Representing Children Living with Visual Impairments in the Design Process: A case Study with Personae

Emeline Brulé, Christophe Jouffrais

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Emeline Brule
CNRS & University Paris-Saclay
Telecom ParisTech
emeline.brule@telecom-paristech.fr

Christophe Jouffrais
CNRS & University of Toulouse
IRIT-ELIPSE
Christophe.Jouffrais@irit.fr

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E. Brule, CNRS & University Paris Saclay, Telecom ParisTech, Paris, FR. emeline.brule@telecom-paristech.fr
C. Jouffrais, CNRS & University of Toulouse, IRIT, Toulouse, FR. Christophe.Jouffrais@irit.fr

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E. Brule, C. Jouffrais

Abstract: Assistive technologies (ATs) must improve activities but also participations of impaired users. Thus when designing ATs, especially for children, one should consider the diversity of users and disabilities but also the educational and societal contexts, as well as subjectivities (i.e. personal experience of disability, own motivations, etc.) Co-design is a method that helps to encompass all those features, but that is not easy to achieve with impaired users, especially when they are children. In the context of a research project on interactive maps for visually impaired people, we first conducted a field study to better describe potential users (visually impaired people, but also parents, teachers, therapists, etc.) and their needs. Building upon this field-study, we developed a set of design cards representing users but also needs, places, goals, etc. We then designed a workshop aiming at improving the knowledge and empathy researchers had about users, as well as the ideation step of the design process. We report on how these methods facilitated the creation of inventive scenarios, interactions and prototypes, but also how they helped researchers to think about their own design and research practices.

1. Introduction

It is estimated that 19 millions of children live with visual impairment worldwide (WHO, 2014). Ensuring their inclusion in society is critical to guarantee equal rights, and because it allows for greater independence. In particular, early inclusion in traditional school have a positive impacts on the abilities children develop (McGaha and Farra, 2001; Holt et al, 2014). ATs have a role to play, as they may be highly empowering (Hurst and Tobias, 2011) and contribute to reduce

E. Brule, CNRS & University Paris Saclay, Telecom ParisTech, Paris, FR. emeline.brule@telecom-paristech.fr

C. Jouffrais, CNRS & University of Toulouse, IRIT, Toulouse, FR. Christophe.Jouffrais@irit.fr

activity limitations and participation restrictions. However, previous studies (Phillips and Zhao, 1993; Polgar, 2010; Kinoe and Noguchi, 2014) show a high abandon rate of such devices, underlining the fact that they do not meet needs (usability, reliability, costs, social acceptability, etc.) This may relate to the fact that users are not sufficiently included in the design process (Phillips and Zhao, 1993). Furthermore, the way children experience their own disability is rarely investigated (Connors and Stalker, 2006). These observations show that it is necessary to understand how the adoption of technologies depends on the various aspects of disability (social, environmental, psychological, etc.) Numerous works have shown that having empathy for users, i.e. the ability to identify with them, is one approach to do so (Wright and McCarthy, 2011).

In the context of designing a collaborative interactive map for visually impaired users, we aimed at encouraging the HCI researchers of our team to better take into account users' context and subjectivities. The activities we proposed aimed at raising their empathy through storytelling and role playing.

In the current paper, we first describe a preliminary field-study aiming at better understanding the educational context and the experiences of visually impaired children. We then present various techniques that we used during a workshop with HCI researchers in order to improve knowledge of users' subjectivities, as well as to stimulate the production of speculative usage scenarios. Both were conducted as a first step of a longitudinal research project with visually impaired users and caretakers. Although the current work was specific to our context, we aim at providing insights on how personae and design cards may be used to help ATs designers taking into account specific needs and the various dimensions of disability.

2. Related work

2.1 Designing accessible interactive maps and tangible interactions

Visual impairment has numerous consequences on cognitive development (see e.g. Maurer et al, 2005), and especially on spatial cognition (Thinus-Blanc and Gaunet, 1997). Hence, there have been numerous research projects devoted to the design of assistive technologies that may improve spatial knowledge of visually impaired users (see Zeng and Weber, 2011, and Brock et al, 2013 for reviews).

Tangible interaction relies on physical objects to interact with digital information. It allows simultaneous use of multiple modalities, and has been adopted in many prototypes for sighted users (see e.g. Ullmer and Ishii, 2000). Because the manipulation of 3D models is appropriate for spatial learning in visually impaired users (Picard and Pry, 2009), a few research projects aimed at designing accessible tangible devices for non-visual exploration of maps. For instance, Pielot et al. (2007) designed interactive objects in order to explore maps with audio output.

2.2 Understanding Use(r)s of Assistive Technologies

Several authors investigating Assistive Technologies (ATs) acceptance rate have underlined the importance of the stigmatization associated to such devices (e.g. Polgar, 2010). Indeed, disability is not only a physiological or functional issue but "the limitations associated with impairment [that] are a joint product of biological features, environmental [i.e. social, political...] factors, and personal goals" (Wasserman, 2001: p.219). Some environmental features are quite obvious (access to the care system, lack of accessibility of public places, etc.), but others are less easy to identify and may be addressed with specific methods.

The current study seeks to provide researchers with tools allowing for a better and wider description of users (including context and subjectivity) and their needs. For instance, Connors and Stalker (2006) identified that children experience disability as "impairment, difference, other people's reactions, and material barriers". When designing ATs, researchers should keep in mind that they are interfaces between: (1) the person living with impairment, including her subjective perception of herself and the world (see for instance Druin 2002, about designing for children); and (2) her social context (political, cultural…). In addition, those interfaces should empower users (Hurst and Tobias, 2011).

2.3 Representing Users in the Design Process

Representing or involving users in the design process is a major challenge that may be addressed with different methods: participatory design, co-design, user research, etc. Visual impairment corresponds to a wide range of abilities, largely influenced by educational and social contexts. There are many variables to consider when describing visually impaired users. Although it would be a valuable solution to directly involve many children with diverse impairments in the design process (Druin, 2002; Bailey et al, 2014), it is difficult to achieve, especially within longitudinal studies, because of various constraints (availability, parental agreement, transportation and communication issues, etc.)

When co-design is difficult or not possible, a method frequently used consists in the identification of representative users described as Personae (Friess, 2012). Personae were proposed by Cooper (1999) as a tool for the design of interactions. They are fictitious but they embody characteristics that have been observed (e.g. professional roles, type of personality, social origins, personal history, goals, tastes, etc.). Personae are often represented with cards, and facilitate storytelling during the design process. Personae have been criticized because they represent idealized, "artificial" or stereotypical users who "don't talk back"[1]. However, Pruitt and Grudin (2003) have pointed out that well-crafted personae are very helpful when co-design is difficult because they raise designers' sensitivity and empathy, and because they represent an efficient communication tool within small and large teams. They may be part of a larger card deck (also including situations for example) and used in a variety of design activities, to serve as a communication

[1] see for instance http://signalvnoise.com/posts/690-ask-37signals-personas

tool between users and researchers or to help them developing alternative point of views (Wölfel and Merritt, 2013).

3. Motivation and objectives

A previous project on a similar topic (audio-tactile maps) had involved specialized teachers and visually impaired people in the design process, but not children (Brock et al, 2015). The results show that the device improved usability and satisfaction. But the designed prototype had not been implemented in the field. Furthermore, the HCI researchers involved in the project reported various design issues during formal and informal work meetings, which they wish to address via notions coming from the design and field research. First, they felt lacking imagination, having difficulties coming up with new concepts of interaction techniques. They were interested in developing new and original scenarios of use. Second, they were concerned by long term adoption of ATs. Many examples in the literature show that devices that have been successfully evaluated in the lab were not adopted in the field. Third, they were, in many brainstorming and evaluation sessions, working with a restricted number of users. They were afraid that this restricted population would not represent the whole targeted population. Finally, they reported that they did not manage to efficiently share notes and observations gathered in the field.

Our current research project is based on co-design. It is conducted in a research laboratory including the HCI department of a computer science research centre, and an institute for visually impaired people. It also involves a designer, a specialist in psycho-ergonomics, a start-up developing open source software, and various stakeholders of the institute who volunteered to participate (orientation and mobility instructors, specialized teachers, transcribers, and visually impaired people).

In order to understand how the existing interactive map prototype may be adapted and adopted in the classrooms, but also to provide design guidelines for the new prototypes, we decided to conduct a longitudinal field-study and to develop new design processes. Following the field-study, we proposed a two days workshop with the HCI researchers for: (1) sharing the results and recommendations provided by the field study; (2) transmitting ideation methods coming from design research; and (3) developing usage scenarios of accessible interactive prototypes. A transversal goal was to encourage HCI researchers to take into account the physical, temporal and cultural context of the users in the design process, to stimulate their empathy for users, and to develop a reflective understanding of how they were considering (or forgetting) users and their subjectivities during the design process.

4. Preliminary field study

Our field study aimed at a better understanding the overall caring ecosystem of the Institute, and how caretakers (teachers, instructors, transcribers, etc.) use assistive technologies. This Institute hosts and/or assists a hundred of children and

teenagers (up to 18 years old) living with various visual impairments. It also provides rehabilitation and professional training for visually impaired adults.

4.1 Methods

The field-study consisted in twenty-seven semi-directed interviews of various durations (between fifteen minutes and one hour depending on availability). Children were asked about their own experience of disability, usages of technologies, and topics of interests. Caretakers (teachers, mobility trainer, speech and low vision therapists, parents, etc.) were asked about their own definition of visual impairment, their roles in children' education and care practices. We also conducted four weeks of observations over six months. The extensive results of this field-study have been reported elsewhere (Brulé et al., 2015). According to the grounded theory methodology (Charmaz, 2006), they were open coded to identify concepts, and assembled by themes. In this paper, we only summarize the results that have supported the design of the workshop.

4.2 Results

About Children's experience of disability: First, the children reported *feeling impaired* when they are not able to engage in a given activity, or when they fear to fail at a task. This was especially the case for children whose impairment was late-detected, which is more likely to happen if they come from a low-income family with reduced access to the healthcare system. Second, they expressed *feeling different*, either in a positive or negative way. For instance, being able to use a smartphone without looking at it was underlined as positive. Indeed, schoolmates are not able to do so but would love to. They may also feel excluded from mainstream culture, such as cinema, which is pointed as being weird by their schoolmates. Third, they expressed *being concerned about other people reactions*, such as other children telling them they are stupid. These reactions reinforce the feeling of being impaired. Finally the children expressed *a consciousness of material barrier*s and the differences between accessibility policies and their application in everyday life.

On Caretakers practices: First, caretakers highlighted the impact of the educational context, and especially of *inclusion in traditional school*s on children's abilities. The same impairment may have very different consequences depending on social and cultural background, as well as the specific care that children received (for instance, education in classes with sighted or in specialized schools). Second, they felt having *material barriers* in their practices, including a lack of time, financial and/or technical resources. Third, they reported having *strong commitments* in raising public or political awareness, but also in sharing skills with others. Fourth, most of them *engage in continuous and reflectiv*e *learning*: they constantly analyse and question their methods to improve their own skills and knowledges. Fifth, they are *eager to use Do-It-Yourself or digital techniques* to design adapted tools for children they care. Finally, the caretakers mentioned constructive previous experiences with researchers or strong interests in new

technologies as a way to improve their practices. They would work overtime on the project.

In conclusion, it appears that children experience disability not only as activity or ability limitations. Their experience is shaped by numerous additional parameters that should be considered when designing ATs. In the next section, we present the results of the ideation workshop, to see how these findings can be transmitted, understood and used.

5. Ideation workshop

5.1 Design cards

The design cards used in the workshop were developed by the designer, relying on the field-study results and the aims of the workshop. The set was made of personae, places and goals cards with a specific structure. The personae cards included name and surname, but also nickname, so that participants may refer to personae informally, and not via impairment, age or gender. Furthermore, the field-study showed that context and subjectivity were important to understand usages. The cards aimed to provide personae with a social and cultural background, including date and place of birth, a general description, a list of topics of interest, as well as a personal history. An additional insert allowed drawing a portrait. Finally, a field was reserved for the role(s) that personae had to play with the prototype (e.g. teaching, learning, helping, designing...).

The field-study also revealed the importance of educational context (e.g. insertion in regular classes). Each place card described a location with spatial configuration and qualitative description (modern or ancient building, school, museum...).

The goal cards were initially blank. Because each caretaker has his own objectives, it was interesting to let participants elicit the caretaker practices and the associated needs they want to address in the scenario. They could freely fill in the cards including needs, tasks, skills to acquire, personal requests (for instance "knowing my own size compared to the world.")

5.2 Activities

The workshop was conducted with six HCI researchers involved in the project (including a blind and a visually impaired). The workshop facilitator observed the participants, and gathered results and feedback. After each activity, the results were presented and followed by a general discussion. The organizer specifically asked to react on the method and the results. The workshop consisted in four activities.

i. Filling up persona, place, and goal cards

This activity was based on blank cards of three different types: persona, place, and goal cards (Fig.1). Participants had one hour and a half to fill them, according to people, places or goals that could fit in the project. They could rely on people they had met, their office and the tasks they have to do. They also describe persons

that may potentially use the intended prototype. The goal was to force participants elicit how they were conceptualizing, narrating or stereotyping users.

There were four additional types of cards: “aesthetic” (e.g. minimalist or modern), “spatiotemporal context” (e.g. Canada 2020, India 2060, Moon 20120), “ludic mechanisms” (e.g. everyone is in the same team or they play against each other), and “qualitative” (e.g. the overall feeling expressed in the scenario, such as contemplative or hurried). Ten of those cards were previously completed by the designer based on existing games.

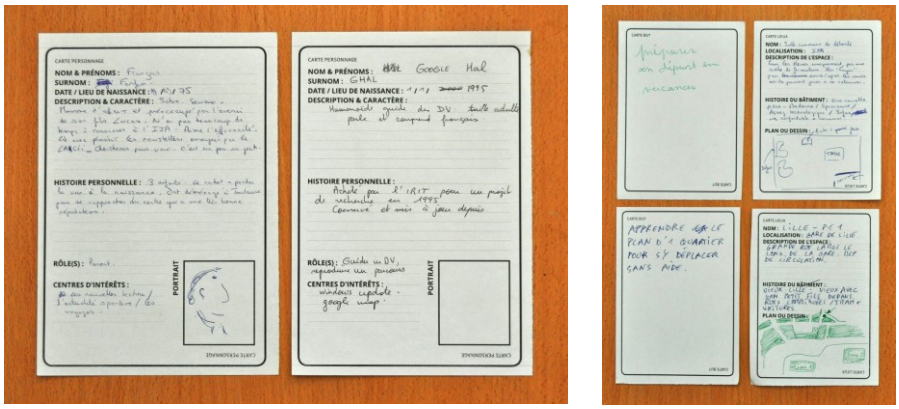

Fig. 1: From left to right: persona, goal and places cards, filled by workshop participants. We see that the personas were quite roughly described.

ii. Imagining scenarios

Each group had to pick up three personae, one goal and one context, and imagine as many scenarios as possible with these cards. Participants had to write down a maximum of scenarios during two hours. Finally they were asked to perform some of these scenarios (including being blindfolded if they had to represent a visually impaired person) using everything they had at hand (objects, paper prototyping, etc.) The aim was to engage participants in roleplay and storytelling, in order to better describe users’ subjective experiences.

iii. Designing prototypes showing emotions

Participants were then asked to design prototypes displaying emotions. One participant selected an animal. The next participants successively picked up a temper (e.g. extrovert or nervous), and a feeling (e.g. surprised or hungry). Finally, the next participant had to describe an imaginary interactive table prototype that holds all these features (e.g. a table that looks and reacts like a surprised nervous kangaroo). Each group described two such prototypes with annotated sketches in twenty minutes. The goal was to mobilize cultural representations, i.e. a set of symbols used to communicate in a given culture.

iv. Extended scenarios

The final activity focused on extending scenarios using the first card set (personae, places, and goals) completed with additional cards prepared by the facilitator (aesthetic, context, ludic mechanisms). The goal was to come up with completely new and speculative scenarios, as well as to extend the importance of cultural representations in scenarios.

5.3 Results

i. Filling up persona, place, and goal cards

The participants filled 14 persona cards, 9 context cards and 12 goal cards. They wrote quite succinct descriptions of personas who were mainly defined by their "professional" role (student, teacher, locomotion trainer…) The visually impaired personas were mostly described by impairment, which was not linked to a personal history. They did not contain any physical description, social background, etc. The context cards illustrated the institute classroom, various iconic buildings (museum of science…) or speculative ones (the moon station). The goal cards were mostly about acquiring new skills in geography or locomotion. There were no cards mentioning subjective, reflective or autotelic goals. The goals were highly pragmatic, thus minimizing the users' personal motivations.

ii. Imagining scenarios

Each group of participants came up with at least 10 to 15 scenarios. Some were pragmatic and could be immediately prototyped, such as 3D printing children figurines so that they could project themselves into a 3D model of a neighbourhood. Others were completely speculative, such as playing a game with a robotic dragon within a lunar station. They also proposed artistic settings, games or pedagogical activities. One group really used many personae in scenarios, while the other group mostly focused on goal and context cards, designing for one persona only. The participants willingly used objects found in the room (sugars, pencils, etc.) to illustrate ideas (Figure 2) but did not physically perform or play the scenarios.

iii. Designing devices displaying emotions

The participants completed the task in less time than allocated. They all came up with rich, illustrated, and annotated drawings of speculative devices. The blind participant provided verbal descriptions that were illustrated on a Dycem sheet by the facilitator. The prototypes included inventive techniques of interaction with various inputs and outputs (illumination, warming, shape changes...) to express the emotional state of the device.

iv. Extended scenarios

The participants had difficulties in imagining scenarios making actual use of aesthetic or qualitative properties. The number of generated scenarios was still high, but they had to pick up new cards frequently to get inspiration. They thought that the number of parameters was too high, and sometimes too conflicted, in order to pull something interesting out. They nevertheless came up with highly creative

scenarios (such as large scale interaction around the prototype) and described much more lively their users (e.g. clothing or motivations), which illustrates a higher degree of empathy. They also described much more precisely how users interact with the device (e.g. pitch of voice, object temperature, etc.)

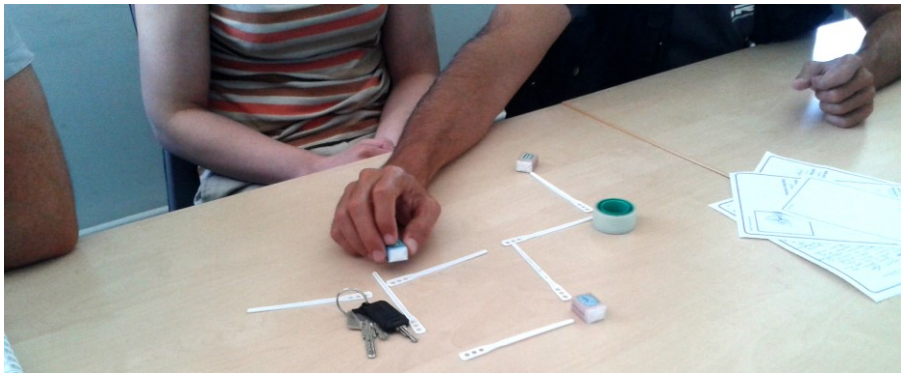

Fig. 2: Researchers prototyping scenarios with sugars, keys and other various objects.

5.4 Observations

After each activity, the groups were asked to present outcomes to the others, and make comments on the current activity and related aims. Although participants were used to work with scenarios, they reported having difficulties, especially in activities 3 and 4 (“Now I see that imagination is a muscle that should be flexed and trained much more”; “This is easy for you, but we are not used to it”). None of them had used similar methods before. When they were questioned about their own perception of the activities and the relevance of the outcome in future research, they, in the first place, expressed uncertainty. They were wondering how to integrate these methods and results (for instance the speculative scenarios) in their research activity (“and how do we use it... concretely?” “What can we do with those scenarios?”) However, after discussion, several participants agreed that such a card set, precisely describing potential users and goals, could be of great use in the future. They emphasized that it helped them thinking outside of a task-oriented, pragmatic approach, which is very often focused on impaired adults needs and experiences.

6. Discussion

The results of the field study (see Brulé et al 2015 for extended results) were consistent with the literature on children's experience of disability. Disability encompasses many notions like: feeling impaired, feeling different, a concern for others reaction, or the existence of material barriers (Connors and Stalker, 2006). The results also confirm the positive impact of inclusion (McGaha and Farra, 2001; Holt et al, 2014), and the importance of rapid prototyping and new technologies

(Hurst and Tobias, 2011). In our case, it helped structuring the card set that was used in the workshop.

Concerning the workshop, it is interesting to note that the participants gradually proposed richer descriptions of users and interactions. Because none of them had experienced similar methods before, they were confused by the method, but also by the number of parameters to deal with. Nevertheless, it allowed them to avoid design fixations (Jansson and Smith, 1991). Clearly, the workshop session led to propositions that would not have emerged from traditional brainstorming sessions. For instance, many speculative scenarios involved tangible interactions with rich input and output including haptics, gesture, light, temperature, etc. Some participants also described the pitch and the warmth of the prototype voice when interacting with children. On a short-term and pragmatic level, these quick ideation sessions confirmed the importance of tangible interactions, but also opened new perspectives to be prototyped and evaluated (such as the use of figurative objects).

However, the researchers expressed uncertainty about the "practical outcomes" of the workshop, and especially how speculative scenarios might help to design actual devices. During the discussion, the facilitator mentioned the risk of a design process mainly focused on functions and goals. They observed that it may lead to the exclusion of specific users or to failure to consider crucial aspects of interaction. They were reminded how models inherited from the disability studies may help them develop other perspectives. In fact, the cards helped the researchers to think about their own practices (Schön, 1983). By the end of the workshop, the participants were interested in using the design cards in order to better describe users, but also to enable long term sharing of field observations and knowledge (the cards were preserved and may be reused). Furthermore, the card set can always be updated. It may thus help framing future research projects. As co-design is not always possible, such cards may also be used by stakeholders to describe themselves and their goals.

7. Conclusion

The field-study helped us to better describe children living with visual impairment and how they interact with assistive technologies. It also showed how those interactions are shaped by a larger context (such as policy, culture, context, etc.) These observations guided the development of a set of design cards and workshop activities, which aim to improve the representation of users and increase empathy. In addition to the improvement of ideation within the team (production of inventive scenarios and interactions), the workshop helped researchers to think about the knowledge they had about users, and highlighted how this knowledge may shape the design process. Future observations will estimate the impact it may have on the future design practices within the team.

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