

Entertainment with Public Displays and Personal Screens – Children’s Ubiquitous Computing Practices in Urban and Domestic Settings

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Human-computer interaction (HCI) research has recently become more interested in studying practices. Looking beyond the novelty of technology, practice studies try to understand how technology becomes integrated into everyday life and how it shapes everyday practices in the longer time span. The contribution of this article is to demonstrate how ubiquitous computing practices develop. The article also sheds light on children’s and their families’ smart device practices in private and public settings. This paper responds to the recent call for practice studies in HCI and tries to understand technology-mediated practices of children and their families in their everyday lives. We first focused on children’s practices with a multipurpose public display through an ethnographic field study, and then broadened our focus to the children’s and families’ smart device practices through a diary study. We showed that children’s practices with a public display were surprisingly similar to their other information and communication technology (ICT) practices at home and elsewhere. In both settings, displays were used for entertainment and time-killing, as well as for babysitting and social interaction. This study indicates that technology-mediated practices do not spring up from the ground fully formed. There are several factors contributing to the practices’ emergence: the artefact itself and its affordances, the nature of the space, and the mind-set of the users. This finding has many implications for research and design, indicating that when developing technology, we should pay attention to a variety of factors that might be contributing to the emergence of practice around that technology – factors not yet fully explored by current research.

Interaction Science Key Words: Children and ICT practices, children, diary study, families, ethnographic study, interactive public displays, practice theory, smart technology, ubiquitous computing, urban computing.

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Fig. 1. Multipurpose public display in use at the swim centre.

1 INTRODUCTION

Digitalization has changed our everyday lives and practices remarkably over the last few decades. Digitalization has brought new technologies, which are capturing continuously bigger shares of our lives and surroundings: streets, squares, homes, schools, and spaces in between. New technologies are increasingly involved in our daily practices. Sometimes technology shapes existing practices, while other times it facilitates the emergence of new ones. Recently, HCI research has started to emphasize the practices around technological artefacts. The practice approach has been called for the purpose of looking at technologies beyond their novelty value – to understand how technology is embedded within social practices in the longer time span [1]. The practice approach has its roots in the social sciences. Instead of discourse or interaction, practice theories emphasize “practices” as the origin of the social construct. Practices are relatively stable performances, the way things get done, routines consisting of a number of interconnected and inseparable elements: physical and mental activities of human bodies, the material environment, artefacts and their use, context, human capabilities, affinities and motivation. Practices are dependent on all of the mentioned elements and cannot be studied individually, without taking the others into consideration. [1].

In this article, we utilize the so-called “practice lens” for studying technology in use [2][3]. The practice lens enables a holistic perspective, which allows us to understand technological artefacts as a complex sociotechnical ensemble with spatial, temporal, social, cultural, material and historical dimensions. We explore these practices in the lives of children and their families. Following Nicolini’s toolbox approach [2], we first conducted a zooming-in study on technology-facilitated practices around a multipurpose public display located in a swim centre. We then conducted a zooming-out study on the multipurpose display users’ everyday lives in a wider scope for understanding their smart device practices in space and time. We report on this trajectory of studies, including zooming-in and zooming-out perspectives.

During the recent decade, smart devices have truly changed family life and practices. Children have easy access to smart devices and use them at a young age [4][5][6]. Smart devices have become a natural part of our daily lives and are intertwined with many of our daily practices. Technology has both changed existing practices and created new ones, e.g., technologies are commonly used as parenting tools [6]. In this article, we compare public display practices identified at the swim centre with the practices families and children have with their personal smart devices elsewhere. We show interesting correspondences between the public and private use of smart devices and distinguish location- and device-related differences between the practices.

In this article, we explore through the zoom-in and zoom-out studies: What are the connections between public display practices (see Fig 1.) and personal smart device practices? What kind of nexuses of technology-mediated practices can be found in children’s and their families’ lives?

This article is formed as follows. The next sub-section briefly presents the theoretical and methodological approach we apply in this article. The following section presents the related work starting with ubiquitous and urban computing, followed by a presentation of research on public displays and public display practices. Next, the focus turns to children and public displays and children as information and communication technology (ICT) users in general. After the related work, we introduce the research design and present the study background,

continuing to present the data collection and analysis methods used, as well as the collected material. After that we introduce the results of Study 1 (ethnographic field study) and Study 2 (diary study), and the combined findings of both of these in Section 4.3. Finally, we discuss and conclude the findings in the discussion and conclusion sections.

1.1 Practice Lens by Nicolini – Zooming-in and Zooming-out

As a methodological tool in this study, we apply the practice lens introduced by Nicolini [2], which combines practice theories and utilizes the sensitivities of different approaches. This approach is coherent with most of the practice theories, as they share common elements. The toolkit approach “adds value and offers benefits, as it enables us to exploit the strengths of the different theories in order to get a better grasp of the nexus of practices we live in” [2] p. 213].

The toolkit approach includes two phases: zooming in on the particular practice and its accomplishment, and zooming out on the relationships of practices in space and time. In the zooming-in study we concentrate on the details of accomplishing a practice in specific time and space, concentrating on following:

1. Performances. Practices are real-time events in specific moments of time and location, which exist only when enacted and re-enacted.
2. Material aspects. Practice always involves body and material artefacts; accomplishing a practice necessitates bodily choreography.
3. Aims and meanings. Practices are performed for some reason. Practical concerns guide the practitioners.
4. Creativity vs. normativity. Practices are re-produced each time they are performed. They are bounded but still dynamic and under continuous evolution.
5. Durability. People with similar skills and aims, as well as the artefacts involved, are making practices durable.

Zooming in is followed by zooming out, where the scope is expanded from the specific time and place. It means “patiently following the trails of connections between practices; observing how these connections come to form entrenched nexuses of nets” [2] p. 230]. Through these stages, an account of the practice and its effects and dynamics is provided [2]. The zooming-out study focuses on:

1. Connections between practices. These are studied by following connections in time and space, shadowing the practice in other places where it shows up.
2. Practice acting at a distance. Practices contribute to the wider picture, and distant practices affect each other.
3. Looking back in time. One should also acknowledge the historical aspect. How did we get here?

Earlier, we conducted a zooming-in analysis of public display practices in the entrance hall of a swim centre [7][8]. This article expands on the earlier analysis by conducting a zooming-out study through following the practitioners to their homes through the diary study approach and expanding the scope to the users’ other ICT practices, as well as finding connections between private and public display practices. The diary study was earlier reported in a shorter version [9].

2 RELATED WORK

2.1 Ubiquitous and Urban Computing

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it” [10]. This is how Weiser [10] first described the central idea of future ubiquitous computing a quarter of a century ago in his essay entitled *The Computer for the 21st Century*. In this and his later articles, Weiser predicts not only technological innovations, but also related socio-cultural changes. Through these two visionary, epoch-making articles, a new research paradigm called ubiquitous computing (also *ubicomp*) was created [11][12].

Today we live in the future that Weiser envisioned, but much has happened since the first introduction of ubiquitous computing. Bell and Dourish also argue that the ubiquitous computing future is already here, but in a fairly different form than the one envisioned by Weiser [13]. Today, the term ubiquitous computing refers to technologies that are everywhere around us and can be used with any device at any location. Ubiquitous computing can also be described as the third wave of computing after the mainframe and personal computing phases [14]. According to Weiser’s vision, ubiquitous computing is invisible, it functions unobtrusively, and it merges with its environment. In reality, ubiquitous computing consists of a wide number of separate technologies (e.g., mobile, wearable, distributed and context-aware computing applications) which are brought together to serve a mutual goal [12]. As a consequence of the difference between reality and foresight, the present achievements are thus neglected [12].

Ubiquitous computing technologies located in urban contexts are often called urban computing or urban informatics. Urban computing refers to the integration of computing, sensing and actuation technologies in everyday urban settings and lifestyles [15][16]. According to Zheng and colleagues, urban computing tries to solve the problems of urbanization through the data that the city generates. Urban computing is an interdisciplinary field that involves computer sciences, transportation, civil engineering, environment, economy, ecology and sociology in the context of urban spaces [17].

Urban computing can be seen to have four sub-themes: place, community, infrastructure and traversal. The challenge is to understand how this future fabric, or digital and wireless computing, will influence and be integrated into people’s social patterns in the urban landscape [16]. Public display and urban computing systems in general have three components, namely space, people and technology [18][15]. Thus, a trans-disciplinary understanding of social, cultural and political context is essential when building such systems [15]. In this article, we are referring to urban computing when talking about ubiquitous technologies that are embedded in the urban context and the public (streets, parks) or semi-public settings (such as offices and schools). One form of urban computing is those technologies that can support communities in future smart cities, e.g., rapidly spreading public displays.

2.2 Public Displays in Cities

Public displays are a pervasive and easily perceived aspect of urban computing systems. Public displays have been part of the urban setting for a long time. Already in the 1980s, low-resolution digital displays were used for advertising and promotions, but with plasma and liquid crystal display (LCD) techniques, the digital signage became capable of displaying full-size video streams at reasonable costs [19]. Public displays distribute information in airports,

motorways, sports stadiums and shopping centres. To put it simply, public displays are located where the people are. The main purpose of these displays is often for commercial use. Most digital signage displays advertisements and functions as a one-way communication channel.

Interactive public displays are a more recent branch of the digital public displays. Interactive displays enable user interaction and transfer the media to a two-way communication channel. These public displays have started to appear in various public spaces, such as museums, shopping malls, libraries and squares, where they interactively offer information and visual experiences for people [20]. The importance of this new media has been noticed, and it is predicted that public displays could become the communication medium of the 21st century, having the same impact on society as radio, TV and the Internet have already had [21].

Along with the spread of these public displays into our urban surroundings, research in the area has been flourishing. Public displays have gained interest in many research disciplines, including human-computer interaction, architecture, social sciences, design, art and media theory. The advantages of these public display technologies have been studied, for example, through collaborative and educative scenarios (see, e.g., [22]). These scenarios, however, differ in various ways from the public display scenarios in truly open and public settings in terms of the variety of the users and use cases [20]. It has indeed been revealed that studying ubiquitous public urban technology that predicts how people uptake, appropriate, or use them is hard or even impossible without proper in the wild experiments wherein the displays are truly integrated into public settings [23].

In 2012, Alt, Schneegaß, Schmidt, Müller and Memarovic carried out a literature survey of the interactive public display research and revealed that there are different types of studies that vary according to the phase of the project [24]. First-phase studies, wherein the prototype is only in the design stage, are often ethnographic or carried out using different types of interviews, questionnaires or focus group methods [25]. Second-phase studies are many times executed in laboratory conditions with more or less functional prototypes [26][27]. During the third phase, these prototypes are brought outside the controlled laboratory conditions to be studied in the field in actual public settings [28]. The fourth and final phase is deployment-based research, wherein the prototypes now become more stable longitudinal deployments.

Deployment-based research introduces the technology into the social setting. Previous research has explored public display usage in a number of different settings, such as urban areas, cafes, working environments and rural locales [29]. These deployments enable researchers to study long-term impacts and practices without the novelty effect [24][30]. According to Alt [24], only in deployment-based studies can the technology be integrated into the everyday lives of people and seen as a natural part of their surroundings. However, that adoption of technology does not always go as planned [31].

Examples of public display deployments that are built for research purposes are, for example, in rural areas. These include Wray display in a rural English village [32], Nnub in a suburb of Brisbane, Australia [33], and the Hole-in-the-wall experiment in a rural area in India [34]. Examples of deployments in the city arena are the screens in the Wild project in London and Nottingham [35] and the MobiDIC network installed on public telephones and showing coupons for nearby shops in the city centre of Münster, Germany [36]. Examples of shorter deployments include the Confession booth [37] in Aarhus, Denmark, and the CityWall in Helsinki, Finland [38]. In addition, an e-Campus display network was installed on the Lancaster University campus in England [39]. Three longer-term deployments in an urban context are presented below in more detail.

The Wray Display Project was conducted between 2006 and 2010 in a small village in Northwest England. The project created a public display to support the local community. The focus was to explore how the use of public displays emerged over time and how authentic experiences with technology could help its community members engage in the participatory design process. The first display prototype, the Wray Photo Display, simply displayed photographs uploaded by the users. The second version, the Wray Display, also displayed users' event information and advertisements. The experiment was successful, and over the years the displays became an integral part of that community's information-sharing practices [32].

The Lancaster University e-Campus project consisted of three built and deployed experimental display systems. The first two were short-term technical probes (a digital signage solution at a conference event and a display system as an element of an interactive exhibition). The last one was a more permanent installation at a campus underground bus station. It consisted of three large projected displays that displayed artistic material, textual information and videos created by the researchers [39].

Still another example of a project of studies on urban public display deployments was the Screens in the Wild project, a collaborative project between researchers from Bartlett, University College London, and the Mixed Reality Lab at the University of Nottingham. Their focus was to study how media screens in urban spaces could be better designed to benefit public life, e.g., by fostering community participation instead of simply distributing commercial content [35].

2.3 Public display practices

So far public display research has touched upon dimensions of the practice approach in scattered studies. Most of the public display research so far has concentrated on audience behaviour around the displays [24]. For example, various public display studies have identified the so-called honeypot effect, wherein those people interacting with a display attract still more people to interact with it [40][36]. The audience funnel describes the passing-by display phases, which can include viewing and reacting, subtle interaction, direct interaction, multiple interactions and possible follow-up actions [41]. The landing effect refers to how passers-by return to the display after first passing it [42]. In addition, display blindness is a well-known phenomenon that refers to people who tend to ignore the public displays [43][44].

The studies that have concentrated on the user experience have investigated the overall user experience of the public displays by comparing different interaction techniques. For example, Redhead and Brereton studied the navigation on a digital community noticeboard during their long-term evaluation of the Nnub system [33]. Interaction has been studied also by Ojala and colleagues [45][38]. User acceptance studies investigate users' motives for interacting with the displays [26]. Aims or meanings of practices have also been touched upon by Memarovic and colleagues [46]. Another niche of these studies investigates effectiveness from the user perspective or looks at users' privacy concerns [47]. Also, the social impacts of the displays [42] and prototypical user roles [48][38] have been studied. Material aspects relating to display location and physical display [49] or bodily aspects [41] have been discussed. In most of these studies, however, the display installations have been short-term, which hinders studying the emergence of everyday practices around the displays in the long run.

There are studies also on longer deployments, e.g., on community display deployments, within which recurrent routines like performances, practices or seeds of practices have been

identified [46][50]. Unforeseen appropriations have been studied by Dalsgaard and Halskov [51] and learning by seeing addressed by Marshall, Morris, Rogers, Kreitmayer and Davies [52]. The burning question, however, is still how public displays are adopted and integrated into users' everyday lives [32]. Previous studies have also concluded that public display installations should be designed so that they cause minimal interruption or fit well with the local practices [29][53][54]. Overall, in related research to public displays, practices have been mentioned as something that should be acknowledged, but the theoretical or empirical approach has been limited.

Although comprehensive practice research on public displays has not yet been conducted, some hints of these practices have been revealed in previous public display deployment studies. As described above, there have been a few long-term deployments (see, e.g., [55][56][57][46][32][31]) that have revealed traces of use practices.

For example, the e-Campus system had a number of regular users during its many years of operation. These users become capable enough to be able to manipulate the system for their own benefit [55]. Also, the Wray Photo Display system was used considerably, according to the log data. Wray Photo Display users uploaded, viewed, browsed, categorized and commented on photos. The photos recorded the community history, shared news, and integrated new members into the community. Residents moderated the content and thus gained ownership of the system [58][29][32].

The Screens in the Wild network has been active for several years in London and Nottingham (see, e.g., [46] [29]). For example, in the Moment Machine experiment, where a camera application was integrated into a public display network, the researchers found certain use patterns and several returning users who had developed use practices with the displays during a 12-week observational study. Also, user interviews confirmed the discovery and revealed that the photo-taking practice was becoming part of the recurrent group activity (see, e.g., [46]).

The Open UBI-Oulu log data revealed that the use of the open WiFi network grew steadily, but use of the public display network remained low or even decreased over time [31][54]. However, some promising exceptions to this trend were reported [57] [31], which indicated that there were some existing practices around UBI-Oulu displays as well. In the UBI-Oulu context, Suopajarvi, Ylipulli and Kinnunen [59] have studied the ICT practices of young adults and the elderly and their perceptions of public UBI displays through interviews and diary studies. Still, the existing research on UBI-Oulu has not yet focused on emerging public display practices, nor studied them more in depth.

2.4 Children and public displays

Children have not been entirely neglected in earlier public display research, but research has been limited. Children's use of these systems have been studied in museums [60], parks [61], schools [62][63][64] and on playgrounds [65]. Several studies around pervasive and public displays have concentrated on learning [22] and behaviour change [65][62]. In addition, observational studies of community or public display installations in urban environments have revealed that children and young people are frequent users of such systems, and keen to play with them [46][42][38]. A branch of these studies has also concentrated on public display use to help children with autism [64].

Although children have been seen as users of public displays, their practices around such displays have not been examined in depth. The children's role in public display research so far has been rather limited. Some observation-based studies on public and community display installations have provided evidence on children and young people's frequent use of such

systems and their enthusiasm for playing with them [66][34][42][38]. In the studies of Memarovic and colleagues, most display users were children who used the display on their way home from school. Children also appropriated the display by innovating their own games and contests using it (see, e.g., [46]).

In the Hole-in-the-wall experiment, a publicly-available computer was installed into a brick wall near a slum in rural India [34]. The display was designed especially for children, who were free to interact with it. Experiments proved how the inexperienced children were able to browse, create documents and play games with the computer within a few days without any support. Mere curiosity drove the children to interact with the display [34].

2.5 Children and ICT practices

Today, children and families also have an ever-growing body of technological artefacts at their fingertips. These technologies offer increasing opportunities for both entertainment and education. TV sets and video recorders have been part of the domestic fabric of everyday life for decades, but the recent development of smart technology has made the ICT an even more pervasive and inseparable part of everyday life for even younger children; see, e.g., the study of babies and toddlers using iPads [67].

Research in, for example, education, as well as in the media and communication fields, has shown that ICT can offer valuable experiences for young children. Researchers have found several benefits of consuming/using ICT at an early age; for example, young children's communicative and creative competencies can be supported using domestic digital technologies [68][69]. In addition, it is known that ICT can foster creativity and collaboration [70]. It has also been found that the problem-solving skills that pre-schoolers learn using touch-screen devices transfer to physical skills [71].

Still, children's and families' ICT usage has become a complex topic. Common beliefs are that childhood and ICT should not be mixed, that ICT hinders social interaction and dominates children's lives, and that their cognitive, emotional and social development are then under threat [72][73]. The younger the children that are involved, the more critical the opinions. Also, academic discussion on ICT consumption of children has risen to prominence in different disciplines. For example, more than 2,000 scientific studies and reviews have indicated that significant exposure to media violence increases the risk of aggressive behaviour in certain children and adolescents [74].

2.6 Families and domestic ICT practices

Parents have commonly taken on ICT as part of the repertoire of parenting tools. Wartella and colleagues revealed that parents use ICT for managing their daily lives with children. Many parents turn to ICT when they need to get things done (make dinner, do chores, take a shower, etc.). ICT is also used for calming an upset child and for rewarding good behaviour. Most likely, the media used in such moments is TV, whereas mobile devices are used more often when a child is older. Parents did not report having conflicts about their children's ICT use, but they also did not think that ICT made parenting easier. Parents were also less likely to use ICT as an educational tool when compared to other activities, such as books or toys [6].

At home, technologies are not only used for occupying children. Wartella found in the survey that parents used ICT with their children, but the amount of shared-use sessions dropped significantly when the child turned six years old [6]. According to Horst, families do like to spend time together and many times watch TV or play console games together, which is considered a time to relax and take a break from the fast pace of life. Many families also use

ICT as a way to facilitate communication and bonding. Some families, especially fathers and sons, primarily bonded through ICT experiences [75].

A recent concern has turned to parents, their (over)use of smart devices, and its influence on children [76]. Besides being truly harmful, using ICT devices at home while with others is considered annoying. Oduor found, with his colleagues, that people often become frustrated with their family members when they are using personal mobile devices when the family is together. Usually people thought that collocated mobile device usage should wait until later because of its perceived non-urgency [77]. Moser et al. also found in their survey that parents tried to minimize their mobile phone usage while with children, and using a mobile phone at mealtimes was considered inappropriate, especially if children were present [78].

Popular culture, news and articles also regularly suggest that parents should monitor and control their children's experiences with media. Discourse on appropriate screen time has been vibrant. The American Academy of Pediatrics provides recommendations such as, "for children ages 2 to 5 years, limit screen use to 1 hour per day of high-quality programs" and "for children ages 6 and older, place consistent limits on the time spent using media, and types of media, and make sure media does not take the place of adequate sleep, physical activity and other behaviors essential to health" [79]. Parents are encouraged to establish clear rules for technology exposure, screen time and access to content [80]. Hiniker and colleagues published an article wherein they interviewed 27 parents and conducted a diary study on ICT usage, concentrating on how parents regulate the media usage of 1–5-year-old children. They found that transition times are the defining feature of children's media experiences as well as their parents' mediation practices. Parents enforce transitions away from ICT when they have finished attending to their own needs and when ICT provides a natural stopping point. Technology-mediated transitions were also significantly more successful than parent-mediated transitions [81].

In the human-computer interaction research, children were neglected for a long time. During the past few decades, however, more child-centred views have emerged. Still, these are mostly related to design for and with children [69]. Such studies are usually conducted in schools and clubs and mostly do not concentrate on technology use in homes or other private settings. In turn, domestic human-computer interaction studies that do examine homes typically concentrate on smart home applications and not on their practices, let alone examine children as users (e.g., [82][83]). However, there is still a need to study how ICT is being consumed at home and in other private settings, and how it becomes integrated with and is shaping everyday practices in these settings. More research on children's technology-facilitated practice is also warranted in human-computer interaction because of the huge prominence of smart devices in the lives of today's children.

2.7 Summary of the related work

Public displays are a visible part of the urban computing scene today. Public displays have been studied tremendously over the last decade. In addition, deployments, wherein public displays are embedded "in the wild", are numerous [29]. These types of studies compared to, for example, lab-based ones, are necessary in order to see how technologies integrate into people's lives and mundane practices, and support communities [24]. Although public display deployments do exist, not many of them are truly long-term. In addition, the mediated practices of public displays and their emergence and dynamics have not yet been studied in depth. This article tries to address this research gap by providing an analysis of the public display practices as well as their emergence.

Technology is a significant part of families' and children's lives today. Recent studies have shown how technologies are integrated into family life. They might make parenting easier, but they also generate tension [6]. Parents have to regulate their children's media use [81], but parents also tend to overuse the devices themselves [76][77]. Several studies have found that technology usage can benefit children in many respects – for example, boost creativity and collaboration [70]. However, the discourse on the disadvantages of technology has also become stronger [72][73].

It has already been noticed that children use public displays eagerly. This was the case with UBI displays (UrBan Interactions), which are in the focus of this study, too. In the UBI-Oulu case, the dominating user group turned out to be children. Although children's role as early adopters has been noticed [84], the mechanisms of how their technology-mediated practices in public settings emerge and develop have not been studied profoundly. Children today seem to be on the front line for the adoption of technologies, and thus, studying how children adopt these technologies and integrate them into recurrent practices is especially interesting. These findings may also be applicable to the context of other types of technologies and user groups.

3. RESEARCH DESIGN

3.1 Study Background

The study first focused on ubiquitous computing infrastructure, which consisted of 18 large, interactive public displays (UBI displays) located in both indoor and outdoor locations around the city of Oulu, Finland. The interactive displays consisted of various services customized specifically for the UBI display, including the news, the weather, public transportation, games, an art gallery, announcements, and advertisements. The content and the user interfaces were identical in all of the displays, with the exception of a display at the city library with customized content. The usage logs of different services is demonstrated in Table 1.

Table 1. Usage logs for the UBI displays from 17 April to 16 October 2015. Most launched applications. Games are in boldface.

Application	Launches	Avg/ day
Start page	3864	117.09
Waste Tower Game	1740	52.73
Hangman Game	1177	35.67
Martians from Outer Space Game	958	29.03
Ubitris Game	637	19.30
Wordster Game	495	15.00
BelleMemory Game	416	12.61
UBI Mosquitos Game	374	11.33
City of Oulu	273	8.27
Hiukkavaara	267	8.09
Streetgallery	247	7.48
Whole city walks – around the world	244	7.39
Oulu University of Applied Sciences	238	7.21

Source: Ventä-Olkkonen et al., 2016b

The infrastructure was launched in 2009 for the purpose of providing a testbed for ubiquitous computing research, as well as for serving citizens [45]. Quantitative logging of use events showed that there were only a few regularly used displays in the network [45][31]. Only one display collected clicks on its surface throughout the year. This display was located at the entrance hall of a swim centre. For the purposes of studying display practices, we decided to concentrate on this particular display. In this paper, we start by zooming in to the swim centre display and describe briefly the four most common display-mediated practices we found (more profound zoom in analysis in [85]). Afterwards, we expand our analysis and follow the connections between practices. This is done by following practitioners and their families and shedding light on their display practices elsewhere. This also necessitates zooming in to understand those practices in more depth.

3.2 Research methods and materials

3.2.1 Study 1 - Ethnographic Field Study. Ethnographic field work was considered a suitable method for in-depth study of people's technology-related practices in context. The study period at the entrance hall of the Oulu swim centre was executed between February and April of 2015. The collected material totalled 55 hours of observations at varying times of the day and week, concentrating on the busy hours. These observations are reported in the field notes. In addition, for approximately half of the time (24 hours) the space was also video-recorded. The hidden camera filmed the space around the public display as well as the users from the back and diagonally from the top. In addition, photographs of users interacting with the system were taken. Prior to the systematic ethnographic fieldwork at the swim centre, interviews with three swim centre cashiers, who regularly worked near the display, were conducted in order to gain some initial perceptions on the dynamics of the display practices.

In addition to the observational data, 39 structured field interviews with the display users and their parents were conducted. Participants were recruited in situ. Interviews were audio-recorded and transcribed. The interview guide included a list of semi-structured questions. The aim of the questions was to study the phenomenon as comprehensively as possible. The questions viewed the display usage from three perspectives (see e.g. [86]):

1. Concrete routines with the displays (questions, e.g., What did you do with the display? What do you usually do with the display?)
2. Symbolic meaning and the role of the displays in users' lives (questions, e.g., What do you like about using the displays? What do you dislike about them? How would you feel if the display was removed from this place? What do you think about other people using the display?)
3. Cognitive aspects (questions, e.g., How and when did you start to use the displays? How did you learn how to use the display?)

The field interviews were carried out until the saturation point was reached and the answers began to repeat themselves. This circumstance happened around the time of the thirtieth interview.

The field study material was analysed qualitatively through a data-driven analysis method. Although the analysis was highly inductive, the practice toolkit approach [2] was used as a sensitizing device and applied when applicable. As in any qualitative research, the researchers' interpretations cannot be separated from their own background [87]. The analysis proceeded as follows. Overall, the interest in the interview and observational data was in:

1. Concrete accomplishments around the displays,
2. Cultural-spatial, temporal, social and material dimensions related to the display performances,
3. Meaning of technology-mediated practices for the people, and finally
4. Creativity versus normativity and durability of the practices.

3.2.3 Study 2 - Diary study. After zooming in on the display practice in the swim centre, the focus turned to the practice networks and how they may influence the swim centre display practices. Expanding that scope was done by following the practices and by extending our observation to other places where other display practices occurred. As the public displays are location-dependent, it was interesting to extend the scope to compare smart device practices elsewhere. To find these practice networks, it was decided to follow the practitioners and their families. This effort was conducted via a self-observatory diary study method [88] and interviews with three families who were also users of the swim centre public display (see Table 2). Diary study was selected as the method of choice, as it provided an unobtrusive possibility to study what happens in people's homes. Diary studies were conducted between December 2015 and June 2016.

Recruiting the participants for the diary study turned out to be challenging. The criteria stated that at least one member of a family used the UBI display more or less regularly and the families also utilized ICT at their homes. Face-to-face recruiting in the swim centre resulted in one voluntary family and two families recruited through the friend and family networks of the authors. All the recruited families had 2–3 children, and at least one of them used the public display sometimes. The number of families was rather small, but even with three families, the study provided fascinating glimpses into their private everyday life and the role of ICT within it. This in itself is valuable and enabled interpretive qualitative analysis, which aims to describe and understand the phenomenon, not to generalize.

During the study period, the participants kept a diary of their UBI display as well as other ICT use (e.g., using tablet computer or smartphones) for several weeks. In addition to the display usage, the families were asked to report on other smart device usage in their daily lives, and to concentrate specifically on their children's smart device practices. The participants were also asked to report every time some of them used the public display and, at least twice a week, on the usage of another media device at home or somewhere else. The diary consisted of 20 descriptions of device usage events. Each participant was asked to answer the following questions related to these events: device used; space of interaction; date and time; where were you, and why; who used the device; who was involved in the situation; what were other family members doing at the time; what was done with the device, and why; why and how use was stopped; and how long was the device used in total?

The study also included two semi-structured interviews with 1–2 adult members of each participating family. The first interview was conducted prior to the diary period, and the second interview was conducted after the diary period, thereby providing the interviewees the opportunity to reflect on their experiences after the self-observatory diary period. There were also children present in some of the interviews. The interviews were semi-structured: Some questions guided the conversation, but the interviewees were free to chat about whatever related to their families' smart device usage. The questions were related to smart devices at home, who was using them, the rules related to device usage in the families, possible conflicts related to smart devices, and their practices at the swimming centre.

The collected material of the diary study was analysed qualitatively using data-driven methods. As said, a researcher cannot interpret the qualitative research material entirely objectively, as the background is inevitably influential [87]. Especially in the case of diary study, interpretations of the research data were influenced by our knowledge of everyday life of families with children in Finland. The analysis proceeded as follows: At first, the interview material was transcribed and read carefully. The diary entries were tabulated, separating family number, device in use, date and time, description of the situation, users and other people present, number of users, what was done and duration of use. Next, the interview material was categorized using the data-driven method into initial categories that were partly influenced by the ethnographic study findings (babysitting, entertainment, parent control, social interaction, concerns, calming the child, positives and negatives). This initial categorization enabled the researchers to identify correspondences with the findings of the ethnographic study at the swim centre as well as to appreciate the intricacies of this material. After that, the zoom-in lenses for the toolkit approach [2] were utilized as a sensitizing device for all the material (diary and interviews). The analysis concentrated on a) each family's recurrent accomplishments with the smart devices and public displays; b) spatial, temporal, social and material dimensions of the practices; and c) meanings/aims/motives of the practices. Point c) was done by classifying the diary entries using the pre-defined groups identified in the ethnographic study: entertainment, babysitting, time-killing and social interaction. At this stage, a new category of information-seeking was also created. Most of the entries were labelled as belonging to more than one group. We combined the diary entries with the public display usage data from the ethnographic study in the swim centre and present this data in Section 4.2. Table 3 summarizes the material involved in this study, and Table 4 demonstrates the timeline of the data collection.

Table 2. Families in diary study

#	Members	UBI display usage	Smart media devices
1	Mom, dad, sons 4 & 8 yrs.	Mainly 8-year-old uses the UBI display at swim centre while visiting.	1 tablet, 1 laptop, 2 smart phones, 2 game consoles, 3 TVs
2	mom, dad, daughters 3 & 6 yrs.	Mainly 6-year-old uses the UBI display at swim centre while visiting.	1 touch screen laptop (~tablet), 1 desk top, 2 smart phones, 1 TV
3	Mom, dad, daughters 4, 4 & 9 yrs.	Mainly 9-year-old uses the UBI display at school.	5 tablets, 2 laptops, 3 smart phones, 2 game consoles, 2 TVs

Source: Ventä-Olkkonen et al. 2017

Table 3. Summary of the research material

Study #	Data	N	Description	Rationale
Study 1	Field notes & videos	80 pages & 24 hours	Ethnographic field study (observations) at around the UBI display at swim centre.	Zooming in: Understanding performances, material aspects, etc.
Study 1	Field interviews	36	Field interviews with display users and their parents at swim centre.	Zooming in: Understanding aims and meanings of the public display practices.
Study 2	Diaries	3 diaries (3 x 20 entries)	Paper diaries with entries about UBI display usage as well as situations with personal smart devices.	Zooming out: Following practitioners and their families. To understand links between smart device practices.
Study 2	Interviews	3 x 2 interviews	Pre- and post-diary interviews with each participating family, which lasted appr. 1 hour each.	Zooming out: Understanding the wider picture and social arrangements behind the practice.

Source: Ventä-Olkkonen et al. 2017

Table 4. Timeline of the data collection

Data collection phase	Time
Cashier interviews	December 2014
Field study, observations	February–April 2015
Field study, field interviews + observations	March–April 2015
Pre-diary study interviews	December 2015–February 2016
Diary period	December 2015–June 2016
Post-diary study interviews	February 2016–June 2016

4. RESULTS

First, we present the findings from the zooming-in study at the swim centre. This is followed by the zooming-out study involving shadowing the practitioners in space and time, and afterwards zooming in on their practices in other settings. Finally, we discuss the connections between the screen practices in public and private settings.

4.1 Study 1 - Zooming in on the Public Display

Frequent use of the swim centre display indicates existing practices in the location. This section is based on material collected through observations and field interviews at the swim centre. This section takes a closer look at the practices around that display. We first discuss some common characteristics of the practices and then categorize them according to their aim and meaning. In this article we only provide a quick overview of the results of the field study. The results are presented more profoundly elsewhere [85][7].

4.1.1 Concrete performances with swim centre public display. According to our observations, the swim centre display is mostly used by 7–12-year-old and younger children (see Table 5). Older children usually play games with the display in groups of 2–7. Younger users also just randomly touch the display surface without actually playing an implemented

game. The display is typically used while waiting. Use sequences typically vary from 5–20 minutes. Adults rarely interact with the display.

Table 5. Observed number of display use sessions with each user group and the type of the session

User group & estimated age	Use Session		Random Tapping/ Browsing		Watching (ads/ others using)		Playing	
	N	%	N	%	N	%	N	%
Young children 2–6 years old	90	27.0	63	70.0	14	15.6	12	13.3
School students 7–12 years old	142	42.6	42	29.6	19	13.4	81	57.0
Teenagers 13–17 years old	10	3.0	6	60.0	1	10.0	3	30.0
Adults 18–70 years old	48	14.4	9	18.8	37	77.1	2	4.2
<17y users from more than one age group	18	5.4	9	50.0	1	5.6	8	44.4
Adult and a child user	23	6.9	4	17.4	3	13.0	16	69.6
Total	333	100	133	39.9	75	22.5	122	36.6

Source: Ventä-Olkkonen et al., 2016b

4.1.2 Cultural-spatial, temporal, social and material dimensions of the public display practice. There are several features which boost the display practice emergence in the space. The display is located centrally in the swim centre entrance hall. The hall is an open space and the display is visible from most of the area. People entering and leaving the space are crossing the display. The space serves as a waiting area for many. During recurrent peak times, the space is crowded, while during quiet times it is almost empty. The display interaction is touch-based. Due to its large size, younger children have difficulties in reaching it. Hence, bodily choreographies to elevate this problem are common; jumping and climbing on the pedals is typical. Parents sometimes lift their children to the display.

4.1.3 Aims of the public display practices. Display as entertainer. The observation of practices revealed that the swim centre public display was often used as an entertainer. In this practice, the display is used every time when visiting the space. Users tend to be young children or primary school-aged children (under 12 yrs.). This practice is learned from, and persisted through, groups of children who regularly visit the swim centre to participate in hobby groups. The space supports practice development in the sense that it does not offer any other entertainment for the children besides the interactive public display.

Display as time-killer. A slightly different practice is using the display as a time-killer. These users do not use the display as enthusiastically as the previous ones. The display is used for spending time when there is nothing else to do. These people are usually teens, children, or sometimes adults who are spending time alone in the space, waiting for something. In these situations, personal smartphones may be preferred over the public display.

Display as babysitter. We also noticed that the display helps parents to handle the waiting situation in the swim centre entrance hall. While children are drawn to the display, play with it, or watch others play, adults line up to pay fees, park their cars, or chat with each other; i.e., they use the display as a babysitter. For frequently-visiting families, the display has become part of the situational routine. Parents may direct the kids to play with the display, open an app for the children, and watch their play from a distance.

Display as supporter for social interaction. The display was also often used by groups who play the games together, talk about the games, cooperate, cheer each other on, and laugh

loudly. The smaller or bigger (2–20 players) groups belong to same training group or school class. These group players are usually approximately 10–14-year-old children and teens, and they are visiting the space during school days (school PE class) or afternoons and evenings (training groups). The large size of the public display supports these group activities; also, certain games are well-suited to cooperation. Another type of social interaction emerges when family members, especially parents with children, use the public display together. In these cases, the pedagogical aspect is often involved.

4.2 Study 2 – Zooming out Through Following the Practice Participants

After concentrating on the public display, we expand the scope by following the practitioners through the diary study. At first we take a look at the different dimensions of the smart device practices within the families studied. This section is based on diary study material and interviews with participating families.

4.2.1 Concrete performances in each of the families. According to our study with three families, displays are often used in the lives of families with small children. Although there were differences in the smart media device practices between the families, there were also similarities.

In *Family 1*, the 8-year-old son used a tablet device, which was his own, typically alone (in 7 out of 20 reported events). He used the device for relaxing between hobbies and school work. He even took it to bed sometimes at night. Sometimes, his 4-year-old brother also watched, but he did not use any device by himself. The family also reported activities in which the whole family, or a parent with one or two sons, participated (7/20) in watching videos or playing games. The family had one tablet, owned by the 8-year-old, but the parents also used it occasionally. The tablet was purchased when the son started school because it was needed for school work. The tablet was usually kept in the kitchen, but the older son could take it into use when he wanted.

In *Family 2*, the 6-year-old and 3-year-old daughters most often used the devices together (18/20). They played with mobile phones in versatile ways; they did not just play games or watch videos. During the diary period the children often used the phone camera and photographed toys, nature, and each other, and looked at the pictures (9/20). Children also used the phone for timing and running around the house. The parents did not use devices together with children. The typical situation of device usage was described by the father as, “It is probably at noon, when I have to make lunch or something, when I put some video for them on YouTube.” The family had only one touch screen tablet at the house. The parents controlled the usage by giving the device to the children and controlling the passcodes.

Family 3 had more smart devices in use than the other families: five tablets, which were shared with all. The 4-year-old daughters usually used the device together (16/20), but the mother also participated sometimes (4/20). Most often, the children watched videos while having breakfast or an evening snack. Parents were doing morning routines, household chores or working at the same time. Also, the 9-year-old daughter used devices, usually alone. She, e.g., listened to a Harry Potter talking book on YouTube. The mother described a typical situation of tablet use: “Well, in the morning when they wake up, they start almost right away to watch something on the iPad. When they eat breakfast – if the older daughter has a later morning, she takes it too.” The 4-year-old twins used devices typically in shared family spaces (living room, kitchen) where parents were able to control what they were doing. However, they usually had free access to the devices and knew the passcodes of each device.

4.2.2 Cultural-spatial, temporal, social and material dimensions of the practices. Children used the devices most often in groups of two, usually siblings watching videos together. Older

children used devices more often alone. All families reported adults doing household chores and other duties while children were using devices. Most of the reported usage events were located at home (living room, kitchen, child's bedroom), but another common place for device usage was the car. Families reported display usage during short daily travels to hobbies, etc. Most often the device was a tablet, which was used at home. Phones were frequently used in the car. All families regulated children's device usage. Devices were taken away from the children when they had used them for some time. None of the families had a specified maximum "screen time".

4.2.3 Meanings of the practices. In the interview diary data, we noticed similarities in the smart device practices at home compared to the swim centre. Next, we discuss the corresponding findings on smart device practices, categorized into the four afore mentioned groups.

Smart device as an entertainer. In these families, using smart devices was fun and entertaining. Children used them eagerly. Thus, most of the reported events concerned used the device as an entertainer. Parents said that at least sometimes the children would use the devices continuously if they would not restrict them.

Well, I guess always when he has time. This 8-year-old would probably use it all the time. (Mother, Family 1)

They would always want to take it to the dining table. Sometimes we try to forbid them, if we have time to eat together, if everybody is eating together or something. I don't think it's [using tablet] any different than reading a paper [at the table]. (Mother, Family 3)

When the device is an entertainer, playing or watching videos, etc., is the primary function. Devices are used because they are fun, and not because parents are trying to keep a tired and hungry child calm, or doing something else. In these situations, devices can be used alone or with others.

Smart device as a babysitter. Parents also used technology to keep the children occupied and still. Using smart devices as "babysitters" was very common at home when adults were not able to pay attention to their demanding children and they had duties to accomplish or just wanted to relax. The devices were either given to children, or the children took the devices themselves. Mornings were mentioned as times when devices were used for this reason: on weekday mornings for letting adults do things, and during weekends for giving parents the possibility of sleeping later. Another busy time for using the devices as babysitters was after the workday when making supper.

Mornings are usually very busy, you have to do many things, so it helps in certain way, so that they are at least not requiring anything when they are watching it [tablet]. Of course, it makes it more challenging when they should start dressing in the outwear and leaving. (Mother, Family 3)

They probably watch more during weekend mornings, when they wake up between 6 and 7 and we do not have to hurry, so we stay in bed. It's just nice to lay down and time might pass. (Mother, Family 2)

It is very typical when you are making supper when you have come from work. There, when they are waiting [they may use tablets] – they don't necessarily feel like playing together right away after day-care. (Mother, Family 3)

Devices were also given to children when they were tired or whining, peeved, or if parents were not able to give enough attention. On the other hand, devices were also taken away from children if they caused arguing between siblings.

Smart device as a supporter for social interaction. At home, devices were often used together; it was more common than using them alone. Siblings watched videos together, or played in turns and watched each other's play. Typically, the older sibling played and the younger sibling watched. However, conflicts potentially emerged in these situations.

The twins were playing side by side (with iPhone & iPad) [at the] Minions game. They chat where they are and how far they can get. (Diary, Family 3)

Yes, occasionally [they use the tablet together], but then again [it] might be that the smaller is poking as much as, you have to let the older son be alone. (Mother, Family 1)

Families also had practices where a parent used devices together with children. Playing games with phone, tablet, or game console was mentioned. While playing games, the next moves were discussed together.

Mom was sitting and resting on the living room couch mobile phone at hand... Mom had the mobile phone at first in hand, but all (twins) were playing. (Diary, Family 3)

Also, watching movies or videos together was common practice for some. However, for movies, bigger screens were typically in use – television was preferred for that.

Smart device as a time-killer. Children (as well as adults) often used smart devices while waiting and having nothing else to do. In a public place, time-killing seemed to be the prominent practice with the display. At home, displays were rarely used for this purpose. This sort of role for technology was especially recorded when travelling in the car. Common for these situations was that some sort of unpleasant feature in the situation led to device usage; children could not move (in the car), they were restless, etc. In the following quote, the smartphone was used in a car, similarly for a time-spending purpose.

We were waiting in the car the older daughter's ballet class to end. It lasts for 45 minutes and the whole family was there this time... The younger daughter started to get tired after a day at kindergarten and started to lose patience in the car, so we didn't go to the store all. Instead she stayed in the car with her father... She was watching animations on YouTube. (Diary, Family 2)

4.3 Connections between public and private display practices

The practices with different displays (public vs. private, fixed vs. mobile) had surprisingly many similarities. Displays in both contexts were used eagerly as entertainment. They were used because they enabled a fun and nice way to spend time. Entertainment was the most common aim of practice in both situations. The difference was that for the public display, the eager users were typically small children or school-aged boys. The user group was narrower compared to the private setting, where all family members used the displays.

Displays were also used for “babysitting” in both contexts. At the swim centre, parents paid swimming fees or parked the car, and at home did household chores or worked while children were entertained with digital screens. In both contexts, adults were also relaxing while children interacted with the displays. What was interesting was that while other adults rarely interacted with the public display at the swim centre, parents seemed to be more lenient with it, guiding their children to use it.

The social nature of technology was visible in both private and public contexts. In the swim centre the public display was regularly used together by groups of friends socially. We found the same sort of behaviour with private and mobile screens in families. Parents played games with children, or siblings watched videos together and discussed the games. Family members

also used multiple devices at the same time, playing the same game side by side. However, in the home context the groups were smaller due to smaller screens and fewer people.

The biggest difference between the two types of display practices was that although private screens were also used as time killers, with the public display this was much more common. According to our diary study, displays were given to children to pass time most often in the car while having nothing else to do. On the other hand, in the swim centre, most people, especially adults and teenagers, preferred their own mobile phones for time-killing purposes.

Although we have no actual evidence, we can assume that display practices at home affected the public display practices at the swim centre. Parents easily left their children in front of the public display for a while as they did at home. Children also eagerly used public displays for entertainment like they used smart devices at home. We can also assume that such practices have travelled in space in other ways as well. Public display practices might have affected “private” display practices, for example, by increasing the social and collaborative uses of ICT at home.

5 DISCUSSION

In this article, we first zoomed in on practices around a public display at the swim centre. We observed that frequent users were children who regularly visited the place. We also identified recurrent usage patterns of the display: using the display for entertaining, babysitting, supporting social interaction and killing time. After zooming in to the swim centre public display (Study 1), we zoomed out to the display users and their families to find out connections between practices in other contexts (Study 2). Surprisingly, the smart device practices elsewhere were quite similar to those found around the public display. This indicates that, especially for children, the public display was just one of their mundane smart device “toys”, which was used for the same purposes as the devices at home. Also, parents seemed to have a similar mind-set.

This article presented the use of a ubiquitous computing system of interactive multipurpose public displays. The article concentrated specifically on urban computing systems and the origins of the emergent practices around that. As Weiser envisioned, new ubiquitous technologies have indeed produced socio-cultural changes and new practices [13]. This article also supports the earlier literature by highlighting the role of the triangle of people, places and technology in urban computing systems (e.g., [18][15]). In terms of the perspective of the emergence of practices, these three factors play the leading roles.

When it comes to the public display practices as performances, the same findings have partially been found in earlier public display studies that have concentrated on audience behaviour and interactional aspects. For example, public display research has acknowledged such phenomena as the audience funnel [41], the honeypot effect [40][36] and display blindness [36]. All of these were also observed to be part of identified display practices in this study. The honeypot effect can be related to children’s communities of practice and their ability to spot each other and to learn display usage from each other. Adults who did not belong to the same community of practice, on the other hand, suffered from great display blindness. In addition, the importance of the visibility of interactions, so that learning by seeing can actually happen, has been acknowledged earlier [43]. In this case, this visibility of interaction especially affected the durability of the practices as evidenced when new users adopted the practices by seeing others using the system. Findings related to user tendency to use technologies differently than they were originally designed and expected, namely so-called creative appropriations, have been reported by the existing research [51][46] and were evidenced in this study through babysitting practice with the public display. Although all

aforesaid elements describe aspects of the performances of practices already acknowledged in the existing literature, the findings of this study further our understanding and contextualize these existing findings of prior studies that concentrated mainly on interactional aspects and audience behaviour. By understanding the reasons behind these behaviours, designers should be able to find better-suited solutions, as well as overcome challenges associated with public display usage behaviour in public settings on a more fundamental level.

In terms of people, the public display users, this analysis supports earlier findings by noticing that children used public displays creatively without prejudice for different motives, while adults rarely interacted with the system. A similar type of finding of children using public displays has been published earlier (see, e.g., [46][42][34]). A new finding here was that children's public display practices seemed to be influenced by their other mundane ICT practices directly, as displays were used for similar purposes in public and private settings – for killing time, entertaining, supporting social interaction and babysitting. The same behaviour patterns have been reported earlier in young people's online behaviour and having family members bond through screen media experiences [75] as well as in children's and their families' screen media usage [81][6]. However, it is important to acknowledge that children's public display practices might also have unintended consequences, such as an increase in children's ICT consumption or even in the potential for technology addiction [81][72][73].

This study indicates that public display (or any other technology-mediated) practices do not emerge out of the blue. We see several factors contributing to the practices' emergence: the artefact itself, its affordances and the nature of the space, but also the mindset of the users and the developers. As for the users of this public display, the display practices are just on one end of the continuum of their media practices. We can assume that public display practices do not come first, but instead the use models are learned elsewhere, after which they are applied to the public displays. Interestingly, parents also seemed to follow the same routine in public context as at home; they harnessed the smart screens for babysitting their children in a similar manner in different contexts. Hence, our study suggests that particular practices may migrate to different places through the practitioners, who end up doing same things and having the same needs in different places with different devices.

This finding has implications for research and design; it indicates that when developing technology, we should pay attention to many factors that might be contributing to the emergence of practice around that technology. Developers make many influential decisions, but understanding users, their motivations and their existing practices is significant too. It is important to understand that it is not necessarily obvious from where the technology-facilitated practices originate or derive their inspiration. In the swim centre case, it was mainly children and their families who found use for the public display, and their existing smart device practices at home bore clear resemblance to the practices in the public space. This might have been difficult to anticipate by developers. It is a challenge to figure out from where the potential practices might be migrating. One natural way to start approaching this is to identify potential users and start examining their baggage with technology-facilitated practices with quite a broad scope. Of course, one could try to concentrate on practices with somewhat similar technology, but it is not always clear what this somewhat similar technology entails. Field studies on the use of existing technology are also important; through those we can develop an understanding of different technologies and the practices that have emerged around them. Evaluations of technology in use necessitate long-term deployments and studies, looking beyond the novelty value of technology.

6 CONCLUSION

Human-computer interaction research has become interested in studying practices instead of concentrating only on the short moment of interaction. The practice studies try to look beyond the novelty value and concentrate on understanding how technology becomes integrated into everyday life and how it shapes everyday practices over a longer time span. The main contribution of this article is in demonstrating how ubiquitous computing practices develop and in identifying various factors that affect the emergence of these practices. The paper sheds light on children's and their families' smart device practices in private and public settings by first focusing on children's practices with a multipurpose public display through an observational ethnographic field study, and then broadening the scope to the children's and families' smart device practices through a diary study. We showed that children's practices with a public display were surprisingly similar to their smart device practices elsewhere. As to the limitation of the study, we can note that the diary study could be extended with an observational one to make sense of the variety and richness of smart device practices in families with children. Diaries and interviews provide only glimpses of the practices. Then again, it might be very challenging to conduct such an observational, longer-term study in people's homes. Moreover, even with this data, we managed to identify similar technology-facilitated practices around smart devices at home and in a public space, which alone is a valuable contribution. This study indicated that there are several factors contributing to the technology-mediated practices' emergence, and these factors should be taken into account when developing new technology. Researchers interested in practice studies, and designers involved in the development of novel technology, should consider the implications of our results in their context; what kind of practice constellations could be identified around technology in their context, and what kind of trajectories of practice migration could one identify or anticipate?

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