercial application building on the same principle is

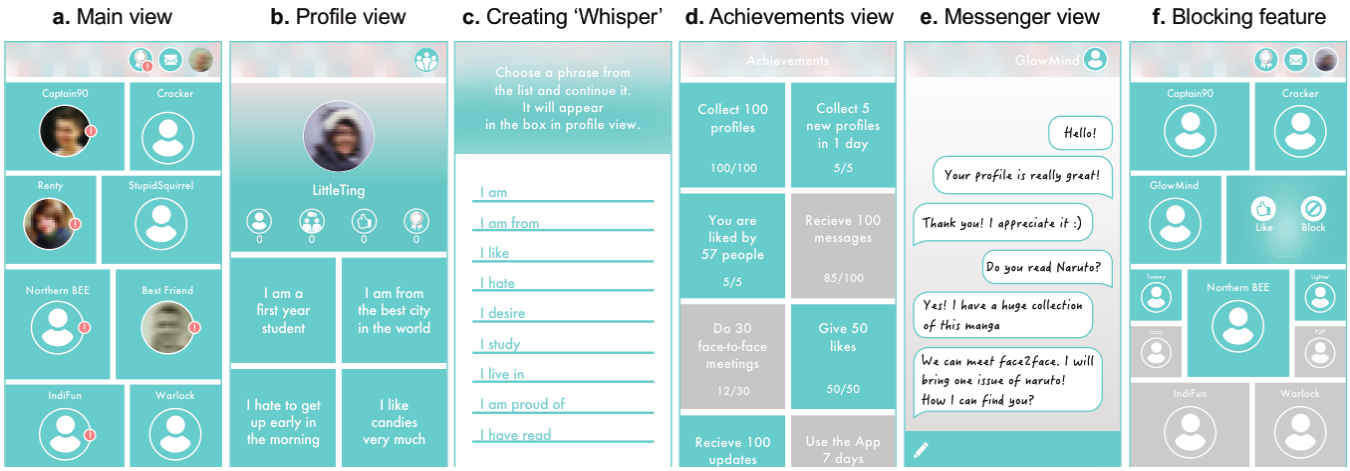

Figure 1. Screenshots of N2U mock-up

StreetPass on Nintendo 3DS devices. User plays games for her/himself, which in turn generate something that is exchanged between nearby stranger players who own the same game. Research on the experiences of StreetPass players [19] has shown that the automatic exchanges of game content motivate exploring the real world and create a feeling of community and interaction with other players. We apply *gamification*, the use of game elements in a non-gaming context [6], to social content in order to see whether it can create similar effects as the exchange of actual game content.

CONCEPT

Next2You (N2U) is a social mobile application that aims to encourage face-to-face interaction between people who are regularly within close proximity of each other but not necessarily socially connected otherwise.

N2U implements light-weight gamification to motivate using the application and interacting with others. Automatic and gradual collection of content generated by other users creates a sense of progress and curiosity. There is a surprise element incorporated in the unexpectedness of social encounters. This quality of serendipity differentiates N2U from related location-based applications (e.g. Foursquare), in which users' actions are fixed to specific known locations. The major element of gamification in N2U is Achievements (see Fig.1 – d), which we expected to increase the users' motivation to be active in the application and motivate them to meet face-to-face. As a reward for intentionally meeting each other face-to-face, users exchange profile pictures. The amount of collected profile pictures in the main view then symbolizes the user's social proactivity within the application (See Fig. 1 – a).

To enable smooth path between non- interaction and face-to-face meetings we designed three levels of interaction– Automatic, Technology-mediated and Face-to-face, which are illustrated on the Figure 2.

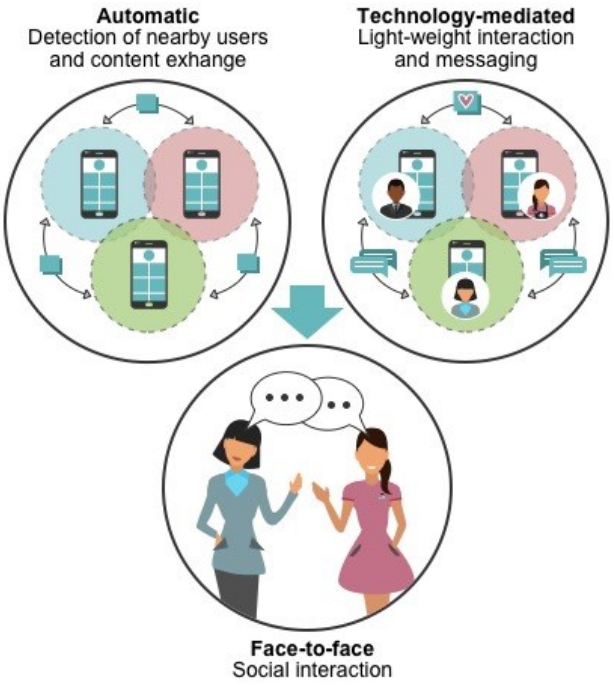

Figure 2. Three levels of interaction in N2U.

Automatic level of interaction

N2U uses Bluetooth to detect other users in proximity and exchange content automatically with them while running in the background of a mobile device. The design is inspired by the design of Nintendo's StreetPass [16] with its main feature of automatic exchange of game content when users are in proximity of each other. However, instead of game content, N2U utilizes a minimalistic profile and user-generated content, so called *whispers*. Instead of fixing the whole profile to a predefined format, we wanted to find out how the users would appropriate proximity-based profiles when they could freely decide what to share. A profile in

N2U (See Fig 1 –b) consists of a nickname, *whispers* and statistics of activities.

Whispers (see Fig. 1 – b, c) refer to the idea of proximity – only people who are close enough could collect them. A Whisper is a small block of text, which could contain any information that the user considers relevant to share (attitudes, personal facts, jokes, etc.). We chose sentence completion approach (See Fig. 1 – c) for creating *whispers* to lower the difficulty of coming up with content. Additionally, the system requires a minimum number of *whispers*, which enforces the creation of at least some content. We designed symmetry in terms of how many cues one shares vs. can receive, which should balance content production in the community – the amount content consumers and producers stays equal.

To make the content exchange more appealing and playful we applied gradual accumulation of the information – the more frequently users encounter each other, the more *whispers* they could collect. Thus, the process of personal disclosure is happening step by step – all collected pieces of information build profiles of encountered users' over a time. This feature creates the sense of progress and curiosity from the perspective of collecting, as well as privacy from the point of being collected by others.

With this design, the automatic level of interactions aims to create a sense of surprise and serendipity as well as a general awareness of one's social surroundings.

Technology-mediated level of interaction

Technology-mediated level of interaction in N2U is a bridge towards the next level of face-to-face meeting. As the application automatically collects information of people in the proximity, the user may at any time explore who is or has been around and view their profiles (See Fig. 1 – a).

At this level, users may initiate light-weight social interaction such as messaging, liking (See Fig. 1 – e). Messaging and liking are aimed to facilitate the development of social relationships between users.

Face-to-face interaction level

Socialization in the physical realm is another design target of N2U. Creating the feeling of the progressed personal disclosure, which is natural way of interpersonal relationships, N2U allow users to gradually get know each other, thus potentially leading to actual face-to-face meeting. The knowledge gained from collected *whispers* would provide tickets to talk, while messenger will allow to agree on time and place of meeting.

Privacy

To exclude undesirable connections a user can block any of the collected users at any time, thus removing so far collected profiles from both sides and preventing any further interaction through the application. This feature is aimed to create the sense of privacy and feeling of control. (See Fig. 1 – f).

In summary, our main design target is to create the bridge between non-interaction and face-to-face communication by means of gamified social proximity-based application. We believe playful elements that create sense of serendipitous discoveries may positively influence user's social proactivity.

IMPLEMENTATION

N2U was implemented for mobile devices with Android 4.3 to 6.0, with Bluetooth and Internet connection. The server side of the implementation consists of two web services (see Fig. 3). The first offers a RESTful API for database access using NodeJS with express framework, and MongoDB. The second provides direct communication over web sockets with Socket.IO. The client side consists of the Android mobile application, which uses Bluetooth to communicate with other mobile devices in range, HTTP requests to send and receive data from the first service, and the client version of Socket.IO to establish communication with the second service.

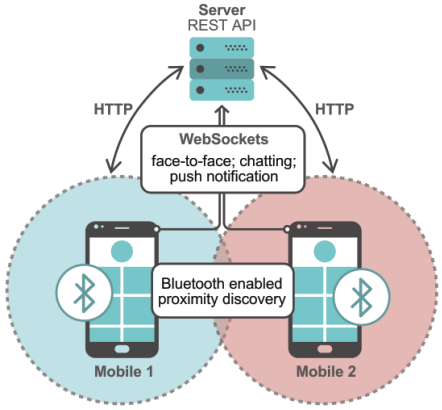

Figure 3. Architecture of N2U

The web service running on the server is responsible for sending the required data from the database to the users' mobile apps, as well as receiving and handling HTTP requests to write, update and delete data on the server. It also provides an "end-to-end" communication between users, utilizing web sockets. This communication is used to carry out exchanging of chat messages between users. Finally, a server-to-client socket communication is utilized to send messages to (all or specific) users, shown as push notifications on the N2U application.

The application creates a background program (service), which runs constantly on the mobile device and is responsible for receiving messages from the server while the app is not on the foreground. It is also responsible for triggering and executing the Bluetooth scan that attempts to discover nearby devices, which are running the application. The interval between the scans was set to 1 minute, which was the minimum allowed by the Android OS. The Bluetooth scan shows all the discoverable devices within range. In order to filter out the ones that are using the N2U app the following method was used: Upon registration on

first time using the app each device's MAC address is matched with the user's name and stored on the server. When the device performing the scan receives the list of devices in proximity, and if a new device has been discovered, it fetches the update list of MAC address - username pairs from the server, and verifies whether it should be added as a new connection.

Finally, there is a server-side only communication between the two services, over web sockets. This is used when specific changes occur to the database (e.g. the completion of an achievement). The "database" service sends a message to the "socket" service, which notifies the appropriate mobile device with a push notification.

METHODOLOGY

Iterations of design and evaluation are central to human-centered design. Our end goal is to be able to arrange a longitudinal field trial with N2U. Evaluation of social proximity-based applications such as N2U requires critical mass of users as well as high quality of user experience. A critical mass of users is needed first of all for the encounters to happen and the further interactions to take place. The user experience of the application needs to be good, so that the user's motivation and activity to use the application are not decreased by properties irrelevant to the core of the concept.

To ensure a good user experience, we decided to gather constructive feedback on the concept with an early phase evaluation. In addition to that, we wanted to obtain the expectations for such a concept in order to compare it later with the experience of real use during actual user trial.

We see university campus as an ideal context for our field trial. Students spend time at the campus on daily bases. This context is expected contain a lot of *familiar strangers*, people who constantly encounter each other but do not yet know each other that well. The students are also expected to have contemporary mobile phones and mobile Internet connectivity needed to use the application. Lecture halls, corridors and lunch lines as well as event-oriented crowded places are expected to provide opportune spaces where other users could be discovered.

The concept evaluation was implemented in focus group sessions. We arranged five one-hour sessions. The participants of our study were technology students in a Finnish university. Ten of our 18 participants were female and eight were male. The average age of the participants was 26 years and ranged from 21 to 40 years. Ten of our participants were from European origin, 6 Asian and 2 South American.

At this phase we had semi-functional prototype available with limited amount of features. Due to this fact and to support participants' comprehension of the concept we created a concept video, which illustrates N2U usage. The video was 5 minutes long and presented the features of the application through a storyline of one user starting to use the application, discovering nearby users, finding someone interesting, messaging and finally meeting the other one face-to-face. After the video we summarized the main points of the concept to make sure that everyone understands the concept in the same way before the actual group discussion.

Each participant was provided with a mobile phone with pre-installed N2U prototype. Before proceeding to the group discussion, the participants were asked to create their profile of *whispers* in the application. We asked them to think about what they would like to share with people they pass by in the campus. The application then started to exchange *whispers* between the participants. The interval of exchanges was set to 5 minutes, allowing most of the *whispers* to be exchanged during the first parts of the group discussion.

The group discussion covered topics like strengths of the application, concerns related to the application, participants' views on gamifying face-to-face meetings, and their suggestions for improving the application.

After the first part of the discussion, each participant spent some time to view the profiles of others they had received gradually. That was followed by a discussion about sharing content with nearby users. As the last step, the participants filled an end-questionnaire to sum up their views on the concept.

In the end questionnaire, we presented the participants a set of statements on a seven point Likert scale ranging from strongly disagree to strongly agree. The point of asking the questions was to further clarify and quantify the qualitative findings from the group discussion, and to let every participant voice their opinion freely without a fear of judgment. We asked the participants to choose all applicable options of different types of content they would share in this proximity-based application.

Group discussions were transcribed from the audio recordings. The contents of participants' profiles were analyzed by categorizing individual items bottom-up. The distributions of the questionnaire results were calculated.

FINDINGS

Quantitative overview

The feedback on the concept collected from the end questionnaire was supportive. Majority of the participants (16/18) agreed that the application is interesting and they would like to try it. All the participants agreed that it would be appropriate for its intended context i.e. university campus. Majority (15/18) also agreed that the application seems like a meaningful way to get information about people they do not know. They could even think of sending a message to a person with matching interest (15/18) and meeting a person face-to-face after connecting through the application (16/18). The participants agreed greatly on creating a profile with truthful rather than fake information (17/18). However, the views on whether the application

allows people to do things that are not supported by other technology varied widely. Additionally, privacy concerns related to the application created a wide variation of views and spread across the spectrum of choices. Participants views varied greatly again on whether they would be more careful when creating a profile for proximity than for online social media.

Potential use cases for N2U

We asked the participants choose applicable options from a predefined set of reasons to use the application. Finding people with similar interests was the most popular choice (16/18) followed by finding new friends (13/16) and general interest in others (10/18) and making others smile (8/18). Less popular choices were finding a partner (3/18), promoting a business (3/18), affecting others (2/18) and making people scared (1/18). Participants added three use cases outside the list: locating current friends, following a trend (if everyone else uses the application) and making others scared in a playful way.

Sharing in proximity

We asked the participants to choose all applicable options of types of content they would be likely to share in this proximity-based application. From our predefined options information about their interests was the most popular (18/18), followed by facts about themselves (11/18) and playful content (10/18). Personal ideology or view of the world would be shared by 8/18 and information about studies by 7/18. Additionally, two participants reported to potentially use application for advertisement purposes. Also options that we had not thought were suggested: invitations to different kinds of events, information about their daily routines (to figure out car pool possibilities), links to music and articles, as well as photos.

Qualitative overview

The group discussions revealed many interesting details of our potential users' thoughts. In the following we go through these qualitative findings in more detail.

Target users of N2U

Several participants saw that the target users of N2U would have inhibitions regarding initiating interaction with strangers. The application was seen to provide both a shield behind which one can hide, but also something that helps to initiate social interaction. The users could for example be new to a certain context or just wish to expand their current social circles. Using this application was seen to signal interest in meeting new people. There were several views that the purpose of this application is to find people with similar interests, but just getting to little by little know new people or a new environment were also seen as a purpose.

Strengths of N2U

Our participants saw several strengths in N2U. It allows users to explore their social surroundings and choose people to meet based on information they share in their profiles. There is freedom in deciding what one wants to share in the profile. This freedom further provides control of disclosing information about oneself.

"You can write whatever you want. You are not bounded to the one idea".

N2U was seen to encourage people to be socially active. Participants pointed out that receiving information about nearby people gradually is fun and motivates to find out more about other users. Gamification was seen to make the application more appealing and entertaining. Our design choices of automatic exchanges, hiding the profile picture and revealing only a partial profile were perceived as the element of social surprises while collecting profiles and meeting strangers face-to-face:

"From my perspective it is great to find a people without knowledge of their background info and profile photo. For instance, you may have a common interest with a guy who is twice older or it could even be your friend. You never know before face-to-face meeting".

The potential of N2U leading to face-to-face interaction

Encouraging face-to-face meetings was considered to be a main point of the application. Our design efforts to motivate people to meet each other face-to-face received positive feedback, but it was questioned whether the design choice of allowing messaging only when in proximity would actually provide enough time to initiate such meeting:

"I don't think people would reach face-to-face through this app, because one does not have enough time to even start a face-to-face. It is too difficult to achieve this moment".

Participants saw that likelihood of face-to-face meetings depends highly on the quality of shared content:

"N2U could encourage face-to-face, if the content is enough important or unique".

"People should share something in common or the profile has to be fun".

"It works, if people provide truthful information in their profile. But there are social risks anyway. Someone can use it inappropriately. One should consider that there is a risk".

Sharing to nearby strangers

Sharing content that would be meaningful and exciting to nearby strangers seems to be a challenging task for users. It was seen that an interesting profile could increase the chances of ending up interacting with others.

When reviewing the profiles of the other focus group members and revisiting their own profile, the participants noted that much of the shared content was somewhat uninteresting.

Figure 4 shows a real but anonymized example of a profile that was created by one of our participants. It follows the idea of revealing more personal details as a result of encountering more, but the first item is obviously too basic

and boring information to be shared in a university campus context. The third item already seems to go too personal, revealing one's home street. The last item, a revelation of something that might be still a secret to the future bride, is the most interesting, but on the other hand it might not have much relevance to a nearby stranger.

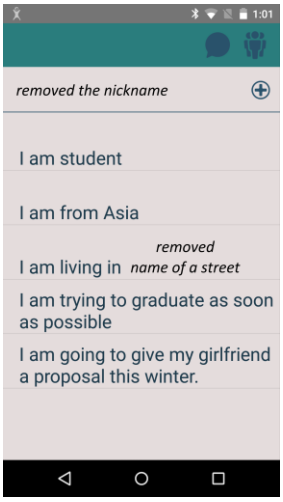

Figure 4. Example profile containing both uninteresting and interesting pieces

The participants suggested several ways to make the profiles more interesting. The profile could have information about one's interests. The shared content could be more fun or reveal something deeper. Reflecting on what other users share and how they react to one's *whispers* were seen to help learning to share something relevant.

Gamification

During the focus group, special attention was given to the discussing the designed gamification. The majority of participants agreed on achievements making N2U more appealing. For some people it seems to be a way to express a degree of social engagement. For others, it is the way to compete with friends:

"Achievements make the App more addictive. It creates competition, which in turn encourages you to act. You can compete with friends".

An opposite opinion relates to the fact that number of collected profiles is not the point of the socialization idea, and the achievements make people an object of collection, which is considered questionable:

"I don't care about achievements, if it is only about collecting numbers, because the thing is about the characteristics of people you met, not their amount. I don't like it. Usually, you don't compete with friends about how many friends you have".

Comparing N2U with other services

We asked our participants to compare N2U with other social applications in order to find out whether it has some unique qualities. The views on whether the application allows people to do things that are not supported by other technology varied widely. N2U was seen similar to messaging applications like WhatsApp, Facebook, Telegram and WeChat. Generally, N2U is considered more informal and open tool for social interactions and communication of identity.

"In N2U I will definitely answer a message if I will have common interest with another user. In Facebook I would reject any interaction with unfamiliar users, in case we do not have common friends".

"With N2U it is easier to start not an online but the face-to-face interaction. With Facebook I would not be able to start interaction with people in close proximity, while N2U allows this".

"In Facebook I would not share something funny. My profile is carefully constructed in Facebook. But in N2U I can freely share anything".

Concerns related to using N2U

Bluetooth as the enabling technology raised two kinds of pragmatic concerns. Our concept allowed messaging only when in proximity. Even though we implemented a five-minute time window for interactions after the detection of another user, the short operation range of Bluetooth was seen to restrict interaction possibilities too much. There was also a fear that frequent Bluetooth scans would drain the battery of the device quickly.

N2U was seen to support initiating social interaction, but not for maintaining it. Then again, the app was seen to become useless when one makes new friends, as one can only be actively involved with a limited number of friends. There was even a fear that in time applications like N2U could replace natural interaction between people. For some people who didn't have inhibitions in initiating interaction with strangers, using N2U seemed to be a too slow way to start a face-to-face interaction. Gamifying the application was considered to potentially create situations where users meet just for purpose of gaining a new achievement.

Privacy concerns related to the application created a wide variation of views and spread across the spectrum of choices in end questionnaire. In addition to appealing to criminals, the somewhat anonymous nature of this application was seen to potentially invite harassment. The focus groups were organized in Finland, which is a safe country to live in. The participants' concerns about personal security when sharing information for nearby people were related to using such application in their less safe home countries. The blocking feature was seen to create an impression of privacy customization.

The number of active users raised two kinds of concerns. On the other hand, a critical mass of users is needed for interactions to happen, but then again a participant questioned what would happen if everyone used it. One trip around the campus could collect thousands of profiles.

Alternative use cases for N2U

Although general interest in other people and finding people to connect with were mentioned as the most popular motivations to use N2U, our participants came up with alternative use cases for the application. N2U could for example help solving urgent problems:

"It would be great if someone could assist me. For instance, if I am new at some place, I could find someone through the N2U to guide me to the building I cannot find".

Also, it could be used to look for experts/specialists in the proximity for business purposes:

"I can share a 'Whisper' that I am looking for a programmer and walk around to see who will reply. Thus, I can build a team of workers just by walking around".

Moreover, participants suggested that N2U could be used as a detector of friends' presence in close proximity:

"I could use this app to see whether my friends close to me. If I know there is some friend here I can call him/her to lunch with me".

According to focus group members, N2U could be helpful for travelers to meet local people for cultural exchange.

Improving the concept

The concept evaluation phase gave us valuable feedback – we need to enable interaction between any collected users, not just those who were in proximity. We were so hard trying to protect our potential users that we would have seriously restricted their chances of actually connecting with others in the way we hope them to do.

There apparently already is a wide range of messaging applications that people juggle with. This led some participants hoping that messaging in N2U would be integrated with one of the common existing platforms like Facebook. While we understand the problem, we do not see how this approach would go along with a concept that tries to provide some sort of anonymity.

Making at least part of the profile more structured to enable social matching and activity partnering was suggested. Wider control over the application being active in both sharing information and notifying of received content was hoped for.

The participants suggested alternative requirements for exchanging the profile picture, which is now only exchanged as a reward for a face-to-face meeting. It could be requested from another user or it could be exchanged after a certain number of encounters. A practical reason for showing a picture before a face-to-face meeting would be facilitating people in discovering each other. We wanted to stay true to our concept, but ended up implementing another suggestion, using system provided avatars, to our final application to make the user interface more attractive. Sharing pictures alongside text in other parts of the profile was suggested as well.

DISCUSSION

Next2You application concept aims to motivate people who are regularly within the proximity of each other to meet face-to-face. We adopted concepts of collecting content, proximity-based interaction, and gamification as external motivation to encourage the interaction. N2U creates serendipitous interaction via exchanging content automatically with encountered stranger users. Most of the previous examples are based on users actively querying their surroundings. This was mostly considered as novel and meaningful way of getting information about nearby people.

N2U uses Bluetooth for the detection of nearby users. It is a valid question whether the Bluetooth range is enough to detect nearby users in a real use setting. Or other way round, what is a critical mass of users needed with Bluetooth based detection to result in further levels of interaction to happen? While critical mass is a true problem when trying to launch a service, proximity-based services also hold the potential problem of too many users.

Privacy is a relevant topic in proximity-based interactions, but our preliminary findings are along the same lines as those from FriendZone[5], people are not very concerned. There were participants who were less concerned about sharing a profile picture with nearby strangers than we had expected, and they were hoping for the picture to be exchanged at an earlier phase. Alternative solutions for motivating and rewarding face-to-face interaction should be researched, even though it must be noted that the main reward for meeting someone is and should be the social interaction during the meeting itself. The more anonymous and local nature of the N2U profile in comparison with public online social network profiles was seen as liberating.

Collecting social content from nearby strangers is central to our concept. Research has shown that collecting game related content from nearby strangers motivates exploring the real world, attending events, and provides pleasant surprises. It can also lead to face-to-face interaction. [19]. More research is needed in order to understand whether collecting social content from nearby strangers can have the same effects. It is also a relevant question, whether gamifying social interaction would result in people meeting others just to gain achievements. Research on gamification has shown that in order for gamification to work there should be intrinsic motivation for the activity [6]. In other words, it is unlikely that someone would find the achievements so appealing that they would meet others against their true motivation to do so.

Our participants clearly struggled in coming up content that would be interesting and relevant for nearby strangers. We aim to organize longitudinal user trials with N2U in order to gain a deeper understanding on that topic.

CONCLUSIONS

We presented a novel concept for interaction between nearby strangers, which uses several elements of

gamification and aims to encourage face-to-face meetings. Our paper describes an early evaluation on the concept and discusses the findings from the evaluation. Our results suggest that the concept has potential to increase curiosity towards nearby strangers and motivate people to interact with them. Privacy does not seem to be a major concern for potential users of proximity-based social applications. Creating meaningful profile content for nearby strangers appears to be a challenging task, which calls for further research and design efforts.

ACKNOWLEDGEMENTS

This research was funded by Academy of Finland (grants 283110 and 295895).

REFERENCES

1. Azza Abouzied and Jay Chen. 2014. CommonTies: A Context-Aware Nudge towards Social Interaction. *Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing - CSCW Companion '14*, ACM Press, 1–4. http://doi.org/10.1145/2556420.2556783
2. Sergey Andreev, Dmitri Moltchanov, Olga Galinina, Alexander Pyattaev, Aleksandr Ometov, and Yevgeni Koucheryavy. 2015. Network-assisted device-to-device connectivity: contemporary vision and open challenges. *In European Wireless 2015; 21th European Wireless Conference; Proceedings of VDE*, 1-8.
3. Mara Balestrini, Paul Marshall, Raymundo Cornejo, Monica Tentori, Jon Bird, and Yvonne Rogers. 2016. Jokebox: Coordinating Shared Encounters in Public Spaces. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing* (CSCW '16). ACM, New York, NY, USA, 38-49. DOI: http://dx.doi.org/10.1145/2818048.2835203
4. Richard Borovoy, Fred Martin, Mitchei Resnick, Brian Sflverman, and Chris Hancock. 1998. Meme Tags and Community Mirrors : Moving from Conferences to Collaboration. *Proceedings of the 1998 ACM conference on Computer supported cooperative work*, ACM Press, 159–168. http://doi.org/10.1145/289444.289490
5. Asaf Burak and Taly Sharon. 2004. Usage patterns of FriendZone: mobile location-based community services. In *Proceedings of the 3rd international conference on Mobile and ubiquitous multimedia* (MUM '04). ACM, New York, NY, USA, 93-100. DOI=http://dx.doi.org/10.1145/1052380.1052394
6. Sebastian Deterding. 2012. Gamification: designing for motivation. Interactions 19, no. 4 (2012), 14-17.
7. Nathan Eagle and Alex Pentland. 2005. Social Serendipity: Mobilizing Social Software.
8. Daniel Kahneman, Edward Diener, and Norbert Schwarz. 1999. *Well-Being: Foundations of Hedonic Psychology: Foundations of Hedonic Psychology*. Russell Sage Foundation.
9. Denise Kandel. 1978. Homophily, selection, and socialization in adolescent friendships. *American journal of Sociology*, 427-436.
10. Reuben Kirkham, Thomas Ploetz, Sebastian Mellor, et al. 2013. The Break-Time Barometer – An Exploratory System for Workplace Break-time Social Awareness. *Proceedings of the 2013 ACM international joint conference on Pervasive and ubiquitous computing - UbiComp '13*, ACM Press, 73–82. http://doi.org/10.1145/2493432.2493468
11. Vassillis Kostakos, Eamonn O'Neill and Anuroop Shahi. 2006. Building common ground for face to face interactions by sharing mobile device context. *Proc. Location and Context-Awareness* (LoCA), 222-238.
12. Alison Lee, Catalina Danis, Todd Miller, and Younghee Jung. 2001. Fostering Social Interaction in Online Spaces. *INTERACT'01*, IOS Press, 59–66.
13. Julia M. Mayer, Starr Roxanne Hiltz, and Quentin Jones. 2015. Making Social Matching Context-Aware — Design Concepts and Open Challenges. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15*, ACM Press, 545–554. http://doi.org/10.1145/2702123.2702343
14. McPherson, Miller, Lynn Smith-lovin, and James M Cook. 2001. Birds of a Feather : Homophily in Social Networks. *Annual Review of Sociology 27:* 415-444.
15. Nemanja Memarovic, Marc Langheinrich, Florian Alt, Ivan Elhart, Simo Hosio, and Elisa Rubegni. 2012. Using public displays to stimulate passive engagement, active engagement, and discovery in public spaces. In *Proceedings of the 4th Media Architecture Biennale Conference: Participation*(MAB '12). ACM, New York, NY, USA, 55-64. DOI=http://dx.doi.org/10.1145/2421076.2421086
16. Kyle Moore. 2014. Software Sorted Streets: Nintendo 3DS 'Streetpass' and the Reconfiguration of Social Interactions. Refereed Proceedings of the Australian and New Zealand Communication Association conference: The digital and the social: communication for inclusion and exchange, 1-12.
17. Elena Nazzi and Tomas Sokoler. 2011. Walky for embodied microblogging: sharing mundane activities through augmented everyday objects. *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, 563–568. http://doi.org/10.1145/2037373.2037461
18. Antti Oulasvirta, Mika Raento, and Sauli Tiitta. 2005. ContextContacts: re-designing SmartPhone's contact book to support mobile awareness and collaboration. *Proceedings of the 7th international*

conference on Human computer interaction with mobile devices & services - MobileHCI '05, ACM Press, 167–174. http://doi.org/10.1145/1085777.1085805

19. Susanna Paasovaara and Thomas Olsson. 2016. Proximity-Based Automatic Exchange of Data in Mobile Gaming: Studying the Experiences of StreetPass Users. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction* (NordiCHI '16). ACM, New York, NY, USA, , Article 26 , 10 pages. DOI: http://dx.doi.org/10.1145/2971485.2971508
20. Eric Paulos and Elizabeth Goodman. 2004. The familiar stranger: anxiety, comfort, and play in public places. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*(CHI '04). ACM, New York, NY, USA, 223-230. DOI=http://dx.doi.org/10.1145/985692.985721.
21. Per Persson, Jan Blom, and Younghee Jung. 2005. DigiDress : A Field Trial of an Expressive Social Proximity Application. 195–212.
22. Mika Raento and Antti Oulasvirta. 2008. Designing for privacy and self-presentation in social awareness. *Personal and Ubiquitous Computing* 12, 7, 527–542. http://doi.org/10.1007/s00779-008-0200-9
23. Jan Seeburger, Marcus Foth, and Dian Tjondronegoro. 2012. The sound of music: sharing song selections between collocated strangers in public urban places. In *Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia* (MUM '12). ACM, New York, NY, USA, , Article 34 , 10 pages. DOI=http://dx.doi.org/10.1145/2406367.2406409.
24. Kennon M Sheldon. 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of personality and social psychology* 80, 2, 325–339.
25. Michael Terry, Elizabeth D. Mynatt, Kathy Ryall, and Darren Leigh. 2002. Social net: using patterns of physical proximity over time to infer shared interests. *CHI '02 extended abstracts on Human factors in computing systems - CHI '02*, ACM Press, 816. http://doi.org/10.1145/506443.506612
26. Loren Terveen and David W. McDonald. 2005. Social Matching: A Framework and Research Agenda. *ACM Transactions on Computer-Human Interaction* 12, 3, 401–434. http://doi.org/10.1145/1096737.1096740
27. Kaisa Väänänen-Vainio-Mattila, Petri Saarinen, Minna Wäljas, Marko Hännikäinen, Heikki Orsila, and Niko Kiukkonen. 2010. User experience of social ad hoc networking: findings from a large-scale field trial of TWIN. In *Proceedings of the 9th International Conference on Mobile and Ubiquitous Multimedia* (MUM '10). ACM, New York, NY, USA, , Article 10 , 10 pages. DOI=http://dx.doi.org/10.1145/1899475.1899485.

PUBLICATION 4

Playfulness and progression in technology-enhanced social experiences between nearby strangers

Paasovaara, S., Väänänen, K., Malapaschas, A., Olshannikova, E., Olsson, T., Jarusriboonchai, P., Hošek, J. and Mašek, P.

Proceedings of the 10th Nordic Conference on Human-Computer Interaction (pp. 537-548)

Playfulness and Progression in Technology-Enhanced Social Experiences between Nearby Strangers

Susanna Paasovaara
Kaisa Väänänen
Tampere University of Technology, Finland
susanna.paasovaara@tut.fi
kaisa.vaananen@tut.fi

Aris Malapaschas
University of Glasgow
Glasgow, United Kingdom
Aris.Malapaschas@glasgow.ac.uk

Ekaterina Olshannikova
Thomas Olsson
University of Tampere
Finland
Ekaterina.Olshannikova@uta.fi
Thomas.Olsson@uta.fi

Pradthana Jarusriboonchai
University of Lapland,
Rovaniemi, Finland
pradthana.jarusriboonchai@ulapland.fi

Jiří Hošek, Pavel Mašek
Brno University of Technology
Czech Republic
hosek@feec.vutbr.cz, masekpavel@feec.vutbr.cz

ABSTRACT
Encouraging social experiences and interactions between nearby strangers has received both research and commercial interest over the past years. This paper focuses on two design qualities that have previously been found successful in this area: *playfulness* and *progression*. Employing the research through design approach, we explore these as design principles in so-called people-nearby applications. To evaluate how playfulness and progression contribute to encouragement of social interaction, we carried out a field trial with Next2You, a playful mobile application that automatically detects nearby users and exchanges user-generated profile information. The results imply that the application features demonstrating playfulness and progression did contribute to encouragement of interaction between nearby strangers; however not as expected. The results provide a basis for reconsidering appropriate design decisions and methodological choices with respect to design and evaluation of people-nearby applications that aim to encourage interaction between strangers.

Author Keywords
Proximity-based interaction; people-nearby applications; collocated interaction; nearby strangers; social interaction; mobile application; field trial; research through design.

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

INTRODUCTION
Current mobile technology is primarily designed for connecting users with distant others and is thus often suboptimal when considering social interaction between collocated people. For example, people unintentionally ignore familiar others when they focus on using their devices, but also use them to intentionally create a private bubble to separate them from the surrounding crowd of strangers [8]. To amend this often socially disruptive role of mobile devices, researchers have envisioned that mobile technology could be designed to *encourage* social interaction—even between nearby strangers (e.g., [2], [14]). Research interest in encouraging social interaction between any nearby people, not just familiar ones, has been motivated by, for example, reducing social isolation and increasing civic participation and mutual awareness [26, 22]. Conceptually, technology-supported interaction between strangers falls under People-Nearby Applications (PNA), i.e., social matching systems that allow strangers to connect in real time based on geographical location [7]. The ubiquity of mobile devices equipped with capabilities to detect nearby devices provides an opportune technical platform for developing PNAs.

Prior user research on PNAs—either commercial applications or research prototypes—has discovered positive attitudes towards the fundamental underlying concept [1, 14]. User experiences of *curiosity* and *playfulness* often feature in the reported user study results [27, 21]. However, the research area is missing detailed analysis of the features and qualities that would contribute to creation of social experiences and new social encounters. Many central research questions remain unanswered, for example: what type of awareness of others can trigger an initial step of interaction? How to encourage people to advance from technology-mediated interaction to face-to-face interaction?

In addition to applications that are intentionally designed as PNAs, recent research has also studied commercial systems

that indirectly enable interaction between nearby strangers, e.g., Nintendo StreetPass [33] and Pokémon GO [32]. Research on StreetPass, the proximity-based social feature on Nintendo 3DS handheld gaming devices, has discovered that automatic exchanges of game data between nearby strangers have provided positive game experiences as well as positive social experiences, with high user retention [18]. Research on Pokémon GO has also discovered a wide variety of social interactions around the game [14, 19]. This raises the question of how such applications where the encouragement of face-to-face interaction is not the main aim can be so effective in reaching this design goal.

The above-mentioned commercial systems feature two general design qualities that contribute to the positive social experiences and interaction. First, *playfulness*, demonstrated as playful atmosphere and rewards, separates StreetPass from the more purpose-oriented social matching, making it casual and rewarding to take part in social interaction. In Pokémon Go, a similar ludic atmosphere, coupled with location-based playing, was found to support the emergence of various ad hoc social encounters and collaborative gaming amongst groups of strangers [16]. Second, *progression* refers to incremental advancement of the interaction from light-weight, low-barrier interaction towards more highly engaging interaction (e.g., in StreetPass, first becoming aware of others through automatic exchange of content, then engaging in technology-mediated interactions, and finally possibly engaging in a face-to-face encounter). In Pokémon Go the progression is less explicit: features related to teams and Gyms allow that the players identify each other as players of the game, and the inherent asymmetry of information between the players motivates them to approach each other also in the physical realm. We assume that *progression* can create curiosity towards and awareness of other users as well as facilitate new encounters by decreasing the social barriers for initiating interaction.

The aim of this study was, first, to design novel manifestations of these two design qualities, playfulness and progression in the design of people-nearby applications and, second, evaluate how the designed features contribute to social experiences and encourage social interaction between nearby strangers. Following the research through design approach [29], a mobile application called Next2You [30] was designed and implemented with a well-thought set of features. Next2You (N2U) automatically exchanges user-generated content between nearby strangers when users get to physical proximity to each other. While the overall application concept has been presented earlier [16], the present work focuses on describing the design from the perspective of the two qualities, as well as evaluating the user experiences with regard to application features relevant to the two design qualities. To this end, we conducted a seven-week trial study with altogether 162 users.

The contribution of this paper is three-fold: (1) we present novel design solutions with regard to playfulness and progression as featured in Next2You; (2) based on an extensive trial study, we present an analysis of the social experiences and interactions resulting from such design; (3) we present considerations for designing mobile applications and evaluation trials for PNA focusing on encouraging interaction between nearby strangers.

RELATED WORK

Research and commercial efforts on designing mobile technologies to support socialization between nearby people have been ongoing for about two decades. Some of the work focuses on supporting socialization between nearby friends and some has a clearer focus on nearby strangers. While many research prototypes have demonstrated concepts from technical perspectives, also the users' experiences and user behavior with these systems have been studied. We present a selection of related systems, showing how they relate to the focus of our work, the design qualities of *playfulness* and *progression*.

Discovering nearby users of the same systems is one of the key elements of people-nearby-applications. Lovegety is an early example of a commercial proximity-based device designed for dating purposes. It revealed users with matching dating preferences within five-meter range by playing a sound alarm and a flashing light. Hundreds of thousands of devices were sold in just few months in late 1990's [9]. Hummingbird aimed to increase awareness of nearby group members by playing a humming sound when their devices were detected within 100 meter range [6]. Jabberwockies [20] would capture and present visually information about the nearby presence of other similar devices, thus contributing to the awareness of familiar strangers; we consider this as the first level in the *progression* of social interaction.

In addition to these simple devices, earlier research concepts and prototypes have experimented with exchanging different kinds of content between nearby stranger users, i.e., technology-mediated interactions that we see as the second level of *progression*. Some systems have required users to initiate a search for nearby users e.g. [11], while others do it automatically notifying users of the discovered users [3]. In tuna [1] and CapitalMusic [23], the social experiences were to arise from sharing song choices. DigiDress [21] and Scent [11] included sharing identity expressions with textual and picture content. Challenz [17] aimed to create social experiences in form of nearby strangers contributing to shared video stories. TWIN [27] allowed file sharing between nearby users. In many of these research cases, the content is aimed to be consumed at that instant, for instance by connecting with the discovered user to listen to the music they play [1] or to fetch their digital identity expression [21]. Automatically collecting and accumulating content from nearby users has not been researched as a key element of design. Automatically collected avatars play an essential role in Nintendo StreetPass [33] design but there the emphasis is on the game benefits the collected profiles provide. The

findings from StreetPass users' experiences [18] point out that in addition to the game benefits, StreetPass provides social experiences, which motivates further research explorations related to collecting playful content in physical realm without the game benefit.

Recent mobile dating applications, e.g. Tinder [34] and Happn [30], use user's location as a part of their matching process. There the concept of 'nearby' spans from being located in the same city to having visited the same place at the same time. Dating applications often emphasize profile pictures, showing promise of one's appearance [4], and finding automatically matches in users' interests. In addition to dating, mobile social matching applications can be used for making new social connections for friendly and professional purposes. Previous research has explored for example looking for matches between users' contact lists to infer a common ground [12], and looking for common interest to give tickets-to-talk [10]. Promising results have been found about using simple wearable devices to infer a nearby match in professional events [2]. In contrast to social matching and dating applications, our research explores whether users can be motivated to interact with nearby strangers upon encounters in physical realm with a design based on *progression* and *playfulness*, without the knowledge of compatibility and under an illusion of anonymity. Dating application profiles have been lately designed for immediate approval or dismissing of the suggested matches [13], whereas progressive disclosure of information upon encounters in physical realm has not been explored.

Research has shown that users of existing commercial people-nearby-applications have an inherent motivation to meet others offline [7] and have different strategies to building trust before taking these online connections with strangers to offline meetings. Profile pictures and online discussions as well as crosschecking other online profiles play a role in that. StreetPass design instead limits communication between users. We saw that the role of technology-mediated communication in playful interactions between nearby users is not yet understood.

Previous research features several studies reporting that use of the studied prototype has led to face-to-face interactions [1, 21, 27, 2], which we consider as the last step of *progression*. The reports are, however, vague on how the different features contributed to the face-to-face meetings.

The evaluations of previous research prototypes have been mostly short term or small scale, often remaining on concept evaluation level. Many small-scale studies have been conducted by controlling the circumstances so that the few concurrent users encounter each other. In such evaluations, the novelty effects related to new technology affect the reliability and generalizability of the findings. As the early solutions like Hocman [5], the social application for traffic encounters between motorbikers, and the social music application tunA [1] required specific hardware, they were evaluated with less than ten users. Later on, mobile phones allowed user studies to be conducted with participants' own phones as part of their everyday activities. Such long-term, in-the-wild field trials are rare exceptions, leaving the true potential and problems undiscovered. The notable exceptions of field trials are DigiDress [21], Scent [11] and TWIN [27], each having hundreds of users over months. Even though DigiDress and Scent were successful at the time within the corporate setting of the field trial, the commercial product created based on the research was not successful. Their success can partly be explained by the novelty of having even some kind of an application in the phone. Today's mobile applications have to compete of user's attention together with thousands of other applications making the applicability of the same design decisions questionable.

THE DESIGN OF NEXT2YOU

The overall design goal of N2U is to create social experiences between nearby strangers and encourage technology-mediated and face-to-face interaction between them. Its target users are especially people that are often within close proximity to each other but not necessarily have interacted before, i.e., *familiar strangers* [20]. As the application concept and implementation of N2U have been reported in [16], in the following we summarize the key features, particularly considering the design of *playfulness* and *progression*.

N2U automatically exchanges pieces of profile information between users that are within Bluetooth range from each other. A background process handles the exchanges, and the user gets a notification upon such event. The profile of a user consists of user-created snippets of information in textual form (called "*whispers",* referring to the idea that only people close enough may obtain them), as well as a profile picture which is by default hidden from other users.

Designed to encourage the creation of content, N2U proposes each user to create at least three whispers as part of profile creation. Also, N2U requires exchanging at least one whisper before any further interaction, i.e., sending personal messages or registering face-to-face meeting with other users can happen. Exchanges are reciprocal: one can receive only as many whispers from others as they have shared themselves.

Nearby users' avatars are highlighted in the main view (see Figure 1), which is expected to increase the awareness about others and curiosity towards them. Users' privacy is protected by revealing only their presence in the proximity, not their location. Furthermore, users can freely decide what and how much they share about themselves in their whispers. Building trust before face-to-face meeting can happen through personal messages. In case of misbehavior, the user can block another user to remove the exchanged content and to prevent any further discovery.

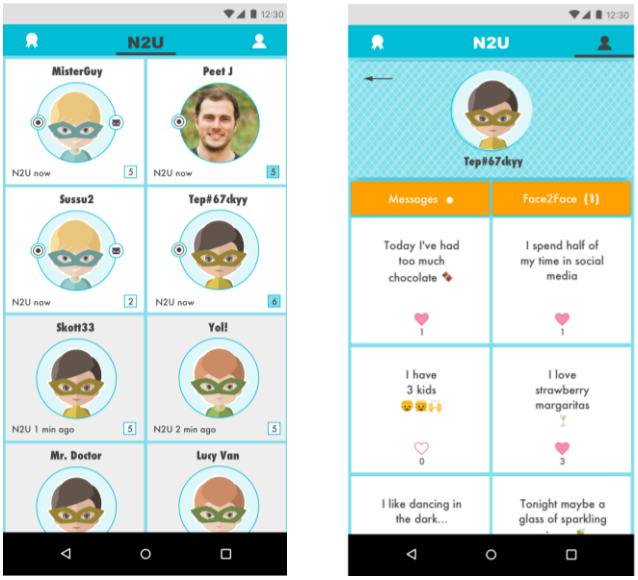

Figure 1. N2U main view and profile of an encountered user.

Progression in N2U

The design principle of *progression* relates to two different aspects. Firstly, each encounter with the same person reveals a new whisper, allowing one to discover the profile of that person progressively. Here, an *encounter* refers to the fact that two users have been in close proximity, regardless of whether they interacted or not. As the profile information accumulates over several encounters (see Figure 1), the risk of sharing too much in any one encounter is decreased. In this way, progression has a dual function of both motivating exploration and preserving privacy. Furthermore, the user can define the order in which the whispers are revealed one after another.

Secondly, the design provides possibilities and encourages users to progress from the mere awareness of nearby others to learning about them by reading the whispers, further to interacting with them with likes and personal messages in the application, and finally in a face-to-face setting. Liking is aimed to provide a low-threshold form of interaction. The knowledge gained from collected whispers could provide tickets to talk, while personal messages allow discussion on them or agreeing to meet.

Playfulness in N2U

Playfulness is an overarching design principle manifesting in the application design in several ways. One central element in the design is collecting, in this case, other people who have been nearby. The main view of the application is empty in the beginning. By encountering other users in proximity, their representations are collected in the main view. Each encounter collects a new whisper from the other user and adds to the counter of how many times they have encountered each other.

Playfulness of created content, i.e., whispers, is supported by providing predefined sentence starters e.g. “My superpower is”, “I dare you to” and “Did you know that”, but also leaving the freedom to create the whole sentence from scratch. Users can furthermore take advantage of the emoji provided by their mobile device operating system. Our choice of textual content allows user generated playfulness in a way that requires minimal effort in creation phase, however being descriptive and understandable (cf. photos or videos).

Playfulness was also implemented in terms of gamification, achievements in particular. Achievements could be earned in eight different categories representing the different actions enabled by the application, and each category comes with four levels of increasing demands. This aimed to motivate the users to actively use the system and encourage them to interact with other users on different levels, e.g. collecting profiles, liking whispers, sending messages, having face-to-face meetings.

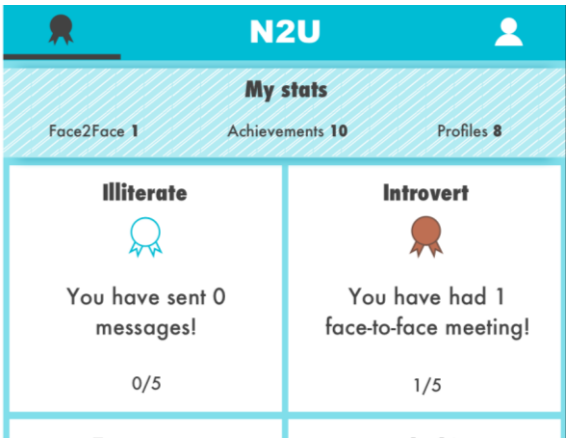

Figure 2. Excerpt of the list of achievements in N2U.

Encouraging face-to-face meetings was associated with two further playful aspects. The identities of other users remain a mystery as their profile picture is replaced with an avatar wearing a mask; the profile picture is revealed only as a reward of registering a face-to-face meeting with the given user. The number of revealed profile pictures would thus signify user’s social activity as another type of collectable achievement. Registering a face-to-face meeting can be done by going successfully through a playful sequence of selecting correct avatars requiring both users to see each other’s displays. The feature is available only when the two users are detected in proximity of each other.

Figure 3. Registering a face-to-face meeting.

FIELD TRIAL

To evaluate the effectiveness of our design in a realistic setting, we organized a field trial with 162 voluntary participants that started to use the application over a period of seven weeks. The aim of the field trial was to investigate the overall user experiences of our research artifact N2U, and the social experiences that emerge from using it. In particular, our goal was to understand how the features manifesting *playfulness* and *progression* contribute to this.

Study Setting

The field trial was arranged in spring 2016 at two university campuses: Tampere University of Technology and Brno University of Technology. Both campuses are geographically relatively restricted and densely built, creating an opportune context for users to encounter each other. As the application is proximity-based, there was no interaction between the users at different campuses. The two sites provided a practical opportunity to increase the number of participants; however, our intention was not to compare the results between the two sites.

The possibility to take part in the trial was promoted in university classes, through mailing lists and websites, on paper posters and flyers. There were also two Facebook groups, one for each campus to promote the user trial already in advance. There was no reward given to every participant but several prizes were announced to be raffled among all participants.

To minimize the need for personal meetings with the trial organizers and thus better enable for a large-scale trial, the application was available for downloading in Google Play [31], and all the necessary instructions, tutorials and the research consent form were incorporated directly into the application.

Data Gathering

We gathered research data in several ways during the trial. When installing the application, the users first gave an informed consent to take part in research and analysis of their data, and then provided the following details about themselves: gender, age, campus, membership (student, staff, other), and e-mail address.

The interactions between users as well as the content of the created whispers were analyzed from server-side log files by importing necessary information to Excel sheets and processing them manually. The non-English whispers were first translated to English. Then all the whispers were coded and categorized into one or more categories. The contents of personal messages exchanged through the application were excluded from the analysis to maintain privacy of correspondence.

In addition, two online questionnaires were sent to the participants via e-mail. The first questionnaire was sent to each participant one week after they installed the application, and the second questionnaire was sent to everyone at the same time in the end of the field trial.

Participants

Altogether 162 individual users installed the application and registered as users. 21% of the participants were female and 79% were male, which is in line with the gender distribution of the technical university campuses. The average age of participants was 23 (min 18, max 48). 92% were students, rest were either staff members or some other affiliation. 78% of the participants were located at Tampere and 22% at Brno. 53 individuals answered the first-week questionnaire, and 24 answered the end-questionnaire.

Questionnaires

The questionnaires included both closed-ended and open-ended questions aiming to understand the respondent's usage of the application, experiences with it and respondent demographics. The first-week questionnaire aimed to discover the initial perceptions of the application and the activity with it, including questions such as: "What do you think Next2You is all about?" and "What did you do to collect Whispers?" The end-questionnaire aimed to reveal more detailed user experiences and behaviors, including questions such as "What kind of Whispers from others did you find interesting?" and "Did the achievements in Next2You motivate you to use it more actively?"

FINDINGS

We first give an overview of the N2U usage based on server-side logs and reported user experiences, followed by findings that are related to the design qualities of *progression* and *playfulness*.

Overview of Usage Activity

Interaction with the application and other users decreased with every step that required users to be more socially active. Figure 3 visualizes this conversion funnel of interaction during the trial.

From the users that installed the application and filled their details to take part in the trial, 93% (151/162) added at least one whisper. This means that they could take part in automatic exchanges upon encounters with other users. These participants created altogether 445 whispers. The average number of created whisper per user was 3, but 27% (44/162) created only one whisper.

72% of the participants (117/162) encountered at least one user, and exchanged whispers because of that. Altogether 477 exchanges were made during the trial. These exchanges took place between 349 individual pairs. In 79% of these pairs (276/349) only one whisper was ever exchanged. This means that many users did not experience the progressive disclosure of another user and only received the small about of information provided in one whisper. 60% (97/162) of participants received at least one like for their whisper. Altogether 331 likes were given for 165 whispers.

38% of the participants (62/162) sent at least one private message. Altogether 474 messages were sent during the trial. This seems like a high number, but it is not the full truth. Our analysis did not cover the information content of private

messages, only the connections. Based on repeated messages between pair of users, we assume that 18% (29/162) took part in some sort of conversations with others. Our analysis on the message lengths tells that the messages were about 6 letters long. Just enough to say for example "Hello!" This lets us believe that messaging was not used extensively for the intended purpose of taking next steps towards face-to-face interaction but, rather, simply for testing purposes. Only 5% of the participants (8/162) registered a face-to-face meeting, and all of them only with one person.

It is likely that these numbers have been positively affected by actually familiar people interacting with one-another, rather than all interaction happening between actual strangers.

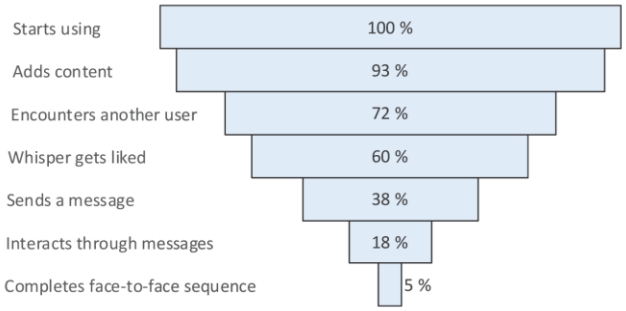

Figure 3. Funnel of interaction in the N2U trial.

Overview of reported user experiences

53 participants responded to the first-week questionnaire and 24 responded to the end-questionnaire. Intention to continue using N2U was high among those who answered the first week questionnaire, 70% (37/53) reporting to plan to continue using it. The mentioned main motivations were interest to meet new people (9/37), continuing to test the application while still unsure of its benefits (7/37), finding the application fun (6/37), belief in the concept (6/37), and being motivated by collecting (5/37).

> *"It's nice to meet people which I see all the day and don't know :)" (Male, 22 years old, Brno)*

> *"I see a potential in this way of using modern technology to motivate users to be more social." (M, 20, Brno)*

The first-week questionnaire asked to describe in one's own words what N2U is about. Meeting and connecting with new people was the most common impression but also other viewpoints were reported. The answers underline that people are likely to start using such applications with different expectations and motivations. For example, some focus on the content while others focus on the people, and some stress meeting while others stress anonymity. Table 1 presents our bottom-up, data-driven classification about the perceived essence of the application from the respondents' descriptions. Overall, the participants seemed to have understood the gist of the application very well.

Table 1. Perceptions of what N2U is about

Meeting or connecting with new people	22
Starting conversations or messaging	7
Sharing and discovering ideas	5
Revealing common interests	4
Anonymity	3
Exploration	2
Awareness of what is nearby, curiosity	2
More personal social network	1
Encouraging face-to-face meetings	1

> *"I see it as more personal social network which by its principles encourages users to be more social by going to places with more people in order to collect their account information." (M, 20, Brno)*

> *"I think the main point is to have people to connect face to face, to make people talk to each other and remind them that a "whisper" is enough to have something to talk about. Actually it may help introverted societies (such as Finnish society) to learn how to communicate easily with each other." (M, 28, Tampere)*

N2U was experienced as playful, but was not successful in creating surprises. Figure 4. presents the distribution of answers to Likert-scale questions regarding the experiences of playfulness and surprises with N2U.

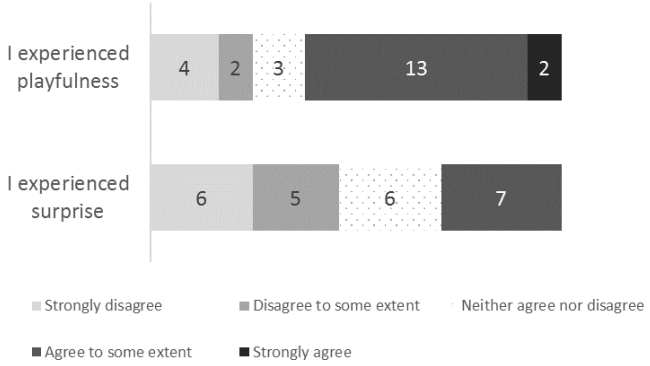

Figure 4. Experienced playfulness and surprise with N2U.

Even though our research artifact was technically well polished in general, there were some functionality issues that resulted in negative feedback. Some users faced sudden peaks in battery consumption, even though generally the battery consumption was such that it did not hinder normal use of the mobile device. Furthermore, the notification volume and notification timing received some complaints.

Design Principle: Progression

As said, with *progression* we refer to users progressing from awareness of others by acquiring more information about each other upon each encounter towards social interaction on different levels: automatic exchanges, lightweight technology mediated interaction of liking, messaging and face-to-face meetings. In the following, we report the

qualitative findings related to progression from the two questionnaires.

In general, the respondents perceived being able to view which users are nearby positively, despite the flip side of showing their own presence to others. 16/24 of end-questionnaire respondents expressed positive perceptions of it, describing their positive feelings and the social opportunities it provides. 3/24 expressed concerns, but did not really elaborate them.

"Exciting and thrilling." (M, 20, Brno)

"It gives potential for meeting new people, and organizing quick happenings" (M, 28, Tampere)

"A little scary" (F, 21, Tampere)

The respondents' perceptions of automatic exchange of content between nearby people were mainly positive (19/24). The explanations related to for example novelty and feeling of control. 4/24 expressed concerns that were related to privacy or security.

"Interesting, It's like twitter on roller skates." (M, 22, Brno)

"I really didn't think about it so I think it didn't bother me. I hoped to find more people to share things. I know I wouldn't share anything too private in my whispers so I wasn't worrying about sharing content…" (F, 30, Tampere)

"The automatic feature via bluetooth seems unsafe. I would prefer GPS for locating people/devices." (F, 27, Tampere)

As it can be expected based on the log data about number of exchanges between pairs of users, the experiences with progressive disclosure were mixed. Based on their experiences, 11/24 expressed positive perceptions of progressive disclosure of the profiles, while 4/24 expressed negative perceptions. Even some of those who had a positive perception of it commented that single whispers carry too little data, and that the application seems empty in the beginning. Whispers becoming out of context over time was mentioned as a downside as well.

"One whisper at the time make people more active." (M,28, Tampere)

"…Seeing only one whisper from one user leaves it quite irrelevant and distant." (F, 39, Tampere)

The end-questionnaire respondents' experiences with the face-to-face feature were very limited. One respondent commented it being "all right". One had tried it with a friend but mentioned that they would not try it with others. Two had tried the feature but did not see the point. Others either did not try it or did not get it to work.

Design Principle: Playfulness

In this section we will go through how our main design choices related to playfulness (i.e., collecting, creation of playful content, and achievements) contributed to the user experiences of N2U.

Collecting digital game rewards from the physical world can be highly motivating as depicted by the research related to Pokémon GO [14, 19] and Nintendo StreetPass [18]. Collecting other people's profiles through automatic exchanges, however, did not seem to motivate our participants to explore the physical realm to such extent. The most common approach was passive exploring (42/53 of the first-week questionnaire respondents), i.e. carrying along the phone while running the application in the background. Participating in events and utilizing friends to provide exchanges were both mentioned by 8/53 respondents. Only 4/53 reported to have actively explored their surroundings to discover more users.

Even though the number of created whispers was more than what was exchanged eventually, their content may partly explain the lower-than-expected use of the application. The textual format itself was considered appropriate, but in addition to the intended playful content, there was a high share of nonsensical content, created by users who just wanted to test the application. This seems to have created demotivating experiences for others.

23/24 of the end-questionnaire respondents expressed positive perceptions of text-based content, some stressing how it feels better for considering privacy than other type of content. 7/24 mentioned hopes for being able to share also other content types, such as pictures.

We asked the end-questionnaire respondents to describe the content of the whispers they added, and about the ones they received. 10/24 described having created whispers just to be able to test the application. 8/24 had used whispers for self-presentation. 4/24 had whispered about timely events. 3/24 respondents specifically mentioned that they tried to whisper something that others could like.

"Mostly test whispers, about beer." (M, 23, Brno)

"My ideas and my feelings and some favourite quotes from lyrics of my favourite bands." (M, 22, Brno)

"Jokes. Something anyone could just "like"" (M, 28, Tampere)

When queried what kinds of whispers were or would be interesting, the responses were classified as follows: funny whispers (5/24), users' hobbies and interests (5/24), something personal like mood or feeling (4/24), information about nearby or upcoming events that the others are attending (3/24). A relatively high proportion, 10/24 respondents, claimed that they did not receive any interesting whispers, and some of them even thought that there would not be anything interesting to be received

"Funny whispers were the best ones." (M, 21, Tampere)

"…I would like to get whispers, that could show me if the other person is like me, if he/she thinks like me." (M, 19, Brno)

Our bottom-up classification of the content of the whispers revealed eight categories. Table 2 presents the categories and examples of whispers in them. One whisper may have been

categorized in several categories. Here for example "*Would you like to have a cup of C22H18O11 with me??"* would be categorized both in *Inviting contact* and *Playful*. The most common category was *general profile,* i.e., general information about oneself, such as home town or student status, as well as likes and hobbies. The whispers in the second most common category, *nonsense,* had no clear relevance and were most likely created just for the purpose of being able to try the app out. The third category was *playful* whispers. The fourth category was *timely information*, such as participating in an event, one's current activity, current mood or experience. The fifth category included different kinds of greetings. The sixth category, *inviting contact*, included whispers with more active tone of voice, clearly trying to get someone to answer. As the two last categories, there was a small number of *vulgar* whispers as well as clearly *dating* oriented whispers.

Table 2. Whisper content categories.

Category	#	Examples
General profile	104	"I like ice cream." "I am Peter" "I am optimist"
Nonsense	84	"1234567890" "hmmmm" "blablaba"
Playful	73	"I am beer powered problem solver" "Did you know that you can drink a lava, but only once?"
Timely information	73	"Is anyone here in the library?" "I am hungry"
Greetings	31	"have a nice meal !" "Hello everybody"
Inviting contact	30	"Anyone to chat?" "Would you like to have a cup of C22H18O11 with me??"
Vulgar	7	"Did you know that more times took pic of me peeing, than peed next to stranger guy"
Dating	5	"single girls call me" "offering love <3"

The application provided 11 predefined sentence starters and a possibility to write the whole sentence from scratch. The most commonly used option was to create the whisper from the scratch. These whispers include both the most interesting and the most irrelevant ones (researchers' subjective opinion). See *Nonsense* category above in Table 2 for examples of irrelevant whispers, and examples of more interesting whispers below.

"Just got into 3D printing by buying Prusa i3 kit. I am so excited to assemble it." (anonymized whisper)

"when you are in jeans you have to open doors by yourself but if you are in dress they are opened automatically" (anonymized whisper)

Half of the end-questionnaire respondents felt that achievements motivated to use N2U more actively. The scarcity of encounters seems to have decreased the power of achievements.

"I liked to take a look at them from time to time and I wanted to complete them but since there weren't that many users I felt it wasn't possible to do so." (F, 30, Tampere)

DISCUSSION

Our trial findings show that our research artifact, N2U, was relatively well accepted and on the scale of the whole trial there was activity on each level: automatic exchanges, lightweight technology-mediated interaction of liking, messaging and face-to-face meetings. However, the interaction did not effectively progress towards face-to-face meetings on the scale of individual users. The progression in terms of new whispers from the same person remained low, and the conversion dropped on each level of interaction. The whole concept of conversion refers to the fact that not everyone proceeds towards the intended goal, so this was expected. In this case, the problems with conversion mean that the evaluation of the features and their effects on realized social interactions and user experiences proved to be challenging despite the breadth of the field study.

Another evaluation challenge is that there are no established criteria for success in encouraging social interaction between nearby strangers. What are the user behaviors and experiences that would reveal success? We argue that the numbers of resulted face-to-face meetings or new friendships are not the only relevant targets. In fact, our recruiting effort got 162 people to successfully install the application (until the point where they provided their e-mail address). From this number, 24 participants filled the end-questionnaire and 19 of them expressed positive perceptions of automatic exchange of content between nearby people. These numbers could be regarded in many ways. Rather, other possibly more relevant, benefits of the application include increased awareness of nearby strangers, experiences of curiosity, and joy caused by discovery of a playful piece of content. Such effects, however, are hard to be operationalized into scientifically valid measures.

In retrospect, we consider three main reasons to explain the problems with conversion: scarcity of encounters, quality of user created content, and engagement with the application. These can be further refined to issues with trial arrangements, technology and application design. The following discusses these perspectives in more detail and their relation to the design qualities of playfulness and progression.

First, we believe that the scarcity of encounters, that are the backbone of our application, failed to provide the instant gratification from collecting other users, which in turn led to users stopping to use the application, and this further prevented the intended progression. The scarcity of encounters also prevented the playfulness of the design to show its full power. The requirement for instant gratification is seen as a pattern of human behavior that should be considered in interface design [24]. Bluetooth, as the choice for detecting nearby users, has relatively short operation range, which requires a high density of users to result in

sufficiently frequent encounters. Our trial arrangements were apparently not good enough to counterbalance this choice of technology. Later in this section, we will discuss different design options for tackling these issues.

Second, the findings indicated a high number of nonsensical whispers as well as whispers conveying merely simple profile information. Another pattern of human behavior closely related to instant gratification, *deferred choices*, states that users do not want to spend time upfront answering questions but rather skip them and come back later [24]. Our design asked the users to add three whispers at start, which may have resulted in users adding nonsensical content just to get started with the application. The problem with poor quality content is related to both *progression* and *playfulness*: uninteresting content does not invite social interaction, and receiving such does not feel rewarding. We will later discuss different design options for ensuring good quality content.

Third, the trial findings furthermore show that while users adopted lightweight interaction of liking, they did not dive into conversations with others in large scale. While we did not query the reasons for this, we can speculate that much of this is likely explained by the scarcity of encounters. Furthermore, our design expected users to take a leap of faith from reading a whisper or liking it to sending a personal message to a stranger. We argue that the design of progression lacked a less serious level of content-mediated interaction, such as commenting whispers.

Our data gathering did not include client-side data logging, so our knowledge of the users' interactions with the application is limited. Based on the low number of exchanges and interactions between users, we can assume that there was scarcity of new whispers and messages that would have invited user to open the application. We will later discuss different design options for maintaining user engagement in the beginning of proximity-based applications between nearby strangers.

The trial findings show a proportion of participants that perceived playfulness and gamification positively. Naturally, the excitement was nothing compared to the global craze over searching Pokémon in the real world some months after our trial. Collecting whispers did not motivate the study participants to actively explore their physical surroundings. One explanation may be that it would have needed more positive reinforcement, receiving whispers at different times and places from different people, to first create a feeling that active exploration makes sense. This leaves us also pondering about the collectible nature of user profiles. Research on digital collecting suggests that making things challenging to acquire by demanding effort may enhance the value of collections [28]. On the other hand, research on collecting in digital games has found that, for example, the utility of the object and its rarity affect the perceived value [25]. The profiles of others in N2U proved indeed hard to acquire but the range of possible interactions with them were limited and even though each profile is obviously unique, it is not possible to quantify their individual values. This collecting aspect is however, where N2U differs from most people-nearby-applications that allow online search of other users instead of requiring encountering them in the real world first.

Design considerations

To extend this retrospective deliberation, we have translated the identified issues into application and trial design considerations to help guide future work on this topic.

Supporting encounters

The scarcity of encounters between users was a clear problem affecting our trial in many ways. The longer detection range of WiFi Aware, which was not available during our trial, would be a better option for potential future implementations. GPS, even though not accurate indoors, would allow detecting nearby strangers with adjustable distances. Adjusting the definition of "nearby" could be a way to ensure exchanges during the early stages after the application launch, when a critical density of users is not yet formed.

Regarding the trial design, we did not want to create social interaction by rewarding it. We hypothesize that the following participant recruitment and rewarding strategy could solve the problem of maintaining user engagement while not compromising the results: The participants are recruited for two different purposes. One group is recruited to create enough density. They may receive a small reward for starting to use the system and having it running to ensure encounters and exchanges for the other group. The other group would be people who commit to providing feedback. They could be screened more carefully and in the end possibly rewarded for giving feedback. Screening could target specific user characteristics like introverts.

Application design related considerations for ensuring encounters include the following. Our design demanded reciprocity for exchanges to happen, i.e. if another user had created five whispers and another had created only three whispers, their encounters would not leave any mark after the three encounters. Related to *playfulness*, for the application to reward in the cases where the profiles include different numbers of whispers, the reward mechanism could be separated from receiving user-generated content. Again, to ensure exchanges and make the experience more rewarding in the early stages, each encounter could start a series of few exchanges during the following days, which would be refreshed by another encounter or seize if no encounters happen. Each exchange would serve as an invitation to technology-mediated interaction, i.e., support *progression*. Our Bluetooth based approach did not give a possibility get any information about where to search other users. GPS based application could be used to give at least some clues to user where and when one might encounter others. This might encourage the playful action of active exploration and also prevent disappointments of fruitless

explorations. However, as anonymity and privacy concerns are central to these kinds of applications, pointing the exact location of other users is not what we mean with this.

Supporting creation high-quality content

Receiving uninteresting content, either nonsensical content or uninteresting basic information, was not experienced as rewarding or playful. We expected the users to have challenges in coming up with relevant and suitable content for such new application type, as suggested by our early stage research on the same concept [16], but we believed that the lightweight interaction of liking and seeing examples from others would encourage the users to modify their whispers. It seems that better and faster means to ensure good quality content are required. As possible means to this, we see the following. First, before creating their own profile, users could already get a glimpse of what others share, for example most liked whispers this week. Second, content could be imported from user's other social media profiles or automatically generated from activities, for example, in social media and games. Third, the basic profile information could be separated from the dynamically shared content, and shared already in the first encounter. Finally, to support the evolution of collective norms of shared content and to get rid of uninteresting content, disliking could be introduced to motivate users to rethink the quality of their whispers.

Supporting engagement with the application

Supporting engagement starts by supporting encounters and quality of content. We see the following as additional means to support engagement with the application. N2U users were able to access the whispers only through profiles. Therefore, a *content feed,* which would give an easier access to the whispers from the encountered users, could have been useful for inviting more technology-mediated interaction, i.e., second level of *progression*. To support the engagement with the application in a *playful* way, the application could feature some standalone activities like generating playful content within the application or interacting with the content in a playful way. The playful collecting aspect could be strengthened by introducing a clear collectable element, whose value can be quantified, to each profile. Following the example of StreetPass, the application could have mini-games that are powered with the encounters or even played without them to give a reason for the user to visit the application. Another, and probably the most viable option, is to build interaction with nearby strangers as a feature to already successful applications.

CONCLUSION

We explored the design qualities of playfulness and progression by arranging a field trial with our research artifact, Next2You, a proximity-based mobile application aiming create social experiences and encourage social interaction between nearby strangers. While playfulness as a quality has been relatively well studied, the concept of social progression, i.e., first creating mediated interaction between nearby strangers and then converting the mediated interaction into face-to-face interaction, remains largely unexplored. The application design presents several features manifesting these design qualities.

The application managed to encourage various interactions that we argue would not have otherwise taken place. While the qualitative results could be considered to support the relevance of these two design qualities, in such an in-the-wild trial, it is challenging to measure the specific effects of the designed features. This was challenged by insufficient critical density and other practical limitations (thus scarcity of interaction) in the trial, and partly also by weaknesses in the design. This kind of hyperlocal communication between strangers represents a new, unparalleled communication medium. This means that the participants did not have the time to establish norms and good practices about what to share. At the same time, receiving nonsensical content further decreased the users' motivation.

We argue that Next2You was based on well-grounded reasoning inspired by prior design and research with similar intentions. Similarly, the field trial, compared to the norms in HCI, was relatively extensive and long-term. Yet, the results about the social effects of Next2You disappointed the authors. The low conversion made it difficult to draw strong conclusions. We see places for improvement in both the application and trial design. As a result of this, we provide an extensive list of design considerations for applications that have such ambitious aims of creating positive behavioral effects on social interaction amongst strangers, and trials aiming to evaluate it.

All in all, this study implies that we need both more design contributions to address social encouragement and more applicable methodologies to study the social effects of technology in a valid fashion. Particularly the concept of social progression still calls for new approaches and courageous design explorations.

ACKNOWLEDGMENTS

This research was funded by Academy of Finland (grants 283110 and 295895).

REFERENCES

1. Bassoli, A., Moore, J., & Agamanolis, S. 2006. tunA: Socialising music sharing on the move. Consuming music together, 151-172.
2. Jay Chen and Azza Abouzied. 2016. One LED is Enough: Catalyzing Face-to-face Interactions at Conferences with a Gentle Nudge. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16). ACM, New York, NY, USA, 172-183. DOI: https://doi.org/10.1145/2818048.2819969
3. Nathan Eagle and Alex Pentland. 2005. Social Serendipity: Mobilizing Social Software. IEEE Pervasive Computing 4, 2: 28–34. https://doi.org/10.1109/MPRV

4. Nicole B. Ellison, Jeffrey T. Hancock, and Catalina L. Toma. 2012. Profile as promise: A framework for conceptualizing veracity in online dating self-presentations. New Media & Society 14, 1: 45–62. https://doi.org/10.1177/1461444811410395
5. Mattias Esbjörnsson, Oskar Juhlin, and Mattias Östergren. 2004. Traffic encounters and Hocman: Associating motorcycle ethnography with design. Personal and Ubiquitous Computing 8, 2: 92–99. https://doi.org/10.1007/s00779-004-0260-4
6. Lars Erik Holmquist, Jennica Falk, and Joakim Wigström. 1999. Supporting group collaboration with interpersonal awareness devices. Personal Technologies 3, 1–2: 13–21. https://doi.org/10.1007/BF01305316
7. Joey Chiao-Yin Hsiao and Tawanna R. Dillahunt. 2017. People-Nearby Applications. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17, 26–40. https://doi.org/10.1145/2998181.2998280
8. Mizuko Ito, Daizuke Okabe, and Ken Anderson. 2009. Portable objects in three global cities: The personalization of urban places. The reconstruction of space and time: mobile communication practices, 67-87.
9. Yukari Iwatani, Y. 1998 "Love: Japanese Style, Wired News". www.wired.com/culture/lifestyle/news/1998/06/12899
10. Pradthana Jarusriboonchai, Thomas Olsson, Vikas Prabhu, and Kaisa Väänänen-Vainio-Mattila. 2015. CueSense. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '15, 2127–2132. https://doi.org/10.1145/2702613.2732833
11. Younghee Jung and Jan Blom. 2006. Scent Field Trial - Understanding Emerging Social Interaction. 69–76.
12. Vassilis Kostakos, Eamonn O'Neill, and Anuroop Shahi. 2006. Building Common Ground for Face Interactions by Sharing Mobile Device Context. Proc. Location and Context-Awareness (LoCA), 222-238
13. Leah E. LeFebvre. 2017. Swiping me off my feet. Journal of Social and Personal Relationships: 26540751770641. https://doi.org/10.1177/0265407517706419
14. Susanna Paasovaara, Pradthana Jarusriboonchai, and Thomas Olsson. 2017. Understanding collocated social interaction between Pokémon GO players. In Proceedings of the 16th International Conference on Mobile and Ubiquitous Multimedia (MUM '17). ACM, New York, NY, USA, 151-163. DOI: https://doi.org/10.1145/3152832.3152854
15. Susanna Paasovaara, Andrés Lucero, and Thomas Olsson. 2016. Outlining the design space of playful interactions between nearby strangers. In Proceedings of the 20th International Academic Mindtrek Conference (AcademicMindtrek '16). ACM, New York, NY, USA, 216-225. DOI: https://doi.org/10.1145/2994310.2994344
16. Susanna Paasovaara, Ekaterina Olshannikova, Pradthana Jarusriboonchai, Aris Malapaschas, and Thomas Olsson. 2016. Next2You: a proximity-based social application aiming to encourage interaction between nearby people. In Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia (MUM '16). ACM, New York, NY, USA, 81-90. DOI: https://doi.org/10.1145/3012709.3012742
17. Susanna Paasovaara, Ekaterina Olshannikova, and Thomas Olsson. 2015. Collaborative Video Challenges. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '15, 1923–1928. https://doi.org/10.1145/2702613.2732882
18. Susanna Paasovaara and Thomas Olsson. 2016. Proximity-Based Automatic Exchange of Data in Mobile Gaming. In Proceedings of the 9th Nordic Conference on Human-Computer Interaction - NordiCHI '16, 1–10. https://doi.org/10.1145/2971485.2971508
19. Janne Paavilainen, Hannu Korhonen, Kati Alha, Jaakko Stenros, Elina Koskinen, and Frans Mayra. 2017. The Pokémon GO Experience: A Location-Based Augmented Reality Mobile Game Goes Mainstream. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA, 2493-2498. DOI: https://doi.org/10.1145/3025453.3025871
20. Eric Paulos and Elizabeth Goodman. 2004. The familiar stranger. In Proceedings of the 2004 conference on Human factors in computing systems - CHI '04, 223–230. https://doi.org/10.1145/985692.985721
21. Per Persson, Jan Blom, and Younghee Jung. 2005. DigiDress : A Field Trial of an Expressive Social Proximity Application. 195–212.
22. Robert D. Putnam. 2000. Bowling Alone: The Collapse and Revival of American Community. New York: Simon & Schuster.
23. Jan Seeburger, Marcus Foth, and Dian Tjondronegoro. 2012. The sound of music: sharing song selections between collocated strangers in public urban places. In Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia (MUM '12). ACM, New York, NY, USA, , Article 34 , 10 pages. DOI=http://dx.doi.org/10.1145/2406367.2406409.
24. Jenifer Tidwell. 2010. Designing interfaces: Patterns for effective interaction design. O'Reilly Media, Inc.

25. Zachary O. Toups, Nicole K. Crenshaw, Rina R. Wehbe, Gustavo F. Tondello, and Lennart E. Nacke. 2016. "The Collecting Itself Feels Good": Towards Collection Interfaces for Digital Game Objects. In Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '16). ACM, New York, NY, USA, 276-290. DOI: https://doi.org/10.1145/2967934.2968088
26. Sherry Turkle. 2012. Alone together: Why we expect more from technology and less from each other. Basic books.
27. Kaisa Väänänen-Vainio-Mattila, Petri Saarinen, Minna Wäljas, Marko Hännikäinen, Heikki Orsila, and Niko Kiukkonen. 2010. User experience of social ad hoc networking: findings from a large-scale field trial of TWIN. In Proceedings of the 9th International Conference on Mobile and Ubiquitous Multimedia (MUM '10). ACM, New York, NY, USA, , Article 10 , 10 pages. DOI=http://dx.doi.org/10.1145/1899475.1899485
28. Rebecca D. Watkins, Abigail Sellen, and Siân E. Lindley. 2015. Digital Collections and Digital Collecting Practices. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15). ACM, New York, NY, USA, 3423-3432. DOI: https://doi.org/10.1145/2702123.2702380
29. John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through design as a method for interaction design research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07). ACM, New York, NY, USA, 493-502. DOI: https://doi.org/10.1145/1240624.1240704
30. Happn. Retrieved April 15, 2018. https://www.happn.com/
31. N2U. Retrieved April 15, 2018. https://play.google.com/store/apps/details?id=fi.tut.cs.social.proximeety (Europe only)
32. Pokémon GO. Retrieved April 15, 2018. www.pokemongo.com
33. StreetPass. Retrieved April 15, 2018. https://www.nintendo.com/3ds/built-in-software/streetpass
34. Tinder. Retrieved April 15, 2018. https://tinder.com/

PUBLICATION 5

Outlining the design space of playful interactions between nearby strangers

Susanna Paasovaara, Andrés Lucero, and Thomas Olsson

Proceedings of the 20th International Academic Mindtrek Conference (AcademicMindtrek '16). ACM, New York, NY, USA, 216-225

Outlining the Design Space of Playful Interactions Between Nearby Strangers

Susanna Paasovaara
Dept. of Pervasive Computing
Tampere University of Technology
Tampere, Finland
susanna.paasovaara@tut.fi

Andrés Lucero
SDU Design
University of Southern Denmark
Kolding, Denmark
lucero@acm.org

Thomas Olsson
Dept. of Pervasive Computing
Tampere University of Technology
Tampere, Finland
thomas.olsson@tut.fi

ABSTRACT
Designing interactive technology with an aim to encourage social interaction between nearby strangers is challenging. While there are various social norms, cultural practices and privacy concerns that hinder interaction with strangers, ignoring the other people can be even more detrimental in the long term (e.g., leading to a low sense of community and missed opportunities). In order to better understand this paradoxical design space, we arranged co-design workshops aiming to create ideas of future services where interactive technology playfully encourages interaction between nearby strangers. By analyzing the resulting ideas, we identify various aspects and elements that conceptualize and theorize this so far fuzzy design space. We explicate concepts like *Hotter, Hotter, Changing Other's Avatar* and *Dancing*, and analyze the 60 resulting concepts to identify elements and viewpoints important in this design space. The conceptualization can help ideating future services, identifying relevant research questions, as well as evaluating design solutions with respect to relevant quality attributes.

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

Keywords
Proximity-based interaction; playfulness; social interaction; co-design.

1. INTRODUCTION
Everyday, strangers surround us in public places of urban environments. In fact, we may not even know our neighbors or colleagues. Civil inattention [6], i.e., the process of acknowledging the presence of nearby strangers but at the same time blocking further interaction with them, is a common social norm in public places. Cocooning, the common urban practice of creating a personal space by concentrating on mobile media technology [8], further fuels this trend of social isolation in public spaces. Consequently, the threshold for starting a face-to-face conversation with a stranger is high, especially in large cities and cultures where small-talk is not a common practice (e.g., Finland). The benefits of interacting with strangers may not seem worth any potential social risks. Therefore, we argue that with suitable interaction design we could nudge people to focus on the social opportunities rather than on the risks of interacting with strangers. There is room for exploring how to create socially meaningful experiences between nearby strangers.

The "gray mass" of strangers could play an important role in people's lives through lightweight social interaction, which could lead when appropriate to further interaction and collaboration. This overall goal can be approached with different kinds of solutions (dictating social rules, changes of policy, etc.). Our main approach is technological: we explore if and how lightweight, *playful interaction* [19] between nearby strangers—mediated by interactive technology—could lower the threshold to initiate interactions that are meaningful enough to motivate doing so also in the future. However, despite focusing on technological solutions, it is crucial to base the design on a sociological and psychological understanding of social behavior and cultural aspects.

Technology-mediated interaction between strangers in the same area has been explored to some extent. Social matching applications like MeetMe[1] and Skout[2] allow its users to browse others in the same area and connect with them. They provide information about common interests with the other users. The dating application Tinder[3] also uses location information to show potential partners to the user. Location-based playfulness in forms of Ingress[4] and Geocaching[5] provides platforms for lightweight interaction between strangers, but most often these people are not doing the activities at the same time in the same place. In July 2016, the launch of a location-based augmented reality game, Pokémon GO[6], caused interaction between nearby strangers as masses of people invaded public spaces trying to catch Pokémon. This happened even though the social features in the game are minimal. StreetPass[7] in Nintendo 3DS exchanges game content automatically with other users when they come close enough to each other. StreetPass is the only one of these commercial

[1] www.meetme.com
[2] www.skout.com
[3] www.gotinder.com
[4] www.ingress.com
[5] www.geocaching.com
[6] www.pokemongo.com
[7] www.nintendo.com/3ds/built-in-software/streetpass

examples that intentionally creates interaction between nearby strangers like we define it: people that are so close that they could easily approach each other, assuming that a good reason to do that is provided. StreetPass was used as inspiration for our work, but at the same time we wanted to explore the broader possibilities of interacting playfully with nearby strangers.

Another motivation behind our work and the technological approach is the foresight of direct device-to-device communications becoming more common in mobile platforms. This opens possibilities for discovery of nearby devices and data exchange between them. These technical enablers can be used for different purposes but our interest lies in understanding how this can be used to create meaningful playful interaction between nearby strangers.

With this work, we take a step backwards from a technology-driven approach, and explore the design space of playful interactions between nearby strangers by using co-design [16] as our approach. We argue that such an approach helps the research community to identify meaningful ideals and utopias for the future (i.e., design targets), take experience and social interaction as starting points instead of what is technologically possible, and harness the life experience of people, as this is a topic that everybody has experienced before. We collaboratively ideated and sketched various kinds of solutions (services, apps) with design researchers and students. The resulting ideas were analyzed to identify various aspects and elements that outline and conceptualize this fuzzy design space.

The contribution of the paper for playful interactions with nearby strangers is twofold: first, interesting novel service ideas and, second, the conceptualization and theorization of the design space, based on the analysis of the 60 ideas produced in the co-design workshops.

2. RELATED WORK

Research related to encouraging interaction between nearby strangers stretches over 10 years and has taken many forms. Different means of making it happen have been presented and the research has had different focuses. In the following, we outline this area mainly with regard to match-making between strangers, technology-mediated interaction, enriching gaming experience with co-located other players and encouraging people to interact with interactive technology.

Mobile devices have been seen as a good platform to perform social matching of nearby strangers. Serendipity matched profiles within Bluetooth range for professional use [5]. CommonTies is a wearable wristband for context-aware matching of profiles. The idea is to encourage two nearby strangers to interact with each other by revealing a match through showing the same color on both of their devices [1]. CueSense is a wearable display that aims to provide tickets-to-talk by revealing matches in the social media content of encountering strangers [10].

McCarthy et al. experimented with using proactive public displays to reveal information about nearby people in the context of an academic conference. The revealed information had two purposes, increasing the awareness of other participants and providing tickets-to-talk. Conference participants could make a profile that was stored on an RFID tag attached to their conference badge and made visible on a public display when they asked a question in a paper session or queued for coffee [24].

There have been several examples of mobile applications that enable technology-mediated interaction with nearby strangers. Capital Music provided a way for sharing song choices with nearby strangers and allowed interaction through commenting the songs [29]. DigiDress [27], Scent [11] and TWIN [31] present functionalities like messaging, discovery of proximate users, expressing identity and sharing content with other users. Viewing the profiles of proximate users was found to be the motivation of continued use of DigiDress. Direct messaging on the other hand was not commonly adapted. The user trial for TWIN showed that the motivations to use it were mostly related to fun and entertainment, not to any practical goals.

Paulos and Goodman designed a Bluetooth-based device as well as a mobile application called Jabberwocky for logging and showing encounters with frequently encountered strangers. They believed that such devices could encourage solidarity in public places [25].

Enriching gaming with nearby players has also seen different forms. Bell et al. introduced a location-based game called Feeding Yoshi, where nearby players could see each other on a map and could swap digital resources [3]. In Insectopia nearby players could team up to catch digital insects generated by Bluetooth devices [26]. Szentgyorgyi et al. found barriers for ad-hoc, collocated pick-up games on Nintendo DS with strangers. They included finding gaming opponents, social awkwardness of initiating a game with a stranger, the problems related to joining, and exiting an ongoing game [30]. Looking at a specific Nintendo DS game, Dragon Quest IX, Licoppe and Inada witnessed players appropriating public places for gaming with nearby strangers [14]. A newer version of Nintendo's 3DS handhelds features StreetPass, automatic exchanges of various kinds of game content with players who are within WiFi range. Briceño critiques StreetPass stating that it prevents true social interaction and leads to players viewing each other as in-game currency [4].

Examples of researching the social effects of interactive installations on public places include Jokebox [2] and coMotion [12] a shape-changing bench. Jokebox is a set of two interconnected installations that require two nearby people to coordinate their actions and interact with the devices simultaneously in order to hear a joke as a reward. Jokebox created a "honey pot" effect inviting more people to approach it when others were using it. Interaction was more likely to happen within groups of familiar people than between strangers, but people were also seen championing the device to strangers. Experiencing a sudden change in the shape-changing bench sparked a conversation between two strangers sitting on it, but the conversation did not elaborate further from the bench topic. Yoon et al. proposed encouraging social interaction in informal social environments through collocated play and introduced FishPong, a game for an interactive tabletop to be played with coffee mugs [32].

Stepping away from a prototype-centered approach, Heinemann and Mitchell analyzed a set of breaching experiments, social interventions with the intention of encouraging and supporting collocated strangers to collaborate. Their research revealed how social order of public places indeed imposes barriers to collaboration. Availability, facilitation, perspicuous settings, and perspicuous participants were seen as qualities that encourage and support collaboration [7].

Jarusriboonchai et al. researched the opportunities and challenges of digital tickets-to-talk in encouraging face-to-face interactions between collocated strangers. Offering concrete and collaborative activities was seen more prone to lead to meaningful face-to-face interactions than offering chances for online interactions that

encourage offline interaction or mere self-expression for nearby strangers [9].

All in all, this research area has been strongly driven by design and evaluation prototypes designed by researchers. Only few publications cover more than one idea and analyze the landscape beyond a single design artefact. More importantly, the area lacks theoretical foundations and well-defined terms to describe and analyze various relevant aspects. With this paper, we aim to take a different approach and focus on co-design as a method and conceptualization as the goal of the work.

3. METHODOLOGY

Dialogue-labs is a co-design method developed by Lucero et al. It combines the use of process, space and materials in a structured way and provides a clear step-by-step procedure for a two-hour idea-generation session in which participants first work in pairs and then as a whole group [16]. This section describes how we applied the dialogue-labs method, and what kinds of task and materials were used for sensitizing and facilitating ideation.

3.1 Tasks

The overall task in the workshop was to *think of playful ways to encourage interaction between nearby strangers*. Five subtasks were defined in order to encourage the participants to approach the topic from different angles. The tasks draw attention to (1) what could motivate people to interact with nearby strangers, (2) what would actually happen when encountering a stranger, (3) how to build the relationship during one encounter or across several encounters, and (4) how to take privacy concerns into account. The tasks were named and described as follows:

- *Rewards:* What is a playful and meaningful reward when interacting with nearby strangers? (1)
- *Awareness:* How can people become aware of the playful and social opportunities with nearby strangers? (2)
- *Meaningful:* How can people take appropriate steps with nearby strangers towards real-life connection? (3)
- *Frequency:* What are playful ways to utilize the knowledge of being nearby the same stranger repeatedly? (3)
- *Privacy:* How can people interact with nearby strangers in a playful way so that it both protects their anonymity and leaves room for revealing their identity? (4)

3.2 Materials

Each task was accompanied with some material to support ideation. Three of the tasks were accompanied with a different deck of design cards [20]. We did not want participants spending time learning each deck's set of usage rules, so we decided to use them in our own simplified and consistent way. The decks were divided in several piles and the instructions were to reveal one card from each pile, and use as many of the appearing cards in ideation as feels suitable. At any point, the participants could discard the previous cards and turn around a new combination. There were no other rules regarding how to take turns in ideation. The instruction was simply to *ideate together*.

For the *Awareness* task, we used the Design Deck cards designed in Northumbria University. The cards feature four categories: emotions, technology, personas and issues. The personas are very provocative and issues contain worldwide problems, which result in interesting combinations when picking one card from each category. For the *Frequency* task, we provided PLEX Cards [18]. PLEX Cards are an idea generation tool that is created based on the Playful Experiences framework. To assist in coming up with playful ways to *Reward* interaction with nearby strangers in a meaningful way the VNA cards [13] and a subset of IDECARDS idea generation cards for game designers [14] were provided. IDECARDS actually include Verbs, Nouns and Adjectives familiar from the original VNA, but the set is less extensive than the original set. From the IDECARDS we chose Emotions, Animals and Non-symbols.

The *Privacy* task was supported with a pile of random pictures cut out from magazines spread on a table, out of which the participants could make collages or mood boards [17]. For the *Meaningful* task, pencils and paper for sketching were provided. This was the only ideation station where the participants could sit down. For the final discussion, we provided a set of Playmobil[8] characters, accessories and furniture.

3.3 Participants

We organized three workshops each consisting of six participants. Two of the authors of this paper took part in all three sessions and the remaining 12 in only one session, for a total of 14 individual participants. Ten of the participants were design students from the University of Southern Denmark, and four were research and/or teaching staff. In our participant recruitment we focused on harnessing the creativity of open-minded and visionary interaction designers instead of, e.g., systematic and analytical engineers; this was particularly because the field of research is strongly based on social interaction and interactive technology being a *mediator* or *facilitator* instead of the centerpiece. The ages of the participants ranged between 22 and 41 (average of 28). Six of the participants were female and eight were male. The participants represented nine different nationalities, covering Europe from North to South and East to West, and two countries from South America.

3.4 Procedure

Each two-hour session started with a 15-minute sensitizing phase. We presented three mobile services to the participants in order to get them thinking about different ways of interacting playfully with nearby strangers to them. The main differences between these services relate to the type of content that is shared, how that content is generated and what forms of interaction between users are supported.

The first presented service, StreetPass, is a commercial feature on Nintendo 3DS handheld gaming devices, which can be activated in a wide variety of 3DS games. It automatically exchanges avatars and game-related data between stranger users carrying their devices along with them and passing by each other. The user will find out about the exchange, when they check the device and see a green LED being lit up. The encounter between the user's own avatar and the received avatar can be viewed. It includes a discussion between the avatars, and the encountered avatar reveals something about itself. The user can at any time view the collection of all the encountered avatars. Different games utilize StreetPass in different ways. The user can for example receive gifts from the encountered users, have them fight on their side, compete against them, or see their creations.

The second service, *Next to You* (N2U) is a social mobile application that automatically recognizes nearby users of the same application based on their Bluetooth address. After recognition, it automatically exchanges pieces of profile information called 'whispers' between the nearby users. N2U is based on a gradual revealing of user profiles. The full of the other user builds one Whisper at a time, each time the two users encounter. N2U offers

[8] www.playmobil.com

means to take the interaction further from the automatic exchange. Whispers can be liked and in-application messages can be sent to any collected user. Unlike many social matching applications the profile pictures are not in a central role. The profile picture is revealed only after the two users meet face to face, and prove it by playing a mini-game together.

The third service, *Challenz* is a mobile application that provides a possibility for strangers passing by each other in their daily lives to collaborate over video content by continuing the story that the encountered user had started or continued. Later on, when the two users encounter again, the new parts to the story will be automatically transferred to the previous contributor, as a reward. *Challenz* as well as *Next to You* are research prototypes currently work in progress by the authors.

After the sensitizing phase, the group of six participants was divided into three pairs. Each pair chose one of the five locations with a task to ideate around it and document their ideas. After 15 minutes, they changed to a different task. Three ideation rounds were performed.

After a five-minute break, the pairs presented the ideas they thought as their best ones for 15 minutes. That was followed by a co-design session of 15 minutes, used to elaborate on the ideas within the whole group. As a final group activity, designing an ideal solution summarizing the best ideas was conducted. In this phase, the participants used Playmobil characters together with play acting to discuss and present their ideas. After these group activities six ideas, one for each of the five locations plus another for the final group activity, were chosen for quality assessment. Each participant assessed the six ideas on a 7-point Likert scale (where -3 is very bad, +3 is very good, and 0 is neutral) individually.

Figure 1. Co-design workshops setup.

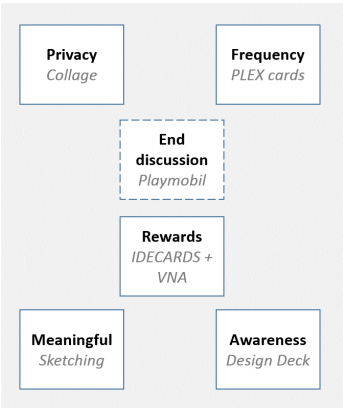

Figure 2. Room, tasks and materials.

A large meeting room was set up to facilitate the process (Figure 1). It included a common area for sensitizing and end discussion. The five tasks were spread out in the room as five separate locations suitable for pair work with the given material. Figure 2 presents an overview of the room, the tasks and the materials.

3.5 Analysis

The co-design workshops resulted in a wide range of ideas of different levels of fidelity and focusing on different aspects of the envisioned system or interaction between nearby strangers. We analyzed the data bottom up, first transcribing the group discussions and identifying individual ideas. In order to objectively measure the quality of the ideas, we calculated the averages of the 7-point Likert scale ratings for the 18 ideas. We then chose the best of those and a set of other ideas to be illustrated as vision sketches that capture the essence of the idea.

The two researchers who took part in every session grouped the ideas according to commonalities and enriched the illustrations with keywords. This led to the identification of the stages through which playful interaction with nearby strangers could go through while becoming more commonplace. The rest of the analysis was an iterative process of going between data, writing, modeling.

4. RESULTING IDEAS

The three workshops generated altogether 60 ideas. They ranged from the conventional (e.g., revealing matching interests and activity partnering) to the futuristic and hard-to-realize (e.g., feeling what others around you feel). Most of the idea descriptions were somehow partial, concentrating on describing some aspects of the envisioned system that were particularly relevant, but leaving others unexplained. The ideas and their explanations reflected the given tasks and materials but were also built on many other aspects such as participants' own experiences and observations of encounters between nearby strangers and their cultural backgrounds.

As we described earlier, each participant rated six commonly chosen ideas from their workshop individually. Table 1 presents these ratings. We describe the seven highest-rated ideas, and relate the presented discussion and conceptualization mainly to these concrete examples.

4.1 Highest Rated Ideas

Shadows (Figure 3) seeks to distract people from their personal bubbles and direct their attention to a nearby stranger by creating a weird moment—a ticket-to-talk—of showing their shadows interacting with each other.

Table 1. Mean ratings ($\bar{x}$) and standard deviations (SD) of the 18 resulting ideas (scale -3 to +3, where 0 is neutral)

	$\bar{x}$	SD		$\bar{x}$	SD
Shadow	**2,7**	0,5	Pattern of meetings	1,0	0,6
Dancing	**2,3**	1,0	Influencing others	1,0	1,6
Hotter, hotter	**2,3**	0,8	Beat up the monkey	1,0	2,1
Honk, honk	**2,2**	0,8	Snake bits	0,7	0,8
Stories of the world	**2,0**	1,1	Show me your colors	0,7	1,6
Change others avatar	**1,8**	1,2	Drones	0,7	1,6
Collective discount	**1,8**	1,0	Make others look funny	0,5	1,4
Fanboy T-shirt	1,7	1,2	Push ups	0,5	1,1
Stranger band	1,0	1,6	Find the A-hole	0,0	1,1

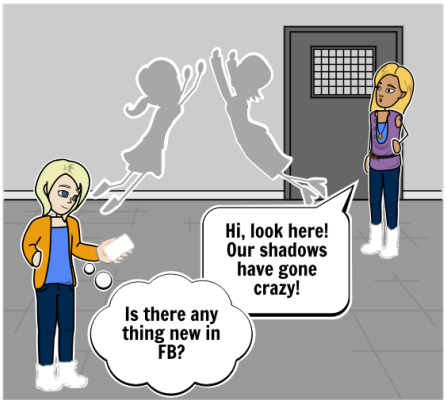

Figure 3. Shadows.

In *Dancing* (Figure 3), the moves of one person in the dance floor are tracked and shown anonymously on a public display for others to imitate. By imitating the moves people submit to the command of the tracked dancer and interact with nearby strangers as part of a larger group.

Figure 4. Dancing.

Hotter, Hotter (Figure 5) is based on the children's game Hide the Key, where the hints about the location of a hidden object are given verbally, by saying 'hotter' when a seeker gets closer to it. *Hotter, Hotter* is a game-like application for players to seek other players based on sensing increasing heat when closer to another player. Players need to be in close proximity of each other in order to score points.

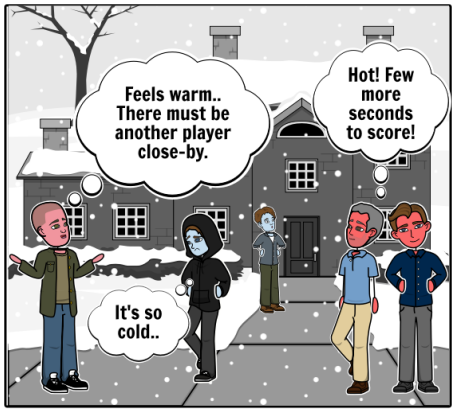

Figure 5. Hotter, Hotter.

Honk, Honk (Figure 6) builds on one participant's experience from the U.S, where others can gesture truck drivers to honk their horns.

...so I was in a car, and you pass by and you are like [does the gesture], and then the guy or girl smiles and then they answer back, and this feedback, sort of, it's just a second but there is a sharing and I found it, I couldn't stop doing it. I did it all trip. And it never happened that someone didn't answer back. ...it's still in my head. Whereas if I think about going more in depth, maybe I don't want to. Maybe then I use different social environment, not an app. If it could be recreated, something like that, that leaves you just a good mood...

We made an illustration of what *Honk, Honk* could look outside of the truck context. The person in the left is commanding the stranger in the right with bodily gestures. The other one responds even though it may be silly as he chooses to obey the rules.

Figure 6. Honk, Honk.

Stories of the World (Figure 7) is a concept for airports. An interactive interface would allow people to view the point of departure and destination of nearby travelers and to subscribe to pictures from their journey. The information serves as a ticket-to-talk and subscribing as a way to share part of their upcoming experience.

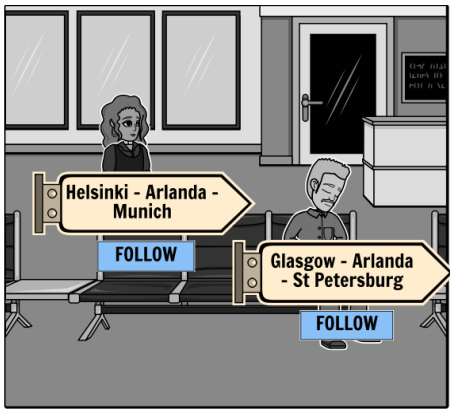

Figure 7. Stories of the World.

Changing Other's Avatar (Figure 8) switches the roles in avatar customization from the owner spending time and effort with perfecting their avatar to giving a nearby stranger a chance to practice their creativity. The idea was that the customization would be done live during a longer encounter instead of having to wait for several consecutive encounters for something to happen.

Figure 8. Changing Other's Avatar.

Collective Discounts (Figure 9) would connect strangers to perform some kind of an act together to receive a discount on a meal, which could be afterwards eaten together.

Figure 9. Collective Discounts.

5. ANALYSIS AND THEORIZATION

There would have been different options to analyze the produced 60 ideas. Looking for example at different contexts of use or kinds of people taking part in the interactions. Our process led us to look at the ideas as descriptions of the systems encouraging interaction between nearby strangers, at the different components they consisted of, and the different roles they had, i.e., what does the system do to encourage people to interact with nearby strangers. Another valuable contribution we saw was describing the different levels of playful interaction the systems enabled, i.e., what do people do or how do they interact with nearby strangers. Third, we looked at how privacy was taken into account in the ideas as it is a relevant consideration in interaction between strangers.

5.1 Systems Encouraging Playful Interaction

On a higher level of abstraction, the systems encouraging playful interaction between nearby people that were identified from the idea descriptions, consisted of one or more parts from the following categories.

- *Interactive personal technology*, for example a mobile device or an interactive T-shirt.
- *Non-interactive personal items*, for example a normal T-shirt of a certain color.
- *Interactive environment modifications*, for example an installation that projects shadows of people interacting with each other when detecting that they potentially could.
- *Non-interactive environment modifications*, for example a specific section in a bus for strangers willing to interact with others.
- *Rules of play,* i.e. knowledge of how to behave when encountering a stranger.

5.2 Roles of the Systems

A central role we can identify from the ideas is *announcing and enforcing the rules*. Having rules is a central element in this design space, as they are to games [17]. The system can announce them through the technology or through the environment, or they can be made known to people through other channels becoming a known code of conduct. Rules can help lower the threshold of interacting with strangers.

Furthermore, the system can allow the user to *prepare for the encounters* for example by defining the content that their interactive T-shirt gifts to others or recording their physical activity to be compared with others. This role is most suitable for interactive personal technology.

The system can *notify of an opportunity* to interact with strangers. The ideas here were further divided into five categories: (1) Personal information technology that keeps the interest to meet others a shared secret between the users of the same system, like in *Hotter Hotter*; (2) Personal information technology that visualizes the user's interest to meet others to nearby people, also to those who do not use the same system (e.g., smart T-shirts with embedded display to visualize common interests, wearable bracelets or personal social drones); (3) The environment can also take a proactive role in bringing people together like in *Shadows*. Examples of (4) a passive role of an environment in providing awareness of an opportunity to interact included different versions on *Stranger sections,* dedicated areas for people who wish to interact with strangers. Even though the purpose of driving a truck is not to play *Honk, Honk*, the truck could be described as (5) a non-interactive personal item that notifies others of the possibility to interact with its driver through gestures. Without rules and mutual interest to play the mere notification can be meaningless. If you see a truck but do not know the rules, there is no play. If you know the rules but the truck driver does not know them or does not want to obey them, the play ends right after you make the gesture.

The system can assume a role of *ensuring mutual interest to interact* to further lower the threshold of interacting. This can again happen through interactive or non-interactive parts. In the case of encountering a stranger in a *Stranger section*, one can assume that they are willing to interact with others and the context to interact is suitable. Another player playing *Hotter, Hotter* should be ready for the discomfort of someone entering their private space, which makes it acceptable to do so. The vague heat sensations of *Hotter, Hotter* are easy to neglect in an inappropriate context.

Interactive technology can assume the role of *connecting* nearby strangers *to interact through technology*. This could happen for example by anonymously playing a game with nearby strangers or in a face-to-face situation through modifying other's avatar.

The system can *justify* the interaction by providing reasons or excuses to approach a stranger. There are different ways of doing that. The system can provide topics, such as common interests, to discuss, so called tickets-to-talk. The system can demand certain types of interactions as a part of a game, rewarding for obeying and punishing for disobeying as in *Hotter, Hotter*. The system can

create such weird moments that they must be acknowledged verbally like in *Shadows*.

The system may *provide common activities* for the nearby strangers. This can be done with interactive technology, for instance by encouraging performing together in *Dancing*. It could also be a non-interactive solution, solving a problem together in the real world. An interesting and successful version of this can be found from Heinemann and Mitchell [7] where students tied strings to block free access to a pathway, demanding collaboration from people trying to get past it.

The interaction itself and the experience of fellowship that it creates are a reward and motivation for interacting with nearby strangers. The system can take a role of additional *rewarding*. Rewards can be digital such as content or points in a game; or receiving used defined content such as their favorite recipes. They can also be tangible such as stickers that are traded between strangers, or have monetary value e.g. a discount for a meal.

Overall, we could identify a broad spectrum of *roles of technology* in the ideas. Some of the ideas embodied several of these, e.g. first *notifying* of an opportunity and then *justifying* social interaction. We argue that the role(s) strongly depend on the context of activity, target users and type of interaction: for lightweight and short-term interaction *providing a common activity* might already in itself produce positive social experiences, while in some cases the system would first need to *ensure mutual interest* and *prepare for an encounter* before actually *justifying* interaction or *providing activities,* plus *reward* the interaction to add to motivation.

5.3 Levels of Playful Interaction

From the idea descriptions, we identified six levels of interaction, i.e., what people do with the nearby strangers. We next describe the levels and provide examples of playful actions on each level.

5.3.1 Affecting Automatically

At the first level, *affecting automatically*, the nearby strangers leave some kind of mark on each other automatically, no active effort is needed while nearby. They might notice this on the spot, later on, or never. The user's actions at this level happen prior and after the actual encounter. The system enables preparing for the encounter and performs the automatic exchange of data between nearby users. Examples of the actions include the following. (a) Collect others. For example, *Chameleon T-shirts* modify their appearance based on content that they collect from nearby users' T-shirts. (b) Give a Gift. For example, automatically gifting your favorite recipes to nearby strangers whose shopping bag content matches with the ingredients of the recipe. The playful interaction lies in choosing the contents that will be swapped with others and in the surprise of the received content. (c) Compare scores is a form of competition familiar from social gaming. In *Push-ups* the players would prepare for the encounter with other players by doing some physical activities such as push-ups. The level of activity would then be compared against each other, and especially encountering the same player repeatedly could lead to a friendly competition and motivation to be more active. (d) Relay and leave your mark. For example, modifying a received story and passing it forward, where the interaction happens through content.

5.3.2 Sensing Presence

At the second level, *sensing presence*, people become more aware of a nearby stranger. This could happen through the screen of a mobile phone, but could also take advantage of unusual senses, e.g. in *Hotter, Hotter*. Example actions on this level are the following. (e) Observe others i.e. passively receive the signals of nearby strangers. Another idea *Feelings Thief* would allow one to actually feel what a nearby stranger feels. (f) Follow cues e.g. in *Footprints* one would leave a trace of footprints behind. The footprints would fade away as the possibility of reaching the source decreases. Both *Hotter, Hotter* and *Footprints* invite to follow the cues and track down the source.

5.3.3 Interacting Through Technology

At the third level, *interacting through technology*, a technology-mediated mutual agreement to interact or a real-time connection may be established between nearby strangers. The technology mediated connection could be used for example to perform the following actions: (g) Modify something of the other, for example *Changing other's avatar* was considered such an intimate act that it requires agreement from its owner; (h) Compete against others. People could for example gain better benefits in a mobile game by playing against nearby strangers in real time without revealing their exact location.

5.3.4 Interacting With Face-to-Face Gestures

At the fourth level, *interacting with face-to-face gestures*, the interaction is short, bodily and mutual like creating an eye contact, smiling at each other, making gestures and replying to them. As the earlier quote related to *Honk, Honk* showed, this kind of interaction can be experienced as meaningful as such. Examples of actions on this level are: (i) Control others i.e. taking an active role in initiating interaction for example raising a hand to a truck driver to demand a honk in return. (j) Obey interaction rules for visual cues, like the truck driver honks to horn when they see someone raise their hand.

5.3.5 Interacting Verbally

At the fifth level, *interacting verbally*, a face-to-face conversation is started between nearby strangers. There are different actions that can lead to a conversation: (k) Obey interaction rules for a physical context e.g. *Stranger sections* provide a known context for communicating with others in there. (l) Act politely e.g. *Hotter, Hotter* demands players to be uncomfortably close to a stranger, to invade their personal space, thus making conversation a way to alleviate the discomfort. (m) Use tickets-to-talk e.g. *Stories of the World* provides information about the point of departure and destination to be used as topics of conversation. (n) Share a weird moment e.g. *Shadows* tries to spark a conversation through showing something unordinary that connects the strangers to have a discussion about it.

5.3.6 Acting Together

At the last level, *acting together*, nearby strangers would act together also on a physical level. Example actions on this level are: (o) Collaborate for a mutual reward e.g. in *Collective discounts* people would form a group, then perform something together and finally go and eat together. (p) Exchange something tangible for example stickers in form of one's home country. (q) Perform together e.g. Dancing can be seen as a collective performance among people choosing to imitate the shown moves.

We call these levels of interaction, but it does not mean that a higher level would necessarily be better, or that a higher level would include or be preceded by all the lower levels. Some ideas such as *Hotter, Hotter* provide possibilities for interaction on several levels. It is also possible to jump over several levels as in *Dancing,* going from *sensing presence* directly to *acting together*.

5.4 Privacy

Privacy is often seen as an important issue when thinking about interaction between strangers. If and to what extent this is true on different levels of playful interaction between nearby strangers

calls for more research. Here we describe how privacy was taken into account in the produced ideas.

Many of the ideas (e.g., *Dancing, Hotter, Hotter, Honk, Honk*) did not include sharing of any personal information. In *Dancing* the visualization of the dancer is anonymized. Anonymization could serve several purposes. It creates mystery around the tracked dancer *('who might it be?')* But at the same time, anonymization supports the fact that the idea is not about finding out who the dancer is, but dancing together in synchrony. Anonymization also removes the effect of the looks of the individual dancer. In technology-mediated interaction with nearby strangers, being able to interact without revealing exact location was discussed as a way to preserve privacy.

Ambiguous information like in *Hotter, Hotter* does not point immediately to a certain person, except in case of having very few people around. There is a degree of ambiguity to sensing heat. It is not necessarily clear who is the source of it and whether you have reached the peak value. It might even be that the heat is not coming from the system, but felt otherwise. Sensing heat can also be a private secret; it does not reveal you as a player to outsiders. Gradual revealing i.e. revealing more information each time the strangers come nearby each other, was introduced during sensitizing, and later came across in some ideas. Encouraging interaction only between people with matching interests was discussed, but it was not a common topic. *Stories of the World* the one system that shared the most private information was still based on choosing to share.

5.5 Evolution of Playful Interaction

We saw a path of evolution, consisting of three different stages, that playful interaction between nearby strangers could go through while becoming a more widespread phenomenon. Two of the seven highest rated concepts were found at each stage.

5.5.1 Stage 1: Rare Users and Awkward Situations

Before technology-supported interaction between nearby strangers becomes mainstream and natural, it may need to be forced. Technology will help the few users to discover each other and give excuses to approach others. There is definitely a sweet spot to the frequency of encounters with other users. If they are too rare, it does not make sense to play, especially if it requires wearing specific gear. On the other hand, too frequent encounters could take the fun out of it. The concepts *Hotter, Hotter* and *Shadows* relate well to this stage. *Hotter, Hotter* embraces the awkwardness and makes it a central element of play.

5.5.2 Stage 2: Empathy Among Growing Number of Users

When technology that supports interaction between nearby strangers becomes more common, recognizing those to play with is not a problem anymore. The interaction can be lengthier and personal, as in *Changing other's avatar;* or be based on commonly known rules such as in *Honk, Honk*.

5.5.3 Stage 3: Natural and Mainstream

At the last stage technology that supports interaction between nearby strangers becomes natural and common, and it interweaves with our daily practices. *Dancing* and *Stories of the World* represent this stage. Dancing in synchrony with nearby dancers and repeating dance moves shown on a screen are things that happen already today. Revealing your point of departure and destination to nearby strangers in an airport as described in *Stories of the World* may not be an act that everyone is ready to take, but we saw that it as a natural continuation of sharing for public in social media. Airports were also otherwise discussed as good contexts for playful interaction between nearby strangers. People spend a significant amount of time there with interesting people around, but the intention is necessarily not to take the interactions to a very deep level.

6. DISCUSSION

By analyzing the 60 resulting ideas of systems that would encourage interaction between nearby strangers, we have identified various roles of the systems, levels of playful interaction and privacy considerations. When designing interactive technology with such social aims, particularly the roles and the levels of interaction are central elements to consider. Furthermore, we presented seven of the 60 ideas to inspire refining them, develop fully new ideas, or implementing interactive prototypes of them.

To point out other sources of inspiration, Lundgren et al. defined a design and analysis framework for collocated mobile experiences [22]. While their focus is not on nearby strangers nor on playfulness, their four perspectives (*social*, *temporal*, *spatial* and *technology*) and the different properties related to these nevertheless enrich the conceptualization of the design space. Our theorization focuses particularly on the roles of technology and levels of interaction, which previous work has not covered this extensively and in this context.

In his thesis Designing for Social Interaction [21] Ludvigsen defines four levels of interaction, *distributed attention*, *shared focus*, *dialogue* and *collective action*, where the context of interaction is co-presence in interactive spaces. We defined nearby strangers more loosely as people close enough to reach each other easily. Unlike in Ludvigsen's case, our strangers could have a wall between them or just pass each other on the streets. His first level, "distributed attention, being in the same space, somehow aware of the others there" is more passive than our first two levels Affecting automatically and Sensing presence. Affecting automatically creates exchange between people even though they might not notice it and Sensing presence is about making some of the strangers stand out from the rest of the grey mass. Shared focus, directing attention to a same thing, is likely present in some of our ideas as well like in *Shadows* and *Dancing*, which are based on projection in space. As the idea descriptions did not focus on it, but rather on the next level where people were already interacting, it was left unnoticed. For his next level Dialogue, he uses also another term, co-exchange, which could then expand Dialogue to cover also our more detailed levels of interacting through technology, with gestures and verbally. The highest level collective action is similar to our acting together.

Mayer et al. have looked at making social matching on mobile devices context aware from a more theoretical perspective [23]. They found out that the context matters in whether matching is relevant in the first place. Contextually rare or odd qualities may be a more relevant reason for matching than just matching based on similar interest. It is unclear what kind of role a social match has in lightweight playful interactions between nearby strangers. People anyway play online games with strangers and in our approach there is no such strong intention to take it to a personal level as with social matching. Suitable contexts to encourage play between nearby strangers need to be considered, but they are most likely different from suitable contexts for introducing a nearby social match. Contextual rarity may be one relevant signal in playful interaction as well.

Some of the previous research on justifying interaction does not look too promising. Learning about common interests i.e.

receiving tickets-to-talk was found to have its limitations in resulting in face-to-face interaction [9]. And, as the research on the shape-changing bench shows [12], the surprise of that kind of an intervention may easily spark conversation, but the challenge is to make it somehow meaningful and not just stay on the level of mutually acknowledging that something weird just happened. But what would happen, if some interesting rules and rewards were combined with providing tickets-to-talk? Or what would the verdict be if the aim of the shape-changing bench was only to make people exchange smiles with each other? More research is needed to understand the meaningfulness of interacting on different levels, as well as to understand what kind of combinations of roles successful systems should have.

One relevant question is whether we really need interactive technology to encourage interaction between nearby strangers. All of the roles for a system encouraging interaction except *prepare for encounter* and *connect* can be implemented without technology, and the system does not have to perform all roles, so the answer is *probably not*. However, technology can be built to support the process all the way from supporting automatic exchanges between nearby strangers to getting people who share the interest to play with strangers together to interact on different levels. Technology can announce and enforce rules that lower the threshold to interact by defining what is expected from people and how they are supposed to behave during encounters.

Regarding methodology, we argue that the choice of method and participants was particularly fruitful to outline the design space in a human-centric way. The process resulted in a good number of desirable futures (even *utopian*) that could serve as design targets, and these allowed detailed bottom-up analysis to theorize the area. One concern of ours was that the applications used to sensitize participants to the topic might affect the ideation to a great extent. On the contrary, the resulted ideas presented a wider range of design possibilities in every sense. Another concern was related to researchers taking part in the design process in every session instead of taking a role of an objective observer. We felt that, instead, it allowed us to build on top of what was discussed in earlier workshops, and that our role consisted of facilitating and moderating the ideation session. In such a role it was possible to give room for our partners to speak and ideate rather than us or specific other participants dominating the discussion. Overall, based on the amount and variety of ideas we argue that using dialogue-labs as a method and design researchers and students as participants was a good choice for exploring a design space that the participants have experience of. Nevertheless, as the ideas tended to be described only partially, we could have arranged additional sessions to expand and elaborate the most promising ones or merge some of them.

7. CONCLUSIONS

We reported the co-design of playful interactions between nearby strangers. Our three design workshops produced 60 ideas. The analysis of the ideas revealed different levels on which the interaction can happen, different roles for systems encouraging interaction between nearby strangers, and different ways of handling privacy in this setting. This knowledge can be used for designing new service concepts for interaction between nearby strangers. Our work explored the research field of nearby strangers in a new way theorizing it and pointing out to relevant future research questions.

8. ACKNOWLEDGMENTS

We thank our co-design workshop participants from SDU Design as well as Merja Ryöppy and Salu Ylirisku for their help in organizing the workshops. The research was partly funded by Academy of Finland (grants 283110 and 295895).

9. REFERENCES

[1] Abouzied, A. and Chen, J. 2014. CommonTies: a context-aware nudge towards social interaction. In *Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing* (CSCW Companion '14). ACM, 1-4. http://dx.doi.org/10.1145/2556420.2556783

[2] Balestrini, M., Marshall, P., Cornejo, R., Tentori, M., Bird, J. and Rogers, Y. 2016. Jokebox: Coordinating Shared Encounters in Public Spaces. In Proceedings of CSCW '16. ACM, 38-49.

[3] Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., Benford, S., Capra, M. and Hampshire, A. 2006. Interweaving mobile games with everyday life. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '06). ACM, 417-426. http://doi.acm.org/10.1145/1124772.1124835

[4] Briceño, V. 2014. The Sound of One 3DS Clapping: User Commodification in StreetPass. In Proceedings of DiGRA 2014.

[5] Eagle, N. and Pentland, A. 2005. Social Serendipity: Mobilizing Social Software. IEEE Pervasive Computing, v.4 n.2, p.28-34, April 2005.

[6] Goffman, E. Behavior in Public Places. Free Press, New York, USA, 1963.

[7] Heinemann, T. and Mitchell, R. 2014. Breaching barriers to collaboration in public spaces. In *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction* (TEI '14). ACM, 213-220. http://dx.doi.org/10.1145/2540930.2540951

[8] Ito, M., Okabe, D., and Anderson, K. 2009. Portable objects in three global cities: The personalization of urban places. The reconstruction of space and time: mobile communication practices, 67-87.

[9] Jarusriboonchai, P., Olsson, T., Ojala, J. and Väänänen-Vainio-Mattila, K. 2014. Opportunities and challenges of mobile applications as "tickets-to-talk": a scenario-based user study. In *Proceedings of the 13th International Conference on Mobile and Ubiquitous Multimedia* (MUM '14). ACM, 89-97. http://dx.doi.org/10.1145/2677972.2677993

[10] Jarusriboonchai, P., Olsson, T., Prabhu, V. and Väänänen-Vainio-Mattila, K. 2015. CueSense: A Wearable Proximity-Aware Display Enhancing Encounters. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (CHI EA '15). ACM, 2127-2132. http://dx.doi.org/10.1145/2702613.2732833

[11] Jung, Y., Blom, J. and Persson, P. 2006. Scent field trial: understanding emerging social interaction. In *Proceedings of the 8th conference on Human-computer interaction with mobile devices and services* (MobileHCI '06). ACM, 69-76. http://doi.acm.org/10.1145/1152215.1152230

[12] Kinch, S., Grönvall, E., Graves Petersen, M. and Kirkegaard Rasmussen, M. 2014. Encounters on a shape-changing bench: exploring atmospheres and social behaviour in situ. In *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction* (TEI '14). ACM, 233-240. http://dx.doi.org/10.1145/2540930.2540947

[13] Kultima, A., Niemelä, J., Paavilainen, J. and Saarenpää, H. 2008. Designing game idea generation games. In *Proceedings of the 2008 Conference on Future Play: Research, Play, Share* (Future Play '08). ACM, 137-144. http://dx.doi.org/10.1145/1496984.1497007

[14] Kultima, A. 2011. "A Modular Ideation Game – The Concept of IDECARDS" in Kultima, A. & Alha, K. (Eds.) Changing Faces of Game Innovation. GaIn and GIIP Research Project Report. TRIM Research Reports 4. University of Tampere.

[15] Licoppe, C. and Inada, Y. 2012. 'Timid encounters': a case study in the use of proximity-based mobile technologies. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'12). ACM, 2759-2768. http://doi.acm.org/10.1145/2207676.2208675

[16] Lucero, A., Vaajakallio, K. and Dalsgaard, P. 2012. The dialogue-labs method: process, space and materials as structuring elements to spark dialogue in co-design events. CoDesign, 8(1), 1–23. http://dx.doi.org/10.1080/15710882.2011.609888

[17] Lucero, A. 2012. Framing, aligning, paradoxing, abstracting, and directing: how design mood boards work. In *Proceedings of the Designing Interactive Systems Conference* (DIS '12). ACM, 438-447. http://doi.acm.org/10.1145/2317956.2318021

[18] Lucero, A. and Arrasvuori, J. 2013. The PLEX Cards and its techniques as sources of inspiration when designing for playfulness. *IJART 6*(1), 22-43. http://dx.doi.org/10.1504/IJART.2013.050688

[19] Lucero, A., Karapanos, E., Arrasvuori, J. and Korhonen, H. 2014. Playful or Gameful?: creating delightful user experiences. *interactions 21*, 3 (May 2014), 34-39. http://dx.doi.org/10.1145/2590973

[20] Lucero, A., Dalsgaard, P., Halskov, K. and Buur, J. 2016. Designing with Cards. *Collaboration in Creative Design*. Springer, 75-95. http://dx.doi.org/10.1007/978-3-319-29155-0_5

[21] Ludvigsen, M. 2006. Designing for social interaction. Department of Design. Aarhus School of Architecture.

[22] Lundgren, S., Fischer, J. E., Reeves, S. and Torgersson, O. 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://dx.doi.org/10.1145/2675133.2675171

[23] Mayer, J. M., Hiltz, S. R. and Jones, Q. 2015. Making Social Matching Context-Aware: Design Concepts and Open Challenges. In Proceedings of CHI '15. ACM, 545-554.

[24] McCarthy, J. F., McDonald, D. W., Soroczak, S., Nguyen, D. H. and Rashid, A. M. 2004. Augmenting the social space of an academic conference. In Proceedings of CSCW '04. ACM, 39-48.

[25] Paulos, E. and Goodman, E. 2004. The familiar stranger: anxiety, comfort, and play in public places. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '04). ACM, 223-230. http://doi.acm.org/10.1145/985692.985721

[26] Peitz, J., Saarenpää, H. and Björk, S. 2007. Insectopia: exploring pervasive games through technology already pervasively available. In *Proceedings of the international conference on Advances in computer entertainment technology* (ACE '07). ACM, 107-114. http://doi.acm.org/10.1145/1255047.1255069

[27] Persson, P., Blom, J. and Jung, Y. 2005. DigiDress: a field trial of an expressive social proximity application. In *Proceedings of the 7th international conference on Ubiquitous Computing* (UbiComp'05). Springer-Verlag, 195-212. http://dx.doi.org/10.1007/11551201_12

[28] Pfeiffer, M., Dünte, T., Schneegass, S., Alt, F. and Rohs, M. 2015. Cruise Control for Pedestrians: Controlling Walking Direction using Electrical Muscle Stimulation. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (CHI '15). ACM, 2505-2514. http://dx.doi.org/10.1145/2702123.2702190

[29] Seeburger, J., Foth, M. and Tjondronegoro, D. 2012. The sound of music: sharing song selections between collocated strangers in public urban places. In *Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia* (MUM '12). ACM. http://dx.doi.org/10.1145/2406367.2406409

[30] Szentgyorgyi, C., Terry, M. and Lank, E. 2008. Renegade gaming: practices surrounding social use of the Nintendo DS handheld gaming system. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '08). ACM, 1463-1472. http://doi.acm.org/10.1145/1357054.1357283

[31] Väänänen-Vainio-Mattila, K., Saarinen, P., Wäljas, M., Hännikäinen, M., Orsila, H. and Kiukkonen, N. 2010. User experience of social ad hoc networking: findings from a large-scale field trial of TWIN. In *Proceedings of the 9th International Conference on Mobile and Ubiquitous Multimedia* (MUM '10). http://doi.acm.org/10.1145/1899475.1899485

[32] Yoon, J., Oishi, J., Nawyn, J., Kobayashi, K. and Gupta, N. 2004. FishPong: encouraging human-to-human interaction in informal social environments. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work* (CSCW '04). ACM, 374-377. http://dx.doi.org/10.1145/1031607.1031669

PUBLICATION 6

Understanding collocated social interaction between Pokémon GO players

Susanna Paasovaara, Pradthana Jarusriboonchai, and Thomas Olsson

Proceedings of the 16th International Conference on Mobile and Ubiquitous Multimedia (MUM '17). ACM, New York, NY, USA, 151-163

Understanding Collocated Social Interaction Between Pokémon GO Players

Susanna Paasovaara [1], Pradthana Jarusriboonchai [1, 2], Thomas Olsson [1, 3]
[1] Tampere University of Technology, Tampere, Finland
[2] Open Lab, Newcastle University Newcastle, UK [3] University of Tampere, Tampere, Finland
susanna.paasovaara@tut.fi, Ting.jarusriboonchai@ncl.ac.uk, Thomas.Olsson@staff.uta.fi

ABSTRACT
Pokémon GO, a location-based mobile game with millions of users, offers an opportunity to study how mobile technology can encourage collocated social interaction between people. Despite being predominantly a single-player game, Pokémon GO has been discussed to induce a variety of social interactions between the players. We conducted a qualitative online survey to gain insight on collocated interactions and encounters that take place around the game, and to understand how they relate to the game design. Our analysis shows that the game design promotes encounters between players, the idle time during the game allows various forms of social interaction to take place, and further, the players gain various benefits from exchanging information with each other. Based on the findings, we present design implications for the design of mobile applications or games aiming to encourage collocated social interaction.

Author Keywords
Pokémon; Pokémon GO; location-based game; face-to-face interaction; collocated interaction; social interaction; game design.

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

INTRODUCTION

A body of research has explored how to design mobile technology that would encourage interaction between collocated people (e.g., [11,28]). One criterion for such systems to successfully influence social interaction is a critical mass of active users [4]. A large number of users means more possibilities for users to encounter each other and engage in social interaction. However, reaching a critical mass has been a challenge in designing and evaluating this kind of social systems [2]. Consequently, many of the systems remain as prototypes or concept designs (e.g., [28]) and evaluations of such systems have mostly been conducted in small-scale settings and with a small number of users (e.g., [11,18]). This withholds the possibilities to study the full potential and effects that such systems can have regarding collocated social interaction. *Pokémon GO,* a commercial location-based mobile game launched in July 2016, has yielded the opportunity to break through this challenge.

Pokémon GO is a game based on collecting digital creatures and most of the features seem mainly to support single-player gaming: playing the game mostly benefits the player him/herself [36]. Interestingly, the hype around *Pokémon GO* suggests that it not only promotes physical activity [1], but may also have qualities that encourage social interaction between both acquaintances and strangers [40,41]. Some players have claimed that the game has had a positive effect on their mental health and has helped them to make new friends [42].

With a community of millions of active players around the world, Pokémon GO provides a rich platform for research. The popularity of Pokémon GO has already resulted in several veins of research. Paavilainen et al [31] explored the overall positive and negative game experiences of Finnish Pokémon GO players. Their findings show that the positive experiences related among other thing to the sociability and the negative experiences to the bad behavior of players and non-players. Colley et al. [13] used the success of the game to study the geographic effects of location-based gaming at a large scale around two themes, places and movement. Also, their finding of Pokémon GO being associated with group movement rather than individual movement supports the need to understand the players' collocated social interaction in greater detail. Differently from these prior works, our research focuses on the social aspects of Pokémon GO looking how and why it has created social interaction between collocated people.

The contributions of the paper are two-fold. First, as an empirical contribution, we report Pokémon Go players' experiences about collocated social interactions and encounters with other players. This is a novel perspective in terms of research about this particular game, and a unique opportunity for studying collocated social interactions that emerge around a popular application. Second, as a theoretical contribution, we devise design implications for other mobile

applications or games that are aimed to encourage collocated social interaction.

POKÉMON GO

Pokémon GO continues the long line of *Pokémon* games and other media like TV series and movies. Throughout the series of games, the player's general goal has been to collect and train Pokémon, and to use them to fight with other players or non-player characters.

The location-based features in Pokémon GO, like *spawning of Pokémon* in different locations, *PokéStops*, and *Pokémon Gyms*, are intended to motivate players to get out and explore their neighborhoods as well as places they have never visited before [43]. Players' visibility in the game world is limited to their surroundings. The game interface shows the existence of Pokémon somewhere nearby, but the player needs to be close to their spawning points for Pokémon to appear and to catch them. In addition to catching wild Pokémon, it is possible to get Pokémon by acquiring their eggs from PokéStops. Players then must walk certain distances in the real world to hatch the eggs. PokéStops and Pokémon Gyms are usually associated with places of interest or cultural significance, and players can only interact with these features by being physically close to their location.

Overall, the game design can be argued to focus on single-player experience around collecting digital creatures. The only form of in-game interaction between players happens within battles at Pokémon Gyms, where one or more players can concurrently attack the defending Pokémon at the Gym. During a battle, the defending Pokémon is controlled by the game system, not the owner of the Pokémon in real time. Players' profiles are not accessible to other players in any other way except by visiting Gyms, which is still rather limited. Pokémon Gyms show the usernames and the trainer levels of players who are controlling the Gym, and the Pokémon they left behind to defend the Gyms. Players have access to Pokémon Gyms after they have reached level 5 and joined one of the three global teams. Pokémon Gyms are the only places where the players' team memberships have an effect in the game. If a player enters a Gym that is already controlled by player(s) from the same team, instead of fighting to gain a control over the gym, the player can *train* the gym to strengthen its defense [43].

At a PokéStop, players can acquire free items they need in the game (e.g., Poké Balls, Berries). Furthermore, players can use an item called *Lure Module* to increase the frequency of Pokémon spawning around a PokéStop for 30 minutes. Lure Module benefits the player who activates the Module as well as other players who are close to the PokéStop.

RELATED WORK

To outline previous research related to this intersection between several research areas, we first discuss various approaches for designing information technology to encourage collocated social interaction and then give an overview of earlier location-based and pervasive games. Throughout the section, we analyze how Pokémon GO relates to the given examples, definitions, and theories.

Technology Encouraging Collocated Interaction

Research related to information technology for encouraging interaction between collocated people has taken many forms, and various system prototypes have been proposed for different contexts. One approach for encouraging collocated interaction is to provide users with potential information that serves as topics for conversations (e.g., mutual interests or background). Many of such systems reveal information about the users to trigger a conversation (e.g., via a mobile application [21,22] or stationary proactive displays [25]). In contrast, the user interface of Pokémon GO does not reveal collocated players, let alone reveal personal information about them. Gym battles are an exception. Concurrent attackers can see others attacking Pokémon.

Another common design approach is providing a technology-mediated communication channel for people nearby to connect with each other. For example, Capital music provides a way for sharing music choices with nearby strangers and a channel to comment about the music [32]. Interestingly, Pokémon GO does not provide any in-game communication channel between the players.

Designing technology that requires more than one user to perform an action is another common design approach. Such designs encourage or even force users to interact with each other to achieve their goals [7]. For example, Jokebox requires two people to synchronously operate a pair of interfaces of an interactive installation in a public place in order to hear a joke as a reward [3]. Pokémon GO does not *require* players to co-operate. However, it provides open opportunities for *voluntary* co-operation. The present study will further analyze what kinds of voluntary interactions emerge around these opportunities.

Furthermore, mobile games have introduced elements to motivate and encourage players to interact with other collocated players. For example, a possibility to exchange digital resources can motivate players to seek for company, driven by the need to progress in the game (e.g., [24]). Pokémon GO does not include a possibility to exchange collected items or Pokémon between players. The items remain only in players' personal collections.

Based on this overview, Pokémon GO can be seen to be fundamentally different from many of the previous solutions that intend to encourage collocated interaction. As the game clearly does not follow these general design approaches, this raises the following questions for investigation:

- *Why do face-to-face social interactions take place between players?*
- *What elements in the game design encourage collocated social interaction between players?*

Location-Based Games

Earlier research has looked into the social aspects of games by, for example, theorizing sociability and social play in games [36], introducing games to encourage social interaction in a stationary setting [39], using mobile devices for a collective activity [19], and in the form of location-based games [8,10]. Location-based games associate players' location and physical environments as part of the games [8]. In location-based games, the boundaries of games extend beyond digital in-game activities, to include real locations and real physical activities, which also allows social playing to take place [26]. Most of such games are multi-player games or intentionally designed to enable or encourage interaction between the players (e.g., [8,10]). Some games are designed to extend the player experience of classic computer games with location-based features (e.g., [18]). Other games are designed to enhance the user experience of an activity with location-based features (e.g., [44]).

Some of the social location-based games are played in limited spaces with limited numbers of players. For example, Pirates! is an early location-based game designed to encourage social interaction between players [10]. If players are close enough to a certain location in the game environment, they can interact with game elements placed at the location. Similarly, as players enter certain proximity between each other, the game enables a battle option where players can choose to fight with each other. Savannah is another location-based game, but played in open outdoor space [8]. Players should explore the physical space as lions. Attacking other animals is an action where several players should collaborate. Only one attack can take place at a given locale and only the players within the same locale can participate in the attack. Similar to Pirates!, Savannah was played at organized game sessions, but design of Savannah focuses more on the collaboration between players.

Location-based games are not only about organizing game sessions in limited space, for limited time, and with certain players. Some games extend beyond these boundaries, embracing characteristics of pervasive gaming. That is, games that can be played anytime, anywhere and players possibly affect and are affected by non-players [26]. For example, Feeding Yoshi is a mobile multi-player location-based game that interweaves the game into players' everyday life. Differently from Pirates! and Savannah that require players to be engaged to the games at all time, Feeding Yoshi allows *intermittent engagement* as players go through their daily routines [5]. Players score points to their teams when they feed Yoshis, the creatures in the game, with digital fruits that can be found around the city. Unlike the abovementioned examples of location-based games, but similar to Pokémon GO, Feeding Yoshi is played over a longer period of time. Playing behavior as well as social interaction around the game are constrained by players' daily routines, which vary from one player to another [5].

Massive Location-Based Games

Several location-based games have been published as commercial products. BotFighter was the first commercial location-based game with a significant number of users [9]. Players gained points by destroying other players' robots. To do so, one had to be close enough to an opponent to attack. Players could run away from the attack by physically moving away from the area [9,35]. Players could interact with each other by sending SMSs through the game as well as via an online forum. A study reports that some players formed a group to fight with a legendary player [9]. However, the requirement for players to be within physical vicinity of each other seemed to limit the playability of the game. Even with more than ten thousand active players, the game faced a problem of not having high enough density of players to always find an opponent to play the game.

Geocaching is another popular and commercial location-based game that has had an active player community for over a decade [45]. Geocachers are provided with geographical location and other possible cues about a *geocache* and should find it in the given area. The game has never entitled itself to be either single-player or multi-player game. However, a study indicates that Geocaching creates an opportunity and motivation for geocachers as well as their friends and family to participate in shared activities of walking together, exploring places, and finding caches together [30]. Geocaching furthermore supports interaction between stranger geocachers, both in the real world and online. Interaction takes place in cache logs, in coincidental encounters at the geocache locations, and with TravelBugs that the Geocachers collaboratively move around the world. Both Geocaching and Pokémon follow the ethos of collecting and aim for personal achievement. Geocaching is a scavenger hunt with physical caches. Pokémon GO, on the other hand, implements finding and collecting virtual items.

Ingress is a more recent mobile augmented reality and location-based multiplayer game, which has a massive number of players. Players belong to one of the two opposing global teams. According to the concept of the game, each team should take control over as large areas as possible on the world map. To do so, players should claim portals by being physically close to those portals [46,47]. The game rules and mechanics require collaboration within team to successfully claim portals, create links, and control fields. This collaboration does not require players to be present at the same place at the same time. However, a strong player community has emerged around the game, and the players for example arrange meetups for playing the game together [48]. There are similarities in the designs of Pokémon GO and Ingress. Ingress portal data was used when creating PokéStops and Gyms. In both games, players belong to global teams.

This study explores how the similarities and differences in the aforementioned game designs affect particularly collocated interactions between players.

METHODOLOGY

We studied social interaction emerging around Pokémon GO with two methods: (1) first-hand experiences and (2) qualitative and explorative online survey. First-hand experiences have been previously suggested as a method to study pervasive games [37]. It provided us with a detailed understanding of how the game works and gave us inputs when designing the online survey questions, and interpret the results. Similar approach, first-hand experience in combination with online survey, has been previously used to understand the practices of Geocaching [29].

First-Hand Experiences

Two of the authors had been playing Pokémon GO since the launch in United States and Europe in early July 2016. At the time of the study, the first author had reached level 22 and had caught 88 different Pokémon, while the second author had reached level 14 and had caught 60 different Pokémon.

The game was played for tens of hours of playing in different social settings: playing alone, playing together with a partner, colleagues, a group of friends, family members as well as with stranger players. The game was played partly in sessions dedicated just for playing and partly as interwoven with daily activities. We experienced a variety of spontaneous interactions both between players and players and non-players around the game. For example, stranger players hung around and had a conversation with us while we were sitting around a PokéStop with an activated Lure Module. A group of stranger players ran after us chasing the same Pokémon. A player asked us about a rare Pokémon in the area. Neighbors who do not play the game asked us about the game while we were heading out to catch Pokémon.

The first-hand experiences provided us with familiarity with the game elements, an understanding of what matters in the game experience, and an outlook to the social interactions around the game. These helped us to formulate relevant questions for the online survey, mainly to determine social interaction other players may have encountered while playing the game and reasons behind the interactions, and their experience with the interactions.

Online Survey

The aim of the survey was to understand the players' subjective experience of the collocated social interactions that result from playing Pokémon GO. The survey consisted of 68 questions where 46/68 were multiple-choice questions related to respondents' playing practices, 13/68 were open questions about playing practices, reasons behind those, and players' social experiences; and 9/68 surveyed the respondents' background information. The questions covered themes about general playing behavior, playing behaviors within specific features of the game, and social experience related to Pokémon GO. Examples of the open questions include: "Why do you play Pokémon GO?", "Please share with us one or more of your positive experiences with Pokémon GO"; "Please share with use one or more of your negative experience with Pokémon GO". If respondents had experienced interactions with other players, they were also asked with follow-up questions like "Why did you initiate conversation or discussion with stranger players?" The questions were in English but we allowed answering the open questions also in a few other languages (Finnish, Thai, and Swedish) to increase the odds to receive answers that are more detailed.

We piloted the survey with six active Pokémon GO players and revised the survey based on their feedback. The final survey link was posted to two Pokémon GO Forums (r/ThesilphRoad and r/pokemongo) in Reddit (www.reddit.com) and national Pokémon GO Facebook groups of Finland and Thailand. In addition, the survey was distributed through snowball sampling technique: the link to the survey was posted publicly on Facebook and Twitter, where it was shared and retweeted to people's network of friends and followers. The survey was open for answering for two weeks starting from August 25th, 2016.

Respondents

We had in total 170 respondents. We excluded the data from four respondents whose player level was less than 5. This decision is justified as some features (team and fighting at a Gym) are available only after players have reached level 5. Our analysis covers remaining 166 respondents (52 females, 114 males). Our sample contains several nationalities. The majority of the respondents were from Finland (68), Thailand (47) and USA (26), along with smaller numbers of respondents from UK, Taiwan, Germany, Belgium, Canada, Switzerland, Italy, Slovenia, Sweden, and Denmark. The respondents' median age was 26 years.

The median player level of our respondents was 20. Even though reaching such level in a short time frame requires active playing, most of the respondents considered themselves as casual players (71/166) or somewhere between casual players and hardcore players (70/166). Only 20 respondents considered themselves as hardcore players. Half of the respondents (86/166) reported to belong to Pokémon GO online communities, which is likely to reflect our recruitment strategy of using online communities for advertisement of the survey.

Data Analysis

The analysis of the qualitative data from open questions was performed by using open coding and inductive reasoning. We started by labeling each answer with one or several themes that emerge from data, without any specific theoretical framework in mind. After going through all the answers to selected open questions, this produced a data-driven and bottom-up hierarchy of themes. Two researchers labeled the data independent of each other. The identified themes were then discussed to form a common understanding of the findings as well as commonly agreed categories, and the numbers of answers in each category were quantified across the respondents. For the quantitative data, we report the frequency of answers for selected questions to support qualitative data.

FINDINGS

Overall, the findings imply that the game has had various influences on the players' social practices with others. Respondents reported, for example, to talk more with their family and friends, to go out more often together, to meet with strangers and to make new friends as results of playing the game. Respondents had experienced that the game has also made interaction with strangers easier and more acceptable.

> *"I go out to parks more often, I talk more with my dad because we play together at time. Get to exercise and meet with friends more often" – (Female, 24 years old, Thailand, Level 20).*

> *"People rarely talk to strangers in England and Pokémon GO has helped break down some of those barriers since we all are having fun with the game" - (F, 35, UK, Level 26).*

At the same time, negative experiences were also identified. These occurred for example when some players took advantage of other players' efforts at Gyms, which respondents consider as ill behavior. This reported behavior, called *Gym Sniping*, has been prevented after one of the game updates introduced after our survey was conducted.

> *"[My negative social experience with Pokémon GO was when] some strangers kept sniping a Gym I took down by myself more than once" - (Male, 30, USA, Level 27).*

The following sections report findings in detail. The findings are structured based on themes that emerged across the data. This starts with reasons to play and goals of playing the game, then moves on to analyzing the social experiences of playing the game and social interactions that have emerged between players. All interactions between players reported here refer to interaction between players when they are co-located.

Reasons to Play

We queried the respondents' reasons to play Pokémon GO with an open-ended question. 36% of the respondents reported that they started playing Pokémon GO because they have been involved with Pokémon already before, for example through playing the earlier Pokémon games or having watched Pokémon TV series. Some noted that the game gives them an impression of exploring the real world to catch Pokémon, which was a longtime dream come true to them.

> *"I dreamed of being Pokémon trainer since I was a little kid! Now I can meet cool people and find Pokémon and have fun while also getting exercise!" (F, 24, Finland, Level 30).*

7% of the respondents reported to play the game because their friends and family members are playing. The rest of the respondents were randomly motivated by, for example, the game being trendy, like playing games in general, or being curious about this new location-based game.

60% of the respondents explicitly mentioned catching Pokémon as their goal with the game. A more ambitious goal of completing the collection of all existing Pokémon was mentioned by 50% of the respondents. 18% of the respondents stated that they did not have any particular goal in playing the game; they just did it for fun and entertainment. Others used the game as a medium to motivate themselves to do other activities like walking, exercising, or going outdoors. Despite this, the following analysis indicates that the social interaction with other players comprise a remarkable part of the game experience.

Playing Together vs. Playing Alone

Most respondents (54%) stated in a multi-choice question that they play the game by themselves more than with their friends or families, with two respondents explicitly stating that they only play the game alone. A quarter of all respondents stated to play with others more than alone, and another quarter reported to play alone and with others equally.

Playing Together

Those respondents who play the game with their friends and family indicated that it was more entertaining to play together. Respondents consider having companies to play the game together provide additional positive experience to the game. Playing the game together was even considered as quality time with family or friends. Furthermore, the game was reported to bridge across generations, engendering uncommon joint activities.

> *"It's fun and while playing, we can have good time together with my boyfriend outside. Also, we have nice conversations with my friends and I interact with them more" - (F, 31, Finland, Level 16).*

> *"Driving around with my wife, my mom, and my mother-in-law trying to visit Stops and catch new Pokémon. We don't do much the four of us as a group" - (M, 32, USA, Level 24).*

Respondents mentioned to play the game alongside their conventional group activities. Some respondents accustom their activities to take advantage of a game element, for example, organizing an activity around a PokéStop or arranging a family walk to hatch Pokémon Eggs. In other cases, playing the game is considered as the main activity, and another activity is organized in parallel.

> *"It was fun hunting Pokémon GO with friends at the same time as we were on our way to nightlife" - (F, 22 Finland, Level 12); "I am training for a [running] race with my friends anyway, so we hatch our eggs while we are running" - (F, 38, USA, Level 22).*

> *"We went to a trip to an island to play the game. We wouldn't have spent time together without the game. We had a nice day playing the game and having a picnic" - (F, 27, Finland, Level 22).*

Playing the game among stranger players was furthermore reported to yield positive experiences of belonging to a community. Pokémon GO players can easily identify other players from their gestures and movements without having to talk to them. Also, being surrounded by other players was reported to create a positive game experience.

"I have never interacted with strangers while playing. Although when I go to a park and see people of their phone, I can tell if they are playing. In a sense, this creates a sort of community even if I am not talking to others" - (F, 26, Finland, Level 16).

"I think talking with strangers at a park is a really good thing. It is a really good atmosphere. Catching rare Pokémon together with many players is very exciting for me" - (F, 26 Thailand, Level 18).

The respondents also reported some negative experiences. While the easy identification of players based on their behavior has increased the feeling of community, it has also made the players an easy target for outsiders to make negative remarks. Furthermore, the game demands attention and interactions with the mobile phone when catching Pokémon. While the game is often played along other activities, sometimes a player might prioritize the game over the other activities and pay less attention to the surrounding people. This can cause feelings of players neglecting their company.

"My boyfriend is cranky because he would like to walk together in a romantic way holding hands. I on the other hand want to keep my hands free so that I can catch Pokémon." (F, 26, Finland, Level 19).

Reasons for Playing Alone

Overall, the respondents of this survey play the game alone more than with others (54%). There are several reasons behind this. One reason is that, as 26% reported, the players integrate their playing with other activities that they mostly do alone. Another reason is that playing together requires organizing mutual free time and players' schedules may not match with each other. Some respondents consider playing alone as a normal way to play the game and playing together as something extra. Furthermore, the game sometimes requires instant action, which others might not want to join. Some players are driven by competitiveness and being better than their friends. Playing alone was seen as a way to become better than others.

"I play while commute or during lunch. It fills time when going from point A to point B" – (M, 36, USA, Level 20).

"I play alone sometimes if there is something nearby that I can run out and catch quickly but no one is interested in coming with me" - (M, 32, USA, Level 25).

"I also play alone while commuting and other routines, possibly to get something that my friends do not have" - (F, 25, Finland, Level 22).

7% of all respondents (12 individuals) explicitly indicated that they prefer playing alone. Seven of these twelve stated that they are introverts and just enjoy their time alone. The rest (5/12) stated that playing alone is easier to do and provides more freedom.

"I usually play alone. It is easier to play whenever I want and I don't need to motivate others to join me. I also feel like I am free to choose destinations and how fast or slow I walk" - (F, 30, Finland, Level 14).

Nevertheless, playing alone does not mean no interaction with anybody. 56% of those who reported to play the game alone more than with others had experienced some forms of interactions with stranger players during their time alone. Furthermore, even though they played the game alone, they at some point had had conversations related to the game with their family and friends.

Social Interactions Between Players

The previous section outlined the social context of playing Pokémon Go. The survey shows that some respondents play the game with others, while others usually start out alone and sometimes end up interacting with stranger players along the way. This section reports three major patterns of interaction that seem to have emerged between players around the game: information sharing, collaboration; and bonds and competition between teams.

Sharing information between players

As catching Pokémon is one of the mutual goals of Pokémon GO players, discussing and sharing information about where to find Pokémon was reported as the most common reason to interact with other players. 66% of the respondents reported to have interacted with acquainted players to find Pokémon, and 42% have done the same with strangers (Figure 1). Respondents considered sharing information with other players as a way for them to advance in the game. The shared information related to places where Pokémon had spawned nearby, potential places to get rare Pokémon in the area, or which Pokémon the other players were particularly looking for. Furthermore, sharing information with other players was reported to generate positive feelings and enrich the game experience.

"It's more fun to play and tell each other when we have found something" - (F, 35, UK, Level 26).

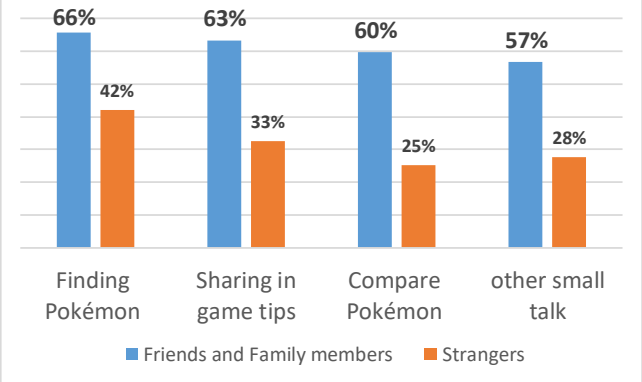

Figure 1. Reasons to interact with other players. The results are based on two multiple choice, multiple-answer questions asking respondents to identify reasons behind their interaction with other players.

Sharing game related tips was reported as the second most common reason to interact with other players. 63% of the respondents reported to have exchanged tips with their acquainted players, and 33% with strangers. Also, teaching

others has led to uncommon interactions with strangers and acquaintances that normally do not interact with each other.

"I taught a 60+ year old man to play it. First I saw him when he was level 3 and taught him the basics. Next time I saw the same guy 2 weeks later, he was level 10 and had some questions for me, and I showed him how to do curveball!" (F, 24, Finland, Level 30).

"A colleague asked me to teach her some techniques in the game. We had never talked before that" - (F, 28, Thailand, Level 13).

In addition to sharing information about the game, respondents reported to make small talk with other players. Often, these conversations include the player's status in the game in terms of e.g., their trainer level, their collections, their best Pokémon and its qualities, and their team allegiance. Some reported to initiate conversation with other players just to have company and break the awkwardness while being together in the same physical space.

"It would feel awkward to just sit on the same bench around PokéStop and be quiet for the whole time" – (M, 25, Finland, Level 23).

Collaboration between players

Respondents reported variety of collaborations in the game. 41% of the respondents reported to coordinate the use of the Lure Module with acquainted players around *PokéStops*, and 18% had done the same with stranger players (Figure 2). Players in a group of acquaintances are likely to activate the module, so the whole group can benefit from it. Lure Modules were activated also to reciprocally pay back to the community. Respondents also mentioned to intentionally activate a Lure Module to attract other players to enrich the game experience.

"[I activate Lure Module] normally when I play together with friends, and we take turns in activating the Lures" – (F, 27, Finland, Level 22).

Collaboration between players is reported to take place also around *Pokémon Gyms*. The respondents reported to experience coordinating Gym fights with other players, acquaintances (43%), strangers (22%). Respondents who fought at a Gym together with acquainted players indicated that this is a good strategy to take a Gym down more easily. On the other hand, the collaboration changes quite much if the other players are strangers. The respondents reported that their practices at Gyms vary from joining in the fight regardless of other players, waiting for other players to finish, to joining only if others belong to the same team. For example, if another player looked friendly, collaboration was more likely to take place. Furthermore, collaboration in a Gym fight between stranger players was sometimes a part of an encounter or a continuation of other conversation topics such as asking about Pokémon and team in general.

"I met a group of kids, half my age [...] We talked about Pokémon GO for a while and I helped them take a gym and ended up to point them in the direction of an Onix" - (M, 23, Canada, Level 26).

"I met a few strangers who happened to be in the same team, and we sprinted together to retrieve a Gym that was just lost" - (M, 23, Finland, Level 17).

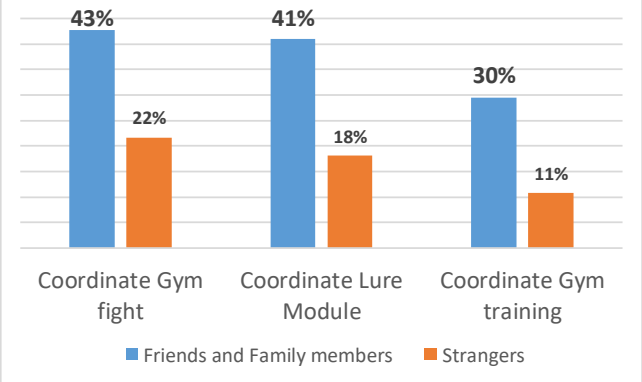

Figure 2. Collaboration with other players. The results are based on two multiple-choice, multiple-answer questions, asking respondents to identify purposes for their collaboration with other players.

Bonds Between Players and Competition Between Teams

Players are asked to join one of the three global teams when reaching level 5. Team allegiance plays a role when fighting at a Gym, but is not otherwise relevant for game play. 43% of the respondent reported that their team choice was affected by their acquainted players' choices of team. However, only 13% stated that the team memberships affect their interactions with acquainted players.

Overall, it seems that competition between teams is not very strong in Pokémon GO. 60% of the respondents reported to fight a Gym to gain rewards from controlling the Gym rather than beating other teams or maintaining team territories. Only 24% of respondents agreed that members of other teams are rivals and they want to beat them. Still, asking about which team a player belongs to was reported as one of the most common questions in a conversation between stranger players. Expressing the team spirit seems to be quite rare and create both negative and positive experiences among players. Only 9% of the respondents reported to have boasted their teams to stranger players in other teams.

"Kids shouted at me near a playground and asked which team I belong to. We happened to be in the same team and they seemed to be really happy about it and smiled and cheered" - (F, 42, Finland, Level 17).

"A lot of players get pretty obnoxious about which team they are in. Even if it's just a joke, it tends to be loud and annoying most of the time" - (M, 29, USA, Level 24).

DISCUSSION

According to categorization of games by Stenros et al. [38], Pokémon GO can be seen as a *massive single player game*. That is, the game is played as a single player game, but it also provides opportunities for interaction between players. The game enables and encourages game mediated interactions between players through *Pokémon Gym*, where players gain advantage in the game from collaborating with each other.

Interestingly, however, the findings indicate that collocated social interaction between players emerges also from other features of the game.

A single player game is conventionally made social by providing, for example, a shared high score list, which is an indirect way for players to interact and compete with others [38]. Players may also interact with other players to share knowledge about how to play a game or techniques to gain advantage in a game [14,38]. Like other popular games, Pokémon GO has its online communities (e.g., [49]), which is a common platform for players to share their knowledge about the game. In addition to these online channels, our findings show that the game has managed to engender a variety of face-to-face interaction between both acquainted and stranger players. Even those who mainly play alone reported to have experiences of interacting with other players. One reason is that Pokémon GO, by its nature, is a location-based game. This encourages people to spend time outdoors and creates a possibility for them to encounter each other while playing. Our findings show that face-to-face encounters with other players lead to sense of belonging to a community, which engenders positive experience for players. While players can simply be collocated and *do not have to interact* with each other, the game design seems to provide various reasons to motivate stranger players to do so.

The following section reflects the design of Pokémon GO with other similar mobile games. This is followed by further discussion of the design qualities of Pokémon GO that could be applied in the design of other mobile applications that aim to encourage collocated interaction.

Pokémon GO, Ingress, and Geocaching

Geocaching and Ingress are other location-based mobile games with massive numbers of active players. This section discusses similarities and differences between Pokémon GO and these two games, highlighting how the games support and engender collocated interaction between players. We, however, do not intended to argue for the best game to motivate and engender collocated interaction. Rather, we point out other opportunities when designing applications for this area.

Ingress players, from the beginning, are given an idea that they are fighting against the opposite team, called faction. Correspondingly, Ingress players are working together towards team goals. The game requires collaboration between players to gain bigger achievements in the game [47]. Karpashevich et al. [23] reported local collaborations between Ingress players, both within a faction and between factions. They observed playing styles and attitudes ranging from casual and friendly to hostile and almost military structures inside local factions. Such collaboration to compete between the teams has less important role in Pokémon GO. Our findings show that the main motivation of Pokémon GO player is to collect Pokémon, that is, to fulfill an *individual goal*. Conquering Gyms for their teams and overall team spirit were found to be less important for the players than the individual reward gained from it. Although Pokémon GO players are not required to work together, our findings show that players do collaborate and interact with each other, however, in a slightly different way and for a different purpose. That is, interactions and collaboration between Pokémon GO players allow them to fulfill their common individual goals more effectively.

Geocaching is argued to motivate outdoor group activities. It is also argued to allow different group members to contribute to the activity differently [30]. For example, someone may just be interested in joining the group for a walk, but not the Geocaching itself. They can still easily blend in to the activity. Furthermore, Geocaching requires only a single device that is relatively often used in the background. This is argued to enable social interaction, as it does not overly immerse people with the use of technology [30]. Pokémon GO, on the other hand, motivates participating in outdoor group activities, but mostly between players, not so much of non-players. One reason might relate to the amount of technology involved in the game activities. In Geocaching, a group can move from one place to their destination without being interrupted by technology. Technology is brought to attention only when the group needs more information related to the game (e.g., navigation, geocache details). In other words, the use of technology in the setting is fully defined by the users. Differently, in Pokémon GO, the moments when players interact with technology are random and defined by the game. Ongoing social interaction within a group can thus be interrupted by, for example, a Pokémon appearing. Furthermore, Geocaching is about searching the physical surroundings, which is something that everybody can join in. In contrast, the interactions with Pokémon GO take place on the screen of a mobile device, making it more difficult for the non-players to take part in playing.

Geocaching may be able to better support broader types of participants as a group activity. Pokémon GO as a group activity is more limited to players only. However, this does not necessarily mean that Geocaching is better in supporting collocated social interaction and an outdoor group activity. The respondents to our survey reported to have had positive social experiences with other players, and considered playing the game with family and friends as entertaining quality time. Pokémon GO can be said to require more attention and engagement from players than Geocaching. However, attention and engagement in Pokémon GO is rather short and intermittent, which provides time for other activities, including social interaction. A similar argument is also addressed in [20], where design implications related to user engagement with technology is discussed.

Design Qualities Encouraging Collocated Social Interactions

Our findings show that Pokémon GO has potential to engender interactions and collaboration between players, in a slightly different way than the other two famous games. Even though the game has only a few in-game features

intentionally designed for collaborative play, players still nevertheless work together. Similar benevolent encounters between strangers have been observed in massive multiplayer online games along with the designed collaborative structures like parties and guilds [27].

By interpreting the findings and analyzing the game elements, we have identified qualities in the design of Pokémon GO that could have driven the reported forms of collocated interaction between players. We summarize the findings as implications for design to exemplify how these qualities could be applied in the future design of mobile application aiming to encourage collocated social interaction between users beyond just location-based games.

Ambiguity, Persistent World and Positive-Sum

Players are only provided with vague information about the nearby Pokémon. Correspondingly, our findings show that exchanging information about the whereabouts of Pokémon is one of the most common reason for players to interact with collocated others. First, the game is ambiguous in terms of which Pokémon will appear, when, and where. Second, players can only access game information about their immediate surroundings. Different players may have taken different paths, which means that they may have different information. When encountering other players, it is possible that they may have more precise information about Pokémon in their current and previous locations, and vice versa. We assume that this *asymmetric information* between the players creates a strong incentive to acquire information from others. Furthermore, sharing information is made possible by the fact that Pokémon GO has a persistent game world: the same Pokémon appear to every player physically close to their spawn locations. Sharing information makes sense as the game is a positive-sum game, which means that one player's gain is not away from others [50]: in Pokémon GO, even if one player catches a Pokémon, the Pokémon can still be caught by other players from the same location.

To summarize, ambiguity encourages interaction and information sharing between players; while persistent world makes it possible for players to share information; and positive-sum makes it sensible to do so. We argue that the combination of these qualities creates a strong incentive for interaction between players around the game.

*Implications for design***:**

- Provide persistent but fragmented or asymmetric information to encourage information sharing or collaboration upon encounters.
- Avoid negative effects of information sharing to promote interaction and collaboration.

Intermittent Engagement and Idle Time

The findings indicate that the game is often played in parallel with other activities and/or in company of others. This is possible because the game only requires sporadic attention from players; when catching Pokémon, acquiring items from PokéStops, or fighting at Gyms. Thus, players have a lot of idle time while waiting for Pokémon to spawn or while walking between PokéStops or Gyms. This intermittent engagement allows playing to be easily integrated in daily activities, with the game being turned on but not requiring constant attention. The idle time opens interaction opportunities between players, including both game-related and non-game-related topics, such as sharing information and tips about the game or just small talks between players as reported in the findings. This is different from more immersive games that require full attention from players; and where the interaction between players during the game is mainly related to the game itself (e.g., [6]).

Implication for design: Do not require users to be too immerse or exhaustively engaged in interaction with the application, but reserve idle time for users to also interact with collocated others.

Simple to Start with Hidden Mechanics

Sharing or gaining game related tips was found to be another common discussion topic between players. The game is simple to start playing but has many hidden mechanics. Pokémon GO provides a simple tutorial that helps players to learn the basics of playing the game, such as catching Pokémon and acquiring items from a PokéStop. However, playing the game in an optimal way to complete Pokémon collection and level up efficiently requires deeper understanding of the underlying game mechanics and learning some tricks (e.g., a technique to increase the success rate in catching Pokémon). The act of reverse engineering the hidden game mechanics, also known as theorycrafting [12], is a known phenomenon from online games. The massive success of Pokémon GO brought together a great diversity with respect to the types of players to the game, including novice and casual gamers as also seen in our sample and findings. While hardcore players usually spend more time with a game and are familiar with searching tips from online forums and communities [15], casual players generally do not spend time learning about the game outside the actual play time [51]. With the current popularity and design that encourages players to gather around physical spaces, Pokémon GO creates a setting where hardcore players and casual players meet while playing the game. Moreover, the above-mentioned idle time provides suitable opportunities for mentoring, i.e. sharing information about the hidden mechanics, to take place.

Implication for design: Knowledge transfer could encourage and motivate interaction between strangers within the same community.

Missing In-Game Social Features

Single-player games often support social interaction between players through shared scoreboards and achievements, allowing players to compare themselves with others [36]. People like to compare themselves to others, so this makes such games more competitive [16]. Our findings show that even without a feature for players to share their statistics inside the game, players still compare their levels and

Pokémon with each other. Missing such in-game social feature seems to encourage players discuss with each other face-to-face, as it is the only way to compare. Furthermore, our findings show that players' profiles and collections serve as opening lines for conversations with stranger players. Similarly, if players wish to discuss possibilities to collaborate in fighting a Gym, they must do it face-to-face, as there is no in-game communication channel. This is where Pokémon GO differs from typical multiplayer games, which provide a communication channel (e.g., Ingress, World of Warcraft).

Implication for design: Restricting the amount technology mediated-interaction can encourage face-to-face interaction.

Gather Players Physically Together

Our findings show that part of the interaction between players happens in the form of random encounters between players. The game promotes players to move in the physical world. Players, however, are not moving randomly. Gyms, the specific spawn locations of Pokémon, and especially PokéStops, which provide revisit rewards in the form of items needed to play the game and feature more frequent spawn of Pokémon, drive players, both familiar and stranger, to gather around the same locations, and, as a result, create opportunities for players to interact with each other. Furthermore, our findings show that Pokémon GO players could easily identify other players from gesture and movements they make while playing the game. This helps identify that users are a part of the same community, which make opening an interaction between strangers easier [17].

Implication for design:

- Provide guided paths or gathering points to increase opportunity for encounters between users.
- Allow users to identify each other to ease the opening of an interaction.

Limitations and Future Work

This study reported preliminary findings of different forms of collocated social interaction that Pokémon GO players had had around the game. The findings were then analyzed to gain a better understanding of the reasons behind these interactions emerging between players, and to identify design qualities that may have engendered these interactions.

Our study was conducted shortly after the launch of Pokémon GO in August-September 2016. Two other explorative studies published so far, Paavilainen et al. [31] and Colley et al. [13], were conducted around the same time with rather similar respondent characteristics. They reached average active adult players, however covering both genders and a wide range of different ages and player levels. Similar to Colley et al. [13], our respondents represented multiple nationalities. Sampling in all these studies was opportunistic, rather than aiming for generalizability, but as such suitable for early stage exploration. Furthermore, according to SurveyMonkey Intelligence [33], the average U.S player around the same period was a 25-year-old female. This is well in line with our sample of players.

After our survey was conducted, several updates and new features have been launched, which might have had an effect on the collocated social interaction as well. Despite all the game updates, Pokémon GO is found to continue to lose its number of active players, leaving only loyal players being active in the game [34]. While the core features of the game may stay the same, the emerging interactions between players may change due to the shift in the number and diversity in the types of players. Future research could study the collocated interactions around the game when it is more settled and the hype around the game has settled. Such research might produce findings that differ from our findings from the early days of the game.

CONCLUSION

Pokémon GO is predominantly a single-player mobile game, and the players primarily work toward their individual goals. However, location-based feature brings players outdoors and creates opportunities for them to encounter other players. This qualitative study provides an outlook to collocated interactions and social experiences between the players, mainly related to sharing information, collaboration, and bonds between players and competition between teams. The forms and their prevalence could be considered surprisingly strong considering the personal nature of the game. We identified several design qualities that allow for and contribute to such interactions to take place. These serve as implications for designing other mobile applications that encourage collocated social interaction. The *ambiguity* in the game makes it difficult for players to play it efficiently, which in turn encourages interaction and information sharing between players; the *persistent world* makes it possible for players to share information; *positive-sum* makes it sensible to do so. Furthermore, the *lack of in-game communication* channel seems to trigger players to interact directly with each other in their face-to-face encounters. All in all, while the earlier studies of Pokémon GO acknowledge the significance of its social aspects, this paper also contributes to understanding the collocated interaction emerged from a wide-spread location-based mobile game.

ACKNOWLEDGMENTS

We would like to thank our respondents for the survey. The research was funded by Academy of Finland (grant 295895).

REFERENCES

1. Tim Althoff, Ryen White, and Eric Horvitz. 2016. Influence of Pokémon Go on Physical Activity: Study and Implications. Retrieved January 2, 2017 from https://arxiv.org/abs/1610.02085
2. Marios Angelides and Harry Agius. 2014. *Handbook of digital games*. John Wiely & Sons.
3. Mara Balestrini, Raymundo Cornejo, Paul Marshall, Monica E Tentori, Jon Bird, and Yvonne Rogers. 2016. Jokebox: Coordinating Shared Encounters in Public Spaces. In *Proceedings of the*

19th ACM Conference on Computer-Supported Cooperative Work & Social Computing - CSCW '16, 38–49. https://doi.org/10.1145/2818048.2835203
4. Arianna Bassoli, Julian Moore, and Stefan Agamanolis. 2006. TUNA : SOCIALISING MUSIC SHARING ON THE MOVE. 151–172.
5. Marek Bell, Matthew Chalmers, Louise Barkhuus, Malcolm Hall, Scott Sherwood, Paul Tennent, Barry Brown, Duncan Rowland, and Steve Benford. 2006. Interweaving mobile games with everyday life. In *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06*, 417. https://doi.org/10.1145/1124772.1124835
6. Steve Benford, Andy Crabtree, Martin Flintham, Adam Drozd, Rob Anastasi, Mark Paxton, Nick Tandavanitj, Matt Adams, and Ju Row-Farr. 2006. Can you see me now? *ACM Transactions on Computer-Human Interaction* 13, 1: 100–133. https://doi.org/10.1145/1143518.1143522
7. Steve Benford, Claire O'Malley, Kristian T. Simsarian, Danaë Stanton, Yngve Sundblad, Gustav Taxén, Benjamin B. Bederson, Karl-Petter Åkesson, Victor Bayon, Allison Druin, Pär Hansson, Juan Pablo Hourcade, Rob Ingram, and Helen Neale. 2000. Designing storytelling technologies to encouraging collaboration between young children. In *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '00*, 556–563. https://doi.org/10.1145/332040.332502
8. Steve Benford, Duncan Rowland, Martin Flintham, Adam Drozd, Richard Hull, Josephine Reid, Jo Morrison, and Keri Facer. 2005. Life on the edge: supporting collaboration in location-based experiences. In *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '05*, 721. https://doi.org/10.1145/1054972.1055072
9. Martin Bjerver. 2006. Player Behaviour in Pervasive Games-Using the City as Game Board in Botfighters. Kungliga Tekniska Högskolan.
10. Staffan Björk, Jennica Falk, Rebecca Hansson, and Peter Ljungstrand. 2001. Pirates!–using the physical world as a game board. In *INTERACT'01*, 423–430.
11. Jay Chen and Azza Abouzied. 2016. One LED is Enough: Catalyzing Face-to-face Interactions at Conferences with a Gentle Nudge. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing - CSCW '16*, 172–182. https://doi.org/10.1145/2818048.2819969
12. Trina Choontanom and Bonnie Nardi. 2012. Theorycrafting: The Art and Science of Using Numbers to Interpret the World. In *Games, learning, and society: Learning and meaning in the digital age*. 185.
13. Ashley Colley, Jacob Thebault-Spieker, Allen Y. Lin, Donald Degraen, Benjamin Fischman, Jonna Häkkilä, Kate Kuehl, Valentina Nisi, Nuno J. Nunes, Nina Wenig, Dirk Wenig, Brent Hecht, and Johannes Schöning. 2017. The Geography of Pokémon GO: Beneficial and Problematic Effects on Places and Movement. In *Proceedings of the 35th international conference on Human factors in computing systems - CHI '17*, In press.
14. Mia Consalvo. 2009. *Cheating: Gaining advantage in videogames*. MIT Press.
15. Mia Consalvo. 2009. Hardcore casual: game culture Return(s) to Ravenhearst. In *Proceedings of the 4th International Conference on Foundations of Digital Games - FDG '09*, 50. https://doi.org/10.1145/1536513.1536531
16. Leon Festinger. A theory of social comparison processes. *Human relations* 7, 2: 117–140.
17. Erving Goffman. 1963. *Behavior in Public Places Notes on the Social Organization of Gatherings*. Simon&Schuster Inc.
18. Maria Håkansson, Mattias Rost, Mattias Jacobsson, and Lars Erik Holmquist. 2007. Facilitating Mobile Music Sharing and Social Interaction with Push ! Music. 1–10.
19. Pradthana Jarusriboonchai, Aris Malapaschas, Thomas Olsson, and Kaisa Väänänen. 2016. Design and Evaluation of a Multi-Player Mobile Game for Icebreaking Activity. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 4366–4377. Retrieved from http://dl.acm.org/citation.cfm?id=2858298
20. Pradthana Jarusriboonchai, Thomas Olsson, Sus Lundgren, and Kaisa Väänänen. 2016. Let's Take Photos Together: Exploring Asymmetrical Interaction Abilities on Mobile Camera Phones. In *Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services*.
21. Pradthana Jarusriboonchai, Thomas Olsson, Vikas Prabhu, and Kaisa Väänänen-Vainio-Mattila. 2015. CueSense: A Wearable Proximity-Aware Display Enhancing Encounters. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '15*, 2127–2132. https://doi.org/10.1145/2702613.2732833
22. Viirj Kan, Katsuya Fujii, Judith Amores, Chang Long Zhu Jin, Pattie Maes, and Hiroshi Ishii. 2015. Social Textiles: Social Affordances and Icebreaking Interactions Through Wearable Social Messaging. In *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '15*, 619–624. https://doi.org/10.1145/2677199.2688816

23. Pavel Karpashevich, Eva Hornecker, Nana Kesewaa Dankwa, Mohamed Hanafy, and Julian Fietkau. 2016. Blurring boundaries between everyday life and pervasive gaming. In *Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia - MUM '16*, 217–228. https://doi.org/10.1145/3012709.3012716
24. Christian Licoppe and Yoriko Inada. 2012. "Timid Encounters": A Case Study in the Use of Proximity-Based Mobile Technologies. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12*, 2759. https://doi.org/10.1145/2207676.2208675
25. David W. McDonald, Joseph F. McCarthy, Suzanne Soroczak, David H. Nguyen, and Al M. Rashid. 2008. Proactive displays: Supporting Awareness in Fluid Social Environment. *ACM Transactions on Computer-Human Interaction* 14, 4: 1–31. https://doi.org/10.1145/1314683.1314684
26. Markus Montola. 2005. Exploring the edge of the magic circle: Defining pervasive games. In *DAC*, 103.
27. Bonnie Nardi and Justin Harris. 2006. Strangers and friends: collaborative play in world of warcraft. In *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work - CSCW '06*, 149–158. https://doi.org/10.1145/1180875.1180898
28. Elena Nazzi and Tomas Sokoler. 2011. Walky for embodied microblogging: sharing mundane activities through augmented everyday objects. In *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, 563–568. https://doi.org/10.1145/2037373.2037461
29. Carman Neustaedter, Anthony Tang, and Judge K. Tejinder. 2010. The role of community and groupware in geocache creation and maintenance. In *Proceedings of the 28th international conference on Human factors in computing systems - CHI '10*, 1757. https://doi.org/10.1145/1753326.1753590
30. Kenton O'Hara. 2008. Understanding geocaching practices and motivations. In *Proceeding of the twenty-sixth annual CHI conference on Human factors in computing systems - CHI '08*, 1177. https://doi.org/10.1145/1357054.1357239
31. Janne Paavilainen, Hannu Korhonen, Kati Alha, Jaakko Stenros, Elina Koskinen, and Frans Mayra. 2017. The Pokémon GO Experience: A Location-Based Augmented Reality Mobile Game Goes Mainstream. In *Proceedings of the 35th international conference on Human factors in computing systems - CHI '17*, In press.
32. Jan Seeburger, Marcus Foth, and Dian Tjondronegoro. 2012. The sound of music: sharing song selections between collocated strangers in public urban places. In *Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia - MUM '12*, 1. https://doi.org/10.1145/2406367.2406409
33. Mike Sonders. Pokémon GO demographics: The evolving player mix of a smash-hit game. Retrieved July 6, 2017 from https://medium.com/@sm_app_intel/pokémon-go-demographics-the-evolving-player-mix-of-a-smash-hit-game-b9099d5527b7
34. Mike Sonders. Pokémon GO retention: No, it's not facing a player loyalty crisis. Retrieved April 20, 2017 from https://medium.com/@sm_app_intel/pokémon-go-retention-no-its-not-facing-a-player-loyalty-crisis-fe0d80fad429
35. Olli Sotamaa. 2002. All The World's A Botfighter Stage: Notes on Location-based Multi-User Gaming. In *Proceedings of Computer Games and Digital Cultures Conference*, 35–44.
36. Jaakko Stenros, Janne Paavilainen, and Frans Mäyrä. 2009. The many faces of sociability and social play in games. In *Proceedings of the 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era on - MindTrek '09*, 82. https://doi.org/10.1145/1621841.1621857
37. Jaakko Stenros, Annika Waern, and Markus Montola. 2011. Studying the Elusive Experience in Pervasive Games. *Simulating & Gaming*.
38. Jaakko Stenros, Janne Paavilainen, and Frans Mayra. 2011. Social interaction in games. *International Journal of arts and technology* 4, 3: 342–358.
39. Jennifer Yoon, Jun Oishi, Jason Nawyn, Kazue Kobayashi, and Neeti Gupta. 2004. FishPong : Encouraging Human-to-Human Interaction in Informal Social Environments. 374–377.
40. 5K people turn up to catch Pokémon in Chicago. Retrieved April 14, 2017 from https://techcrunch.com/2016/07/18/5k-people-turn-up-to-catch-pokemon-in-chicago/
41. You have to see what "Pokémon Go" has done to Central Park. Retrieved April 14, 2017 from http://www.businessinsider.sg/dozens-of-people-gathering-in-central-park-to-play-pokemon-go-2016-7/
42. Pokemon Go's mental health benefits are real. Retrieved April 14, 2017 from https://www.engadget.com/2016/07/13/pokemon-go-mental-health-science/
43. Pokémon GO: Explore. Retrieved April 14, 2017 from http://www.pokemongo.com/en-us/explore/
44. Zombie Run. Retrieved April 14, 2017 from https://zombiesrungame.com/
45. Geocaching. Retrieved April 14, 2017 from

https://www.geocaching.com/
46. Ingress - Wikipedia. Retrieved April 14, 2017 from https://en.wikipedia.org/wiki/Ingress_(video_game)
47. Ingress - Wikia. Retrieved April 14, 2017 from http://ingress.wikia.com/wiki/Ingress
48. Ingress Events. Retrieved April 14, 2017 from https://www.ingress.com/events
49. The Silph Road. Retrieved April 14, 2017 from https://thesilphroad.com
50. Positive-Sum Games. Retrieved September 18, 2016 from https://www.edge.org/response-detail/10135
51. Casual Versus Core. Retrieved April 14, 2017 from http://www.gamasutra.com/view/feature/131529/casual_versus_core.php