“It would be handy if it had pictures, if you can’t read” – Young digital natives as mobile phone users

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ABSTRACT
Mobile devices and communication have become ubiquitous in the west and people born to this millennium start interacting with this environment from early on. These digital natives’ approach to the world and expectations of how it should operate may differ from that of the digital immigrants’. This creates a risk of a design conflict, where solutions developed by immigrants may fit poorly to the natives’ way to do things. It is important to understand digital natives better in order to know what design principles hold true with them. We interviewed 6-7 year old Finnish girls, who had just started school and had gotten their first mobile phone, to understand what their experiences are on using mobile phones, what they think of mobile phone use, and how they use them. This paper reports our preliminary results and proposes possible new avenues for research of digital natives.

Categories and Subject Descriptors
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors.

Keywords
Digital natives, children, mobile phone

1. INTRODUCTION
Today we are increasingly living with and relying on advanced digital solutions composed of servers, software, the Internet, fixed and radio communication lines, applications, as well as terminals ranging from tabletop to handhelds. Mobile connections and devices are ubiquitous and people born to this millennium start to interact with these systems in their early years. In the beginning mobile phones were intended for business people, but nowadays they are a phenomenon especially among children and youth. The iconic status of mobile phones amongst the young has been one of the biggest surprises in the telecommunication industry [18] and a lot of research had been done regarding children, youth, and their use of mobile communication technology.

Children in Finland are well equipped with mobile phones and other similar hi-tech devices [30]. In 2010 a total of 82 % of the Finnish 7 year old had their own mobile phone [27]. Similar pattern can be assumed to hold true for most of the developed world, with developing countries quickly catching up. These children can be truly considered ‘digital natives’[22] as information and communication technology use has been a natural part of their lives from the beginning, unlike with their parents. Consequently their view to, expectations of, and approach to the world and how it should operate may be subtly different from adults who have immigrated to the digitality. This development, however, presents us with two significant design challenges when developing mobile devices and solutions where interaction is mediated through such devices. First, we have adults designing solutions for children, who have a decidedly different set of needs and challenges from adults. Second, we have the immigrants designing and implementing systems that the natives will use, and yet what would be an obvious and intuitive way to do things for natives may be completely missed by immigrants. To counter these design challenges and to be able to do good and fitting design for young digital natives, we need to understand what design principles hold true with them. This has also provoked Vodanovich et al. [34] to raise a research question of “how do we design and implement ubiquitous information systems for digital natives”.

To get some insight to answers to the proposed research question in the context of mobile phone use, we conducted a qualitative, exploratory in-depth study where we interviewed eight 6-7 year old Finnish girls, who had just started school. We chose this age group for our research as in Finland it is typical that children get their first mobile phone when they start going to school [27]. Also, even though technology and media use of Finnish children have been studied recently (e.g. [20, 27, 33]) the use of mobile phone in this age group has not been of interest. Our aim was to learn about these children’s experiences on using their first mobile phone, in order to understand better what they think about the mobile phone use and how they use them. We will not give any definite answers to the question of ‘how to design mobile phones for digital natives’ in this paper. Instead, we want to explore the concept of young digital natives as mobile phone users and what Vodanovich et al.’s [34] research question might mean in this context, in the hope that through understanding of how these people currently use mobile technology we can gain insight to their future expectations (c.f. [13]). Based on that, we want to inspire debate and further research into this area.

This paper has the following structure: The next section presents existing research regarding digital natives as well as mobile technology in children’s everyday life. After that the research design and the procedures of data gathering and analysis are discussed together with positioning of the research and limitations of this study. Then the findings from our study are presented and in the last section we discuss about the implications of our findings and identify possible paths for future work.

MUM '12, December 04 - 06 2012, Ulm, Germany

2. YOUNG DIGITAL NATIVES USING MOBILE DEVICES

The idea of users being divided into 'digital natives' and 'digital immigrants', based on their comfort level of using digital devices was presented by Prensky [22] and has been adopted by many researchers since. While digital nativity has been a research topic for over a decade, the understanding of what digital natives are and what should be taken into account when developing technical designs for them is still in its early stages. In fact, the entire concept is somewhat controversial. Originally, research on digital natives focused mainly on the purported skills digital natives had; assuming that children having born into a digital world, having been immersed in technology since their birth caused them to shape to be e.g., digitally literate, social and highly connected [19]. Recently, however, there has been a growing body of research showing that the existence of a defined generation with common characteristics related to their communication and technology use is quite doubtable (e.g. [2, 14]) and young people's relationship with technology is more complex than many researchers have originally thought and needs more research. Rather, the original argument has been presented from a different viewpoint: instead of assuming all the digital natives to be able to naturally grow into the skills described above, they should develop those skills actively to be able to manage in the digital world [25].

There is no agreed definition of who are to be called digital natives, and not even the term has been set definitively yet (see [15]). The main body of research seems to assume that first digital natives are already in their thirties (see e.g. [2]). However, our view is that for true digital natives to exist some technologies have played a pertinent role in our environment and the true digital natives could actually be much younger. Availability of the elements central to Internet use (World Wide Web publicly available in 1991; the first graphical web browser, Mosaic, in 1993; Altavista search engine in 1995) and growth of the amount of Internet hosts from one million (1992) to 12 million (1996) and 110 million (2001) (https://www.isc.org/solutions/survey/history) made wide use of the digital Internet possible and meaningful, and thus has made it possible for children genuinely grow in 'a digital environment'.

This digital environment and different media technologies (including mobility) have not revolutionized our everyday life as much as thought originally. Children's lives still contain the same integral elements as before: they have their hobbies, meet their friends, and go to school - just as their parents used to [20]. In addition to that they do use the Internet and mobile devices, but the use of different media is just a multimodal part of their lives [28]. It cannot be denied, however, that something has changed: mobile phones and the Internet are currently so central communication media that we don't even recognize them any more as means of communication; mobile communication is just taken for granted, as a part of communication culture of young people [11]. Children of today live in the information society, where television, computer, handheld devices, wireless communication, on-line games, surfing the Internet, and global sharing are very mundane things for them. They use those themselves but they also see people who matter in their lives – their siblings, parents and teachers – using the same devices and tools [17]. Young people and families with children have always been on the frontline of change, and for current children mobile phones have always existed [16]. In the western world, handheld devices (chiefly mobile phones, although tablets are making fast inroads as well) are typically the first point of contact with the modern digital environment for the children, and this will be even more true for the developing countries as the time goes on. We think it is reasonable to state that there is a group of very technology-savvy people and that it is likely to grow in size, mainly from the younger generations, as people get involved with digital technology at ever younger age and learn to use it instinctively. Many of the young people – do we call them digital natives or not – spend a significant amount of time using hi-tech devices and being online from early on, and it is obvious that the world they live in is in many ways different than the one into which their parents were born.This means that the question of how to design solutions for this group is indeed relevant.

2.1 Children's Mobile Phone Use in Finland

Mobile phones are under continuous change and development. Starting from a simple device meant for mobile telephony, they have become pocket computers that include personal calendars, music players, task lists and photo albums, and are used for browsing the Internet, playing games, taking pictures, and watching television. In the future they may be used e.g. for identification. [18] Children are often the first ones to feel the winds of change in form of games, computers and mobile phones [28]. Most of the Finnish 7-8 year old use very diverse media. They read books and magazines, watch television and movies, listen to radio and music recordings, play digital games and use the Internet and mobile phone weekly. [27] In the Finnish information society children are very familiar with different hi-tech media and devices, and are adept users of those – it is just part of their everyday life [28].

Finnish children are currently amongst the top mobile phone users in the world. In turn of the 21st century it was still quite rare, though, that a 12 year old would have had their own mobile phone. In 2001 more than 70% of Finnish 8-10 year old told that they used a mobile phone often but only 29% actually owned one [29]. It was also typical that children got their parents' or elder siblings' previous phone as their first phone. Because of that, the phones were often large and cumbersome and children were not keen on taking the phone along when playing or visiting their friends. Thus the phones were not used in the situations where they would have been most useful. [16] Mobile phones were considered to be more for personal entertainment than for communication [29]. Nowadays, however, Finnish children usually get their first mobile phone as soon as they start to move independently outside their homes (i.e. go to school) as parents consider that owning a mobile phone increases children's safety [18, 21]. 82% of Finnish seven year olds and 94% of eight year olds had their own mobile phone in 2010. 43% of this age group also used mobile phone daily and 82% of them on a weekly basis. When compared to the younger age group, only 14% of six year olds had a mobile phone. [27] According to Suoninen [27] in 2010 of 7-8 year old Finnish children 85% used mobile phones for making calls or sending text messages, 48% of them played games, 28% took photos, and 25% listened to music weekly. 38% of them made calls or text messaged daily. Compared to adults, children still consider mobile phone mostly as an entertainment device but also as a means for social communication [21].

2.2 Mobility and Family Life

While for over 10 year olds communication with friends is more

important, younger children use mobile phones mainly for 'family communication' [7]. Indeed, mobile phones are used as a safety line between children and parents (e.g., [7, 29]). There are, however, some inherent risks in relying on technology in this respect that may result in problems if fall-back systems are not maintained. For instance, many of the children do not know where their parents are when e.g. at school and while parents' phone numbers are stored in the mobile phone the children do not know them by heart. Should the mobile phone get lost or run out of battery, the information contained in the device is unavailable and the child is left without means to reach out. [23] Despite of such shortcomings, mobile technology is still useful in improving interaction between children and parents. Parents have a central role in children's lives, affecting their social, emotional and cognitive development. Hence interaction between children and parents and parents' interest in the children's lives are critical for the wellbeing of a child. The rising trend in divorces and parents having increasingly hectic work life means that children and parents have less and less time to spend together. New ways to help family members to maintain closeness, even when separated, are thus needed. [36]

Figure 1. Lappset mobile playground

'Mobile parenting', a term coined in Finland, raises discussions and emotions amongst parents as many are worried that the possibility of being in contact through mobile phone decreases the amount of time parents spend with their children in person. Still, the possibilities mobile technology offers for communication between children and parents, and as a 'safety line', are not to be belittled. Mobility can also improve the effectiveness of daily family life: parents can make a wake-up call to their children during their way to work, and they can inform about the daily schedules by calling or sending a message while at work. [29]

On the other hand the continuous online presence can have negative effects as well. It increases the reach of the mental umbilical cord and by reinforcing the closeness may hinder the gradual independency that children should develop from their parents and vice-versa. [28] 'A mobile phone society' is in many ways different when we compare it to the earlier times. Back then children used to have mealtimes and curfews limiting their use of free time, but in-between they had their own and undisturbed time and space. Nowadays parents call the children when the meal is ready or it is otherwise time to come home [29]. While the children can negotiate their use of time over phone, it does cause the children to lose some of the control of their own time [28]. Parents can thus use the mobile phone to control their children, but as a positive side it allows flexibility and effectiveness and can encourage the child to be more independent [8, 18, 28].

2.3 Learning and Building Self-Confidence

In its simplest form mobile learning is just using mobile technology in learning something. Location and time independency as well as possibility for personal learning process are typical characteristics of mobile learning. Currently almost all the new mobile phone models have digital and video cameras and possibility for online connection. These features enable mobile learning and offer a good foundation for further development in this area. [32] With more advanced mobile devices children can find information when they need it but they can also go beyond and create information themselves and share it with others. Being able to produce content allows children to exercise their creativity and to better understand the world around them. [6]

Mobile technologies offer many advantages to young users: portability of the devices and location independency suit children very well as they often move quite a lot [6]. According to Guernsey [9] children value portability of a mobile device as it enables device use time and location independently, and most importantly it creates a feeling of control and ownership. Children may even feel that the mobile device is the single most important item they have; responsibility over the device and its use empowers the child. Portability enables them to slip into their own world whenever so desired. Trotter [31] argues that solving of technological challenges when using mobile phones gives children positive sentiments over their skills as they are able to actualize something with technology, increasing children's self-confidence.

Thinking mobility not as much as a feature of a device but rather as a feature of the use of the device gives designers possibility to get children move more, instead of adding to their immobility, which technology is often said to cause [6]. One practical example from the industry comes from the Finnish company Lappset that has developed playground outdoor games based on the insight that children like both technology and physical playing (Fig. 1). Rogers and Price [24] present another example of combining mobile technology with physical play and learning about viral infections where children move around wearing a 'viral necklace' and infect other users who come close enough.

2.4 Usability and Design

Technologies are embedded in children's lives, not only in form of mobile devices but also in toys enhanced with technology or in functions that make our everyday life easier, like sensors used for automatically flushing a toilet [5]. Human-Computer Interaction (HCI) research has for long emphasized the importance of understanding the user needs and the users' participation to the design process. In mobile interaction design the aim is to enhance the user experience and find ways to make users' lives easier [13]. As technology forms an important part of children's lives, they are a large user group and often have good skills in technology use. Designers, however, sometimes forget that children are not just small adults but, instead, a totally different user group with their own needs and interests, which are not necessarily the ones their parents or teachers think them to be [4]. It is hard enough for designers to get into the mindset of an adult user group they don't belong to themselves. It is much harder to do so when you also have to cross the generation gap. Thus having children participating in the technology design process is important [4]. Quite often children are consulted only close to the end of the product development phase but it is possible and even recommended to have children in many different roles when

designing new solutions for their use; children can act as users, testers, informants and also design partners, through the whole design process [3, 10]. Cooperative Inquiry is one example of a method where children can be actively involved throughout the process [3]. Working with children can be challenging, though, and the challenges are different with different age groups as children's cognitive, social and emotional development is fast [10]. Recently, the discussion focus has changed from the technological innovations and their significance to what is important in people's everyday lives and how HCI can be used to support that. To be able to design mobile devices and services children want to use, it is important to understand what is significant and valuable in the young users' lives. [13]

The large amount of features currently offered in mobile phones makes the devices complicated and creates problems with usability [12]. Bay and Ziefle [1] say that the assumption in the mobile phone industry seems to be, however, that improving device usability is not that important in the future as children are used to interactive technology. Therefore it will be easier for them to learn to use new devices than it has been for the adults who have grown up in a less technology-oriented world. Usability should still be seen as an important feature, however. According to Bay and Ziefle [1], interaction design flaws cause similar problems with both children and adult users, e.g., ambiguous naming (two different functions having very similar names or using of very abstract or general terms), illogical grouping of functions, using equivocal icons (users do not understand the meaning of the icon), and changing functionality of buttons in different use situations. They found out in their study of 9-14 year olds that the difference between child and adult users was that children persistently tried to do the task again and again, until they succeeded. Thus, regarding usability, designing devices for children does not need to be markedly different from designing for adults. For illiterate children devices should be designed differently, though. [1]

2.5 Design Dimensions for Digital Natives

The idea of differences between digital natives and immigrants has inspired Vodanovich et al. [34] to ask the whole IS research community a question of "what does the rise of the digital native and ubiquitous information systems mean for IS research" and as a sub-question to that: "how do we design and implement ubiquitous information systems for digital natives". With 'ubiquitous information systems' they mean the intertwined systems consisting of hardware, "people, processes, information, and communication systems and technologies" that are "interconnected and interwoven into the very fabric of our lives through ubiquitous networks".

As a preliminary answer to their own question Vodanovich et al. [34] suggest in their article five interrelated dimensions that could be used when designing and implementing ubiquitous information systems for digital natives. The *personalisation* dimension is about giving the user possibility to change the design of the system or the system adapting automatically to user's behaviour, to e.g. match the system difficulty level according to the user skills. The *interactivity* dimension refers to the level of user activity when using the system, i.e. that instead of just passive consumption users also want to act through their devices. The *intuitive* dimension is about ease of navigation and use, and the *attractive* dimension about the system being somehow pleasing for the user. Finally, the *social* dimension refers to the possibility to present one's 'achievements' to other users as well as the possibility to express a virtual identity. They argue that all these dimensions affect each other and may also enrich each other when all of them are considered carefully in system design.

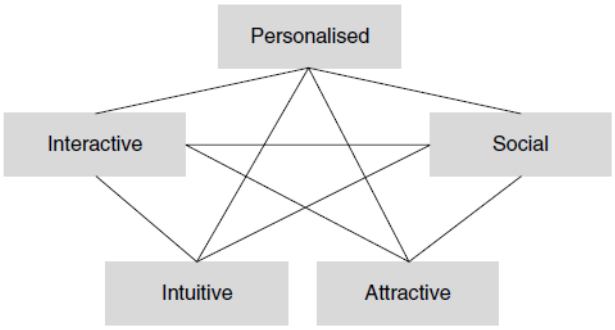

Figure 2. Ubiquitous information systems design dimensions for digital natives [34: 718]

3. METHODOLOGY

We wanted to find out how the Vodanovich et al.'s [34] five dimensions (see Figure 2) are represented in 6-7 year old Finnish girls' mobile phone use. These children can be considered to be 'true digital natives' according to their birth year. Being born to the highly technology-oriented Finnish information society also strengthens this.

3.1 Research Design

To gain insight to how children use their mobile phones and their motives for mobile phone use we interviewed, during fall 2011, eight Finnish girls, six 7-year old and two 6-year old, from middle-class families. We also asked their parents to fill a questionnaire. We felt it was important to have both the children's and parents' points of view as the children were this young. We took care, however, to treat the possible differences in the answers between these two groups as different viewpoints, not as 'incorrect answers' of one party. Engaging the parents gave us also the opportunity to check certain facts should the child not remember it; e.g., for some children it was difficult to remember how long they had had their mobile phone. We were not able to get an equal amount of boys and girls to participate the study and since we had more girls interested in participating, we decided to focus on this gender group only.

Interviewing was selected as a research method as we felt that it suited better than quantitative methods to the exploratory nature of our study. It also gave us possibility to get more in-depth, explanatory data than is possible to have by using observational methods. In this type of exploratory research where the aim is to understand a phenomenon better and to get more information of it, qualitative interviews offer us a possibility to gain new knowledge without knowing beforehand what kind of data it is possible to get. Quantitative studies can be used later to see the extent of the possible new issues found, but this is out of the scope of the present paper.

The interviewees were selected based on their and their parents' willingness to attend to the research. All of them had just started school and thus for the first time in their life had to act rather independently. Finland is still a very safe society compared to many other countries, where it is mandatory to escort the child to and from the school for security and safety reasons. Hence in

Finland children typically go to school by themselves and often have to spend some hours after school alone at home. Four of our interviewees had received a mobile phone a bit before the school started and four had gotten it earlier. The parent questionnaire was filled for each child in the study. Of respondents 7 were female and 1 was male. The questionnaire was discussed with the parent when it was returned, and with some of the parents there was also a conversation about the results of the study.

Four of the interviews were conducted at children's own homes, in their own rooms and four at home of the interviewing author, who was at least distantly known by all the interviewees. Children interviewed at their own homes were relaxed and answered the questions openly and at length. Two of the four children interviewed at the interviewing author's home were tenser in the beginning of the interview but relaxed towards the end of the interview, which showed in e.g. use of longer sentences, not just one-word-answers. The girl for whom both the interviewer and her home were most unfamiliar was also most nervous and answered the questions only by nodding or shaking her head when it was possible. She was also the only interviewee who had her mother present at the interview situation. We saw quite clearly that, in that case, the interview arrangements affected the richness of the data but we were not able to affirm whether e.g. having the mother present resulted in 'better' data or 'worse'.

Interview duration varied from 14-45 minutes but most of the interviews took about 30 minutes. In the interview situation the interviewer sat on the floor opposite the child and the video camera that was used to record the interviews was beside the interviewer. In the beginning of the interview the interviewer checked that the video camera worked and at the same time explained the child what she was interviewing the child for, what the interview would be like and why was it recorded. Use of video camera (compared to only voice recording) did not seem to disturb children. To get the child to relax the interviewer asked first general questions about school and hobbies and gave the child a possibility to draw a picture about mobile phone use; only 3 of the 8 children wanted to draw something, though. At the end the interviewer gave the child a small gift as recognition for her attendance in the study. The interviews were semi-structured theme interviews. Themes were chosen based on the earlier research on children's mobile phone use. The names of all the participants have been changed. The interviews were transcribed from videotape and analysed using content analysis, categorising information based on the ubiquitous systems design dimensions (see Fig. 2). Our results are presented based on this categorisation.

3.2 Research Positioning and Limitations

Our interest lies in the area of design challenges and how to overcome them. Learning more about the target group will help the community of science as well as the community of practice to formulate design principles that help to create better products. While our main focus is in digital nativity, we consider young children as an extremely valuable demographic group for studying this topic. What makes this target group a particularly interesting one is that children pick up technology progressively earlier - at an age where things very strongly shape their world view [35]. 'Nativity' is very much about growing up in a particular environment and suggests that studying the formative age is good for catching the early signals, the 'root causes' that later on express themselves as patterns of behaviour. It is easier to do good design if you understand the reason (why they do this), rather than try to base your design on the symptoms (what they do). Since our interest is in helping to overcome design challenges it makes sense to study young children both as digital natives as well as technology users in general in order to get a more comprehensive understanding of this target group. Care must be taken to be able to separate the two effects, however. We therefore position this research as belonging both to the field of IS design for digital natives and to the field of IS design for children.

This study has obvious limitations due to its explorative nature. Only eight children were interviewed, all of them girls and from the close locality. It is possible that their gender or district affects the results. Our focus in this paper is in mobile phone use and thus other mobile devices, such as tablets, have been left out of this study.

4. EMPIRICAL RESULTS

Both children and their parents taking part in this study had positive experiences of children's mobile phone use and felt that mobile phones were needed and useful for the children. Children used their phones sparingly, most of them not daily, and even those who used them daily did not need any restrictions for the use. The children told that they took care of their mobile phones by themselves and that they were also responsible for the phones, e.g., they felt that they should not loan their phones to anyone. Some of the children mentioned that their younger siblings were too small to have a phone, thus implying that owning a mobile phone was something special and a sign of certain maturity.

Parents in our study felt that significance of mobile phones will only increase in the future, and that children probably will get their first mobile devices earlier than these children had gotten theirs. *No child without a phone and probably they get it ever younger.* (Parent) *Ever younger children get their own phone and the phones have ever more features*. (Parent) One of the parents felt that the mobile phone use can involve a risk of children spending less time playing outside in the future. Generally the parents had a positive attitude about mobile phone use, however.

Some of the parents wished for a simple phone meant solely for children, one that would have only very basic features and designed for ease of use. Because of that they had bought the cheapest and simplest model for their child. Parents were also worried that children this young could easily lose or break their phones. *[Phone] was chosen based on its price (as inexpensive as possible, in case it gets lost or breaks up).* (Parent)

Parents told that the child was provided with a mobile phone to allow convenient communication between the child and parents and to alleviate parents' concerns about child's safety. *[…] when child started moving more outside home boundaries. We wanted to be able to contact the child when needed.* (Parent) *We hoped that it provides mutual safety, if something happens e.g. on the way to pre-school or when the child comes home and there's nobody else at home.* (Parent) *On the way to school calling to check that child has arrived safely at school.* (Parent) Some of the children told that the reason for getting a mobile phone was to keep in contact with their parents while some thought that the phone was mainly for calling their friends and asking them to play. *If some friend lives far away then I call if she can play with me. So that I don't need to go that far.* (Pinja 7 yrs.) None of the children mentioned mobile phone adding to their feeling of safety. Finland is one of the safest countries in the world, thus the safety issue probably is more about normal parents' worries about the

well-being of their children in general, than an acute need for it. Situation might be very different in some other country. Six of the children lived in a small town. For the two living in the countryside the phone was bought partly because of the long way to school.

4.1 The Personalization Dimension

The children used mobile phones for basic functions, such as making calls and playing games, but they also wanted to personalise their phones: they browsed through ringtones and changed them often. They also changed their wallpapers once in a while. *For example when you put your own picture as wallpaper or draw something with your name in it, or then take a picture with a phone, then you can use that as wallpaper. I just recently figured that out*. (Maija 7 yrs.) The physical design and visual appeal of the mobile phone were even more important for the children than the features of the phone. Children liked beautiful covers, were pink was the most favorite color, and favored slide and clamshell models over the simple candy bar design. *When I buy my own mobile phone then I buy a clam phone.* (Nella 7 yrs.) Some children decorated their phones with stickers. In addition to being aesthetically pleasing the decoration had also a functional meaning, helping the child to tell her own phone apart from other, similar looking phones. *Then I put these stickers on the first day so then I recognised this phone.* (Helmi 7 yrs.)

4.2 The Attractive Dimension

Personalisation and attractiveness of the phone were closely related in our study. When asked what kind of mobile phones there could be in the future for children's use, in addition to the phone looking nice, children also wanted to have better mobile phones with diverse functionalities. Most of them wished for a camera and touch screen. *Ones you can touch, touch screens. Ones you can play one of my favourites, and it is… what was it?* (Maija 7 yrs.) *Such kind that they sparkle or such, yeah at least I would buy such kind [of a phone] […] Then I could have such kind of a phone that has camera […] when I'm adult I will […] check what the best phone is and then I buy the one that is best.* (Helmi 7 yrs) Children liked to compare their mobile phones with their friends and they were able to describe what kind of mobile phones their friends had as well as features in them. They also wanted to get similar features for their own phones. *No, I would have wanted one like Leena has but dad did not want to [buy it] as mom has had that kind [of a phone] and it broke.* (Nella 7 yrs.)

4.3 The Interactivity Dimension

This dimension did not feature prominently in our findings, possibly because the children were young and had fairly simple phone models. Nonetheless, these children used their devices as diversely as possible; only one used her mobile phone just for making calls. All the others used it for at least playing games as well. All four children who had a camera in their phone took pictures with it and two of them also used the built-in video camera. Three of the children sent text messages; two used their phones for listening to music and two as an alarm clock. *Well, I play and send messages. […] I check the time. And then … check if the battery is ok, and then … listen to music. […] [I have] filmed. And take pictures.* (Maija 7 yrs.)

4.4 The Intuitive Dimension

Learning to use the mobile phone was not easy for the children initially. Many of them were still illiterate and this made the mobile phone use more difficult. *Well, it [being able to read] might help with some menus or such. […] For example it would be handy if it had pictures if you can't read […] and then [there could be] such kind of phones children know how to use.* (Kiia 6 yrs.) Some children and especially their parents still wished that children's mobile phones would be easier to use and one of the criteria for choosing the phone was the purported ease of use. *So called children's mobile phone has not been designed yet. In the current ones [there are] too many functions and it has not been thought that phone can be used by an illiterate child.* (Parent) *We bought an easy-to-use phone.* (Parent)

Even though learning to use the mobile phone was not that easy, once the children had figured out how to use the basic functions they were more confident with the use and felt it was not so difficult any more. Some parents told that the child was very skilled user already. *Yes, she uses it very skilfully. Does not need help almost at all.* (Parent) *Masters it better than mother!* (Parent) Many of the children mentioned, however, that there were features they did not know how to use yet. *Yes I know, but I don't know almost all of them*. (Maija 7 yrs.) One of the children had found out by herself how to switch key lock on pushing only one key and was very proud of herself. *You didn't know that it's possible to do it with this key? I found it out by myself!* (Helmi 7 yrs.) Children also used ways to work around the literacy barrier, e.g. by using pictures to recognise e.g., who was calling. *Well, you see, as I have those pictures there, that's how I know.* (Kiia 6 yrs.)

4.5 The Social Dimension

For these young children the most important thing in the social dimension was calling their parents, grandparents and friends. If they had their mobile phones with them at school, they typically called or texted their parents on the way home to inform that they were now coming home or to talk about their plans for the afternoon. *[I call mostly] maybe mom. […] sometimes after school if I have something to say.* (Noora 7 yrs.)

Parents told that the main reason for providing the child with the phone was to maintain contact with the child when she spent a growing amount of time outside of home boundaries. They called their children to ask them to come home from friends and to check that the child has arrived safely where she was supposed to go. 'Mobile parenting' per se was not present among these parents; none of the children were e.g. woken up or sent to school by calling them and none of the children needed to spend hours home alone, with just a mobile phone connection to their parents. Children also called their parents to extend play time when they were with their friends but in general they did not need to take care of curfews and other appointed times. Parents usually called their children when it was time to come home. *Yea, or mom calls when I have to go home.* (Maija 7 yrs.) Most of the children in our study were illiterate and thus calling was the media for social interaction. Only three of them sent text messages although some of the other children also mentioned that they would send text messages in the future when they can read and write better.

5. DISCUSSION

This study looks into the use of mobile phones by 6-7 year old Finnish girls revealing a brief glimpse of what they think about these devices and how they use them. The intention was to explore the topic of young children as digital natives as well as technology users in order to gain more understanding of this

target group and to get some insight that would help to establish a preliminary framework for further studies. Our findings support the earlier research results regarding the needs and desires of the young children as users of technology, but we feel that some topics would benefit from more attention: the literacy barrier that is a significant impediment for learning mobile phone use, that children take joy from learning new things, and finally that the devices should allow for growth and change, as children change very quickly when they grow - more quickly than they replace their mobile phones. For digital nativity our data did not give any definite answers, but there were hints that it may be more subtle than what the current discourse is focused on. The digital natives may not necessarily differ that much from digital immigrants in how they use the technology (technical skills), but what they use it for (how it has changed the patterns of behavior in the everyday life) and especially what expectations and assumptions they have of the world and how it should operate.

5.1 Young Children as Users of Technology

Children as users of technology have been a topic of much interest in the field of HCI research over the past two decades. HCI research in general has long emphasized the importance of understanding the user needs and user's participation to design process because designers' own set of preferences, needs, and desires affect the design decisions as well, even to the extent that the outcome can easily become a matter of how well the designer can relate to the target group. E.g. Druin [4] has highlighted that children are a very specific user group and adults may have particular challenges when trying to relate to children's needs and interests. Although a lot of information is already available, there is room for more research. Children pick up digital devices at evermore younger age, which necessitates extending the research towards earlier age groups. Furthermore the fact that children's needs and interests are under constant reform and change as they grow makes them a very challenging user group to pin down. Every bit of research adds to our understanding and even significant issues can still be found.

Attractiveness and convenience. Mobile phones have been present in our interviewees' everyday life since their birth but did not play a central role in their lives. The children did not use their phones every day and did not take the phone with them everywhere they went. Phones were used mainly for communication and usually only when needed. It may be that the novelty value of mobile phones has decreased from the days when the phenomenon was new to the whole society (cf. [16)]. However, these children still wanted their mobile phones to be 'cool' and attractive to use, and compared their phones actively with their friends. Aesthetics and ease of use were considered as key features but the children also appreciated some of the capabilities in their friends' phones and wanted to get similar functionality for their own devices.

As found out in many earlier studies, mobile phone is a 'safety line' for both the children and their parents, providing a convenient way to reach out, coordinate things, and check that everything is ok. It extends the parents' reach and allows them to manage their children's activities almost as easily as if they were at home. Children also used the phone to make it more convenient to coordinate activities with their friends, e.g. asking if they were available, instead of physically visiting them first. As a result these children were able to use their time more effectively and to stay out and engage to their own activities until their parents called them to come home. While logistically very convenient, this also has a potential to make it less necessary for the children to learn some related skills (e.g. how to read the clock) and to take responsibility for keeping with the arrangements (e.g. coming home by the curfew time). While the risk of decreasing children's activity level is also often mentioned, we found out that at least those involved in this study moved quite a lot anyway and liked to play outside. The phone did not make them passive.

Literacy barrier. In our study we found out that the parents preferred simple, inexpensive devices where communication was the primary feature, for their children. The reasons were twofold: firstly the parents were concerned that the device could be lost or get broken - a reasonable concern considering the age of the children and the price and fragility of the devices - and secondly because they were worried that the more expensive devices would be too complicated to use. What we found out, however, was that it was not the feature richness that made the mobile phones difficult to use. Instead it seems that the main impediment was that the children were not fully literate yet. At the age of 6-7 most are still in the process of learning how to read fluently, or at all.

This issue came up very clearly in this study, even though the sample was small, so it can be assumed to be quite prevalent challenge for this age group and one that should definitely be addressed in the device design (cf. also [1]). The problem is further complicated by the fact that the children are venturing to a new and unfamiliar territory: how to use a fairly complex device with few – if any – dedicated hardware buttons that always do the same thing no matter what the device state is. This jump from a simpler physical world into a mutating digital world is challenging for adults and children alike, but adults at least can read the signposts (i.e. menu navigation).

The good thing is that children are very adaptive and find ways to circumvent problems – here they started to use pictures to identify who was calling. This suggests that one possible design approach might be to increase the use of graphics in the interface and navigation, not just in the main menus but within applications as well. However icon-based communication still is a language that has to be learned and can be very prone to interpretation mistakes or problems. We often do not realize how much we rely on our past experiences when interpreting various icons we see around us. Many of us can recognize a 'recycling' icon even though it can take many shapes and forms – and having learned to use GUIs, we may even understand that such icon means 'trash bin' when seen on the screen. For children, such leap of logic may be completely unmanageable without help. Thus the interface design may need to be taken even further and explore other solutions, such as interfaces that utilize voice -assisted navigation (icon speaks out what it does) or actions that have clear analogies in the physical world (similar to drag-and-drop, but taken further and used in the applications instead of providing a menu of choices).

Desire to learn. Our study indicates that children find joy in and satisfaction from learning to use their phones (cf. [31]). Mobile phones were a topic for discussions in their peer groups, and children shared with pride what new tricks and things they had learned about the phone. This suggests that supporting self-learning would be appropriate for the children, at least if designed with the target group in mind. The current approach of text-based manuals full of complicated technical jargon that even adults find difficult to comprehend is not quite appropriate for these users. One possible approach could be short video tutorials –posted on

the Internet or periodically offered directly to the device – that would take one atomic part or function and go through it, explaining what it is for, and provide a screen walkthrough of its use. Such tutorials could also include important basic (simple layman) information of things such as what is a WLAN, and useful tips such as how switching off WLAN sniffing can help to improve the battery life.

Coping with growth. Another important thing to be considered is that children learn and grow and as a result their needs and desires change. The average use time for a mobile phone (i.e. from purchase to replacement) varies from 2 to 6 years (http://www.phonearena.com/news/Americans-replace-their-cell-phones-every-2-years-Finns–every-six-a-study-claims_id20255) which is a long time when considering how quickly the children evolve. Thus, apart from the need to design interfaces for illiterate and early-use phases, the design must also allow room for change and growth. For interface design it means the capability to adapt to match the skills of the user – such as changing from voice and icon-based to more compact text-based as the literacy barrier is removed. But it also extends to audio-visual and functional content i.e. children need means to add features and personalize their devices to fit their needs and preferences.

A solution is in fact already there in the form of on-line application and content stores, but these have been designed with adults in mind. Finding suitable applications, learning about them, taking care of security issues, etc. all require far more skills than an average child has. Children may be very ready to customize their phones, but this will not happen if the threshold to find out about the possibilities is too high and if the parents do not have the motivation to do the work. This also means missed sales opportunities. It would thus make more sense in many ways to provide a store that children find informative and easy to use so that they can browse the selection, make a choice, and then ask their parents to approve and make the purchase.

5.2 Are Digital Natives Any Different?

According to Vodanovich et al. [34], the current IS design is catering for digital immigrants rather than natives. This design conflict goes back to the same issue as discussed in relation with children: the difficulty for designers to relate to the target group because of lack of insight. To improve the situation, Vodanovich et al. suggest research questions that help to learn more of this user group as well as propose a model of key design criteria. The model highlights the criticality of usability over functionality (the elements are usability-related) and identifies five dimensions that are of paramount importance when designing for digital natives. They also highlight some design factors that separate digital natives from immigrants. Starting with the importance of usability over functionality, they imply that digital natives may not differ that much from immigrants as far as their needs are concerned, but rather how things should work. Within each of the dimensions they also point out some design principles that set digital natives apart from the rest. As such, the Vodanovich et al.'s [34] dimensions are fairly universal. One of the authors of our study has worked in mobile phone development for nearly twenty years, and could instantly recognize the five dimensions as major topics that have been very much on the forefront of mobile phone design for the past ten years. It is the insight into the design principles within the dimensions, derived from the target group's needs and priorities that make it specific to a particular target group.

While our findings supported the structure of the model [in 34], they did not bring up any clear issues where these children would have had distinctively different technical skills, world views, or used their device somehow 'differently'. Upon making a deeper analysis, however, we did notice that there was a clear signature of how the mobile communication had changed the way how family life was coordinated and realized that this change may have an impact on what kind of skills the children develop in their formative years. For instance, before the availability of instant and personal communication the family had to rely on agreed schedules (curfews, etc.) to coordinate the daily life. This taught the children to mind the clock, run a 'virtual calendar' in their head, and to take full responsibility for keeping their part of the agreement – or face the consequences (getting grounded, etc.). Nowadays, however, children effectively have their own personal assistant (i.e., their mom) who takes care of reminding what, when, and where. It is not a far-fetched thought that they will grow up having an underlying assumption that the world will provide such information just in time and that they don't have to take care of this logistical part. If this is how they expect things to work, they do not necessarily have the skills needed to operate differently. Such skills can, of course, be learned later on but this is already about having to adapt to a different environment than what these children would consider to be 'native'.

This is but one example of how the digital natives and digital immigrants can have very different expectations on how the world operates. While this particular case may not be a major issue nor does it point out any immediate design conflicts, it does suggest that the difference is there and that it may be far more subtle than suspected. The implication to the research community is that the research of digital nativity should be extended to study what kind of operative patterns the children, who grow up in a technology-rich world, learn to expect and rely on, and how these differ from those learned by previous generations. Analysing these differing patterns of behaviour will provide us a deeper insight into digital natives as users, and can be a rich source of design principles that help us to create better technology solutions for them.

5.3 Overcoming the Design Challenge

The material and insight we gained from our study gave us a good starting point and support for future studies. We felt very strongly that we managed only to scratch the surface and that there is definitely need to go further into this research territory. Our proposal for the research agenda is that the future studies would focus on identifying design principles that are specific for digital natives, using the following three approaches as the framework:

1. **Design principles derived from patterns of behaviour –** By studying the digital environment where the digital natives grow up, what tools and approaches they utilize and how they carry out their activities, we can discern patterns of behaviour that help create solutions that better conform to digital natives' preferences.

   Question 1: What kind of (technical as well as operational) environment the digital native has grown up in?

   Question 2: What patterns can be found in the digital natives' daily life, e.g. when they look for information, solve problems, engage socially, entertain themselves, etc.?

   Question 3: What kinds of problems arise when digital natives use current systems, and how they would prefer things to operate?

Question 4: How do the digital natives' and non-natives' patterns or the tools they use in comparable situations differ?

2. **Design priorities derived from needs -** By studying digital natives' societal environment, needs, and challenges we can identify needs that help create solutions that better conform to digital natives' priorities.

   Question 1: In what kind of society and social environment digital natives have grown up?

   Question 2: What kinds of needs can be identified for digital natives through field research or from literature?

   Question 3: How the digital natives' proposed needs reflect to studies of earlier generations and established models for human needs?

3. **Design strategies derived from values** – By studying digital natives' values and principles (cf. e.g. [26]) we can understand better their world view and priorities beyond immediate needs, which helps us identify areas where new solutions are needed.

   Question 1: What things digital natives value in their lives? What things they value in the society? What are their views to things such as rights, equality, etc.?

   Question 2: How the digital natives' values reflect to those of earlier generations?

Through combining all three can we get a comprehensive understanding of what solutions we should be designing, when and why, and how they should be designed.

6. CONCLUDING REMARKS

While our exploratory study was fairly limited and raised more questions than gave answers, the findings have clearly added to the body of knowledge regarding the children as users of technology. Overcoming the barrier of illiteracy, need for the device to cope with growth and change, and to find ways to support the children's innate desire to learn are all issues that need more attention from the design community. There is still much to learn about this topic, especially because the children get their first devices at ever younger age. If we are to develop good technical designs for this growing body of very young users, we need to extend the research to much younger age groups than before to find out what implications and challenges there are to usability and interaction design.

Our findings also hint that the notion of digital natives being a distinct group and different from digital immigrants may indeed be true and worth of further pursuit. The pervasiveness of mobile communication and digital technology in general has changed how families operate, and this can have an impact on what children learn to expect from the world and how it works. The difference may thus be very subtle and buried in the assumptions that the children develop, rather than in the skills they exhibit. Research should thus be extended towards formative years and findings derived from the (operative and technical) environment in which the children grow up.

We found out that mobile devices are an excellent focus from research point of view because they are typically the first point of contact to the digital world for children – to the extent that we already see cases where tablets are being used by toddlers, who can't even speak let alone read or write and whose motoric skills are very much different from those of adult users, yet who obviously can grasp how these devices work and clearly enjoy using them. One can only imagine how this will shape their world view, giving them a totally different idea of how things should work and behave (cf. how the use of an iPad affects what a child expects from a magazine: Part 1 - http://youtu.be/aXV-yaFmQNk and Part 2 - http://youtu.be/kJZSLvTK4pw).

Studying young children as digital natives is both challenging and rewarding at the same time. Even adults can have hard time in externalizing their thoughts, needs, and desires regarding technology use, and young children may have additional challenges in this respect. Therefore the research of young digital natives should definitely be combined with the existing studies on digital natives and child development on different fields of research, as well as with the research already abundant on the field of cooperative design with children, that has been a topic for human-computer interaction research (HCI) for the past two decades (cf. [3]). Existing research methods and results help us to better work with the research subjects and may help to differentiate which of the findings are related to the subjects being children and which ones are related to digital nativity.

Finally, while we found out that it pays off to study young children as digital natives, it is still important to keep in mind the ethical and moral questions when dealing with this vulnerable target group. Who is to decide if the technology is to be developed or not, and what is really and finally best for the children and their future have to be considered carefully. Our course of action should be ultimately based on the understanding of what is significant and valuable in children's lives, and the findings that help to create more attractive and pleasing technologies have to be used to support this [13, 23], not some other goals.

7. ACKNOWLEDGMENTS

We want to thank the participating children and their parents.

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