Orchestrating experts' assumptions and children's values in the design of Virtual Heritage experiences

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Abstract
The roles that children are allowed to play in the co-design process of an interactive experience are strongly influenced and determined by the views of designers and other adult stakeholders on childhood, as well as by their expectations on children's skills and cognitive capacities. In this paper, we contrast these assumptions in the design of a Virtual Heritage experience for guided school visits at an archaeological site. The goal of our study was to analyse different viewpoints of adult stakeholders in order to find new strategies that balance power relations between adults and children. The study was carried out in the context of the first design stage of an interactive learning experience for a bomb shelter from the Spanish Civil War, known as "Refugi 307". Our analysis reveals some of the reasons behind the assumptions of adult stakeholders. These outcomes were our starting point for defining strategies that can establish collective values among adult stakeholders and enrich the range of roles of children in a design process.

Keywords: Childhood; Design Roles; Values; Cultural Heritage; Participatory Design; Full-Body Interaction

1. Introduction
The contemporary conception of childhood often describes children as independent agents with their own opinions and knowledge [1,2]. However, there are different discourses that underpin the understanding of childhood. Grounded on this premise, museums and cultural heritage sites have an increasing interest in adapting their educational programs to novel learning approaches that allow children to autonomously explore learning contents [3]. In the child-computer-interaction community, these different notions influence the way the community designs for and with children. Thus, children have been acknowledged as valuable stakeholders to inform and participate in museum design practice for technology-oriented exhibitions [4–6].

Regardless of the contemporary perspectives on the notion of childhood, adult stakeholders hold different assumptions about children's agency and their role in the design process. These assumptions may be influenced by stakeholders' personal perspective on the learning topic, cultural influences, teaching methodologies, or

ideologies. Due to children's limited role and agency in some of these perspectives, their voices are still too often absent in the design practice of technology-oriented museum exhibitions [5]. This can be critical because, while visiting a cultural heritage (CH) site for instance, children's experiences and perspectives may not be necessarily aligned with the expectations of content professionals [7]. However, children not only have a right to be heard and their views taken into account [8], but their contributions may also give valuable insights on their interests and understanding of the CH content and the interactive learning experiences.

In the design of interactive technologies for children, these frictions have been increasingly discussed in the community. Dindler and Iversen [9] point out that designers and other participating stakeholders should reflect upon the values and lenses that they bring into the design process. The authors argue for the need of achieving a "relational expertise and symbiotic agreement" among the viewpoints and objectives of stakeholders. The purpose of our study is to extend this theoretical framework by proposing strategies that facilitate designers and researchers to balance power relations among stakeholders. We particularly aim to provide a common ground to better involve children throughout the design process. We present a case study in the context of a cultural heritage location, namely "*Refugi 307*". This site is one of the 1,402 bomb shelters that were built by civilians during the Spanish Civil War in Barcelona aimed at protecting the population.

The paper is structured as follows. In the first section, we outline the historical evolution of the notion of childhood and implications for children's roles in the design process. We then present the procedure and results of our case study. Our evaluation approach was derived from critical discourse analysis (CDA) [10] to compare stakeholders' expectations during this design stage. We discuss and contrast the different points of view of designers, curators, museum educators, guides and teachers in this research context. Based on these outcomes, we propose strategies to establish collective values among stakeholders and provide stronger involvement of children in the design process.

2. Background
2.1 Revisiting the notion of childhood
The historical evolution of perspectives on childhood is the consequence of a significant body of previous work that has been generated in childhood studies and education [11–13]. Previous studies have deeply analyzed child-adult relations, social constructions of childhood in societies and children's agencies [8]. Scholars in this field describe how our culture defines what being a child means, how adult institutions impact children's lives, and how children construct their cultural identities [7].

Before the nineteenth century the notion of childhood almost did not exist [14]. In fact, society tended to regard children as "small adults" with similar responsibilities

to those of grownups. During the romantic era, in reaction to the industrial revolution, society started to reconsider what being a child meant. Romanticists acknowledged childhood as a "special time in life" [7] which required protection from the "harsh realities of the adult world". This debate was influenced by the myth of children's innate innocence [13]. Today's Western societies still refer to this romantic notion of childhood. In this context, Mayall [8] highlights how the notion of childhood has been guided by the intention of providing "ideal spaces and times" that are protected from political influences. Nevertheless, it is a constructed social concept that families are constantly negotiating [15] and that is slowly being ousted by more contemporary perspectives.

In the last century, a conceptual shift and evolution of the definition of childhood has been evoked by several movements. On the one hand, the concept of childhood has been influenced by changes in social structures of our society. Specially, the feminist movement has analyzed women-men relations but also questioned child-adult relations. According to Mayall [8] this debate caused a critical reflection on the ways adults take control over childhood. On the other hand, from a developmental psychology perspective, children were defined as constructors of their own knowledge and scholars emphasized the fact that children understand and learn in a completely different way than adults [16]. In addition, social and cognitive development theories based on Lev Vygotsky's work [17] set out that learning emerges from the socialization between people and that children's learning processes need guidance by adult facilitators.

The latter described concepts of childhood have impacted different sociocultural aspects such as children's rights, approaches in pedagogy and education, etc. Moreover, they are also reflected in the discourse of the design of technologies for and with children in the community. They shape not only the way in which a particular technology is designed, but also on how children's roles and agencies in the design process are perceived and assigned.

A growing body of research in the field of human-computer interaction has revealed that users find products easier to use when they are engaged in both the design and construction of the artifact [18]. Responding to this requirement, from the 1980s onwards, children have been involved in the design and evaluation of information and communications technologies [19]. In the beginning, the main focus was on "children as users of technology" and how technology affected children's lives [20]. Later, children's participation was expanded to roles such as design partners, informants and testers [19,21]. However, children's roles in the design process are strongly influenced and determined by the stakeholders' views on childhood [22] and their expectations on children's skills and cognitive capacities [23]. These assumptions carry the risk of adult researchers and designers making all the design decisions without really addressing children's needs, i.e. they might select the core aspects of the study, interpret data from the sessions and draw conclusions [1].

3. Case Study

Our study was carried out in the context of a cultural heritage location, namely *Refugi 307*. The site is one of the 1,402 bomb shelters that were built by civilians during the Spanish Civil War in Barcelona aimed at protecting the population. The shelter is nowadays part of the History Museum of Barcelona (MUHBA) which provides guided visits through the cultural heritage site to schools and the general public. It consists of an almost empty tunnel 200 meters long (figure 1). Visitors can get an impression of the living conditions during the Spanish Civil War and some facilities inside such as benches, an infirmary, a children's room, etc. The walls and ceiling of the shelter show traces of objects from the past (e.g. the original light system) that were once installed inside. Poor light conditions and the high humidity in the shelter limit the possibilities to permanently install multimedia content in the physical space.

Figure 1. A school class visiting the guided tour of the cultural heritage site *Refugi 307*.

Designing interactive experiences for archaeological sites is particularly challenging. In fact, these site-specific spaces often cannot be modified by adding physical objects or installations due to their value and the risk of damaging them.

These spaces acquire their importance and meaning through situatedness; i.e. meaning about historical contexts is provided by the fact that the visitor is actually physically present on site. At the same time, such visits are often complemented by guided tours to direct visitors' attention towards aspects that are not obvious without further explanation.

Due to specific characteristics and limitations of the shelter, our research team proposed the design of a Virtual Heritage (VH) experience based on the *World-as Support (WaS) interaction paradigm* [24]. This paradigm is based on projective AR; i.e. augmentation is achieved by projecting the digital content on the physical world surrounding the user, via a handheld device based on a pico-projector. In this paradigm the world becomes not only a physical support for the projected content, but also, and very importantly, as a support for meaning making due to its intrinsic and situated value and meaning. The aim was to compensate for weaknesses which arise from other interaction design models in the field of site-specific interaction at heritage places. The traditional augmentative approach and experiences designed for these spaces [25–27] are commonly based on the *Window-on-the-World paradigm* using smartphone- or tablet-based AR. These tend to draw user attention away from

the physical space toward the multimedia content that is displayed through a "digital window" and that concentrates all visual references and interaction activity [28]. Consequently, they may provoke a significant degree of isolation from other visitors and render the experience of the environment a single user experience.

The goal of this first design stage was to evaluate the requirements for the design of the VH experience aimed at complementing the guided visit and fostering relevant learning contents. However, a detailed presentation of the evaluation of the requirements is not the purpose of this paper and can be found in Schaper et al. [29]. Instead, in this study we focus on the different assumptions made about children's roles and how those have influenced the design process.

3.1 Data Collection

For this study, our data collection was obtained through notes and audio recordings that we took during three project meetings with a museum expert, an educational expert and three members of our design research team. The team from the museum was specialized in cultural heritage and educational museum activities. Our design team contributed with an interdisciplinary background in design, engineering and cognitive media technologies. Furthermore, we audio recorded individual semi-structured interviews with three guides and four teachers from three different local schools that visited the *Refugi 307* with their class. We also video recorded verbal expressions and behaviors of a total of 40 children (girls = 18; boys = 22; mean age = 10.78 years old) during two guided visits (Figure 2) and three Participatory Design (PD) sessions. Finally, we included documents related to reflections upon our final results (Table 1) in our data archive.

To illustrate children's participation and assigned roles in this study, we give a detailed description of the interview procedures with curators, museum educators, guides, teachers and designers and the PD activities we employed.

3.1.1 Interviews with adult stakeholders

Semi-Structured Interviews were mainly conducted with teachers and guides after the guided visit in front of the shelter. One teacher sent us her answers by e-mail. The questions concerned how they perceived children during the guided visit, which interests children might have related to the learning topic and how the visit could be improved. Project meetings were carried out at the museum premises during which the different stakeholders discussed topics around the goals of the study, the proposed technological approach and the procedure of the activities. In one meeting, we specifically interviewed the museum experts about their personal views on childhood and children's participation in the design of guided visits.

Figure 2. The guide explained the structure of the physical space of the *Refugi 307*.

3.1.2 Participatory Design with children

During the design workshop, we defined several activities to elicit children's understanding, interests, and ideas for improvement of the guided visit and the first low-tech prototype. Therefore, after the visit, they were asked to perform an activity based on the KidReporter technique [30] in which each group (3-4 children) recorded a 2-minute video about the place in the shelter they found most interesting (Figure 3).

Figure 3. During the KidReporter technique children expressed their interests towards certain places of the cultural heritage site.

In the second session in school, they were again divided into the same groups. Using maps of the shelter they were asked to indicate and explain the places that they remembered and had caught their attention the most (Figure 4).

Figure 4. Children indicated on maps of the shelter the aspects which they remembered and had caught their attention during the guided tour.

After that, each child received a different storyboard template. The first scene or panel was already given with a drawing made by children during the Spanish Civil War (Figure 5). Present children were encouraged to think of a narrative related to the presented drawing. The aim of this activity was to evaluate children's interests and personal values in relation to the learning topic.

Figure 5. Children made storyboards about events during the Spanish Civil War.

Subsequently, the children were instructed to re-design the guided visit according to their own interests and preferences. We explained our technology approach (WaS) to them, which as described above is based on pico-projectors to augment the physical space with projected digital content.

The children were then asked to produce low-tech prototypes using *spotlights*; i.e. drawings on transparent plastic film and paper rolls with flashlights inside (Figure 6) to simulate the projection capabilities of a handheld device based on a pico-projector. Finally, each group gave a 5-minute presentation to explain and enact their ideas with the low-tech prototype. During all PD activities, we recorded short video interviews with each group while they were working on their proposals. The aim was to capture their different ideas and reflections during the design process.
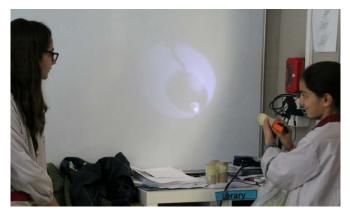
Figure 6. Children presented their ideas for the improvements for the guided tour using a low-tech prototype.

In the third session, the children were again divided into small groups (4-5 children) and provided with a possible scenario for the guided visit using the VH experience. One child was assigned to the role of "a visit guide". The other children enacted the role of "visitors" using pico-projectors (Figure 7). After the activity, we conducted a semi-structured discussion with each group about their experience using the mid-tech prototype.

Figure 7. Children enacted the guided tour using a mid-tech prototype in the school.

3.2 Data Analysis
Altogether, the data archive of the study comprises 277 files that were included in the analysis (see Table 1).

Table 1
Overview of data archive of the study

Field of data	Type of data source	Number of documents
Meeting with museum experts and design team	Audio recordings	2
	Annotations (from 2 researchers)	4
		Total 6
Interview with tour guides	Audio recordings	3
	Annotations (from 2 researchers)	6
		Total 9
Interview with teachers from three different schools	Audio recordings	2
	Annotations (from 2 researchers)	3
	Written response per e-mail	1
		Total 6
Data collection from guided tour	Video recordings	2
	Annotations (4 researchers)	4
	Semi-structured questionnaires with children	40
		Total 46
Data collection from three PD sessions	Video recordings (video per group and activity)	56
	Annotations (3 researchers)	9
	Sheets of activity "Map Activity"	10
	Storyboards	40
	Brainstorming notes	10
		Total 125
Results and related documents	Summaries of findings	6
	Master's thesis on the project	1
	Conference paper	1
		Total 8

Two researchers reviewed the overall material and performed an analysis focusing on participants' behavior and extracted explicit statements related to their assumptions. This procedure was derived by an interdisciplinary approach based on critical discourse analysis (CDA) [10]. Scholars [20] in the field of human-computer interaction have employed the evaluation method to analyze power relations and domination in sociopolitical contexts, e.g. between different "actors" in the design process. These structures are commonly expressed through statements (e.g. in form of language, drawings or technological artefacts [31]).

In our study, we focused on oral and written contributions of the stakeholders. Our analysis started with a careful read of the data archive described above. Potential statements were extracted using the software NVivo11 and synthesized into one document. To facilitate the comparison of viewpoints, we kept the statements of each stakeholder group (museum experts, teachers, designers and children) in a separate column. We reviewed the data and coded the statements according to repeated

concepts that reflected stakeholders' ideologies. We detected the repeated concepts as follows: (1) stakeholders' cultural values related to childhood (solidarity, respect, empathy, identity, enjoyment, ignorance, incompetence and influenceability) and (2) their expectations of children's role and agency in the design of the VH experience (empowerment, co-creators, active participation, informants, guided learning, collaborative learning, educator controlled learning). Two researchers then discussed and compared the produced discourses which were grounded on stakeholder's ideologies and attitudes expressed in the statements.

Finally, we wished to reveal a general outline of differences in the discourses of stakeholders relating to childhood and children's role in the design process. To achieve this, we categorized the outcomes according to a theoretical framework that represents a discursive construction of the concept of childhood. This framework was originally proposed by James, Jenks and Prout [32] through which they identified the following categories: the evil child, the innocent child, the immanent child, the naturally developing child, and the unconscious child. This framework was further developed by Skovbjerg and Bekker [22], who adapted it as a card tool to work with values on children's roles in design. In the following section, we will report a summary of our findings.

3.3 Empirical Results

Tables 2 to 6 show a selection of data collected on the assumptions expressed by the different stakeholders. We have labelled each statement with a corresponding number to facilitate the discussion around multiple perspectives of the same aspect.

3.3.1 Childhood, children's cultural values, and agency

In our study, we observed that the stakeholders of this project had different perspectives on how they perceived children nowadays and which cultural values they attributed to them. To summarize our findings, we grouped these perspectives in the following concepts: a) *The natural developing child*, b) *The unconscious child,* c) *The immanent child* and d) *Children's own perspectives*. The first three concepts used were derived from Skovbjerg and Bekker's card tool called CHIld PerspectiveS In Design (CHIPS). These cards were presented during the workshop titled "Being Explicit about Underlying Values, Assumptions and Views when Designing for Children" held at the International Conference on Interaction Design and Children in 2016 [22].

a) The natural developing child

Our findings indicated that the assumptions of museum educators and teachers about childhood were strongly encompassed in the natural developing child motif [16]. This category is grounded on the Piagetian Development Theory which suggests that the cognitive development of a child is biologically rooted. Consequently, children's capabilities are judged according to predefined age expectations. Adults are supposed to guide and control children's learning activities. This view also implies the need to assess, grade and rank children's achievements against other peers and the "norm" [32].

In our study, museum educators and teachers shared the notion of the natural developing child view. Our results were supported by stakeholders' statements as follows. One main goal of history education is to foster children's competence in understanding and reflecting upon historical events and their consequences (2.1a). In alignment with these goals, we identified assumptions on children's capability for reflection upon aspects related to empathy (5 statements), solidarity (3 statements) and identity (2 statements). However, teachers and educators expressed that, to develop these capabilities, children need to be supported by guided and collaborative learning activities (11 statements). For instance, in the their opinion, children at that age (10-12 years old) are capable of understanding historical contexts and adopting others' perspectives by illustrating examples of children at their age (table 1.b). In school, the students undertook preparatory activities to help them connect historical events with their own identity (1c). Teachers and educators regarded children's empowerment (1 statement) and active participation (2 statements) important for their development (1d). Nevertheless, they considered that teachers are superior to a child (4 statements), that they have control over the learning approach and the participation of children in the activities (1e). Therefore, children's participation during a typical guided visit took place through answering pre-prepared questions prompted by the guide, which were elaborated together with the teacher (1f).

Table 2
Selection of statements related to stakeholders' assumptions towards the notion of The natural developing child

Role of actor	Statements	Source
Educational Expert (museum)	**(1a)** (Our aim is) to foster children's competence in understanding that we must not fall back into these (historical) conflicts.	Interview museum experts and designers
Teacher	**(1b)** It is interesting that they learn during the guided visit about the age children had when they went to the war and about their responsibilities.	Interview answers sent per E-Mail
Teacher	**(1c)** Apart from the traditional methods, the students do an exercise based on a genealogical family album and they research for information about their grand- and great grandparents.	Interview after guided visit in the shelter
Teacher	**(1d)** In class we talk about the visit and what we are going to see. We leave children time to explain what they know and do not know about the context. But only as an oral activity and with those who choose to participate.	Interview after guided visit in the shelter
Teacher	**(1e)** If we make groups for the recording activity inside (the shelter) it is necessary that they are supervised, if not they would make a fuss and damage the installations.	Interview answers sent per e-mail
Teacher	**(1f)** (Together with the guide) we prepared questions to see if the students discovered them.	Interview after guided visit in the shelter

b) The unconscious child

The perspective of the unconscious child is derived from Freud's theory of personality. In this sense, childhood is considered the root of adulthood, a time of needs, demands and unconscious instincts that will eventually form the adult's personality and capabilities. The role of the educator is to curb and guide the child in the right direction. However, children's learning activities should be balanced both by discipline and by enjoyment to achieve positive learning responses.

We observed that curators and guides shared the same assumptions on children's tendency for ignorance (3 statements) about historical and social contexts, incompetence to understand and complete certain tasks (2 statements) and influenceability (2 statements) through their environment. For instance, they assumed that children are not aware of the privilege of living in a developed country with a number of social benefits (table 3.2a). In their opinion, children's personal values are shaped by their family and school environment (2b). Thus, the experts stressed the important role and power of the educator (3 statements) to guide children in the "correct" direction (2c). Hence, the learning contents of the guided visit have been defined in context of the school curriculum and obeying individual teacher's needs and interests (2d). They believed their mission is to teach children that our state of welfare is a fragile condition, and to transmit that errors from historical events from the past should not be repeated (2e). Therefore, they highlighted the importance of transmitting values around aspects related to solidarity (3 statements), respect (4 statements) and empathy (5 statements) through educational activities. For instance, our findings showed that curators and guides believed that children often have problems to show empathy with other people's sorrow. They especially noted a lack of empathy when digital media (such as videos) is involved (2f).

Table 3
Selection of statements related to stakeholders' assumptions towards the notion of The unconscious child

Role of actor	Statements	Source
Curator	**(2a)** Sometimes children forget about the fact that here we had a war.	Interview with museums experts and designers
Guide	**(2b)** When I asked the children where they would go if there was a war in Barcelona, they answered "to the summer house of our family in France". With other schools with low-income families, these questions usually help them reflecting upon people's situation in the past.	Interview with museum expert and designers
Curator	**(2c)** The narrative of the guided visit, and the work that the educator does, is very powerful.	Interview with museums experts and designers
Curator	**(2d)** Researcher: How are learning contents for guided visits usually defined?	Interview with museums experts and designers

	Curator: The learning contexts are based on contents of the school curriculum. Before the visit, we usually speak to the responsible teacher and adapt then accordingly the contents. Researcher: Have you ever involved children in the planning of the contents of the guided visit? Curator: No, that is like asking children what they want to eat. We would not get any useful answer.	
Curator	**(2e)** What you can give the children is comprehension (…) so that they appreciate their luck of not living (the war).	Interview with museums experts and designers
Guide	**(2f)** It makes me really sad when the children watch in the video (in the shelter) how a woman falls and they burst out laughing. This occurs sometimes at the end of the guided visit, when they should have learned something. But children struggle with empathy today. The images on the screen have lost a lot in impact with all what they watch today in television.	Interview with museum experts, tour guide and designers

c) *The immanent child*
Our design team only partially shared the views on children exposed by the other stakeholders. Our values are mainly grounded on the immanent child perspective that understands children from an idealistic view as a "tabula rasa" requiring an adequate environment and guidance for appropriate development. This child view also highlights the importance of considering children's needs and interests to promote learning. The child development is shaped through regulation and socialization.

The results highlighted that our research team tends to start a design process by researching children's needs and particularly interests around the learning context. We believe that learning contents should be motivated by children's own interests (Table 4.3a) because they can provide an important entry point for children to learn about new contents [33]. During the design process we focused our analysis on understanding core meanings and misconceptions that children had towards the learning contents. This approach has shown to be highly effective to define guidelines for the development and improvement of Full-Body Interaction prototypes [2]. Thus, we provided the children with a set of design techniques to elicit their reflections upon the visit and the learning context. We supposed that these techniques would help them to express their opinions and ideas (empowerment: 3 statements) in an adequate way. In general, we assumed that children, if sufficiently supported, are capable of making valuable contributions to co-create content (1 statement) and

inform (5 statements) the design of the VH experience (3b, 3c). Building on our analysis, we concluded that the children were capable of grasping values related to solidarity (1 statement), respect (2 statements) and empathy (2 statements). However, we proposed to enhance children's comprehension about abstract concepts that embrace these values, e.g. aspects related to changes in society, different standpoints upon historical events and long-term effects of the civil war. Moreover, we regarded the educator as facilitator who guides the contents and the ways children learn (2 statements). For instance, in this project we aim to design a VH experience that will take place during the guided visit. We proposed participatory activities (3 statements) that could encourage children to discover contents on their own, e.g. make meaning of historical aspects in context with the physical space of the shelter through their situatedness and embodied exploration (3d). We thought that not only guided learning but participatory collaborative experiences [34] (1 statement) can give children the possibility to explore and learn about certain topics from different perspectives (3e).

Table 4
Selection of statements related to stakeholders' assumptions towards the notion of The immanent Child

Role of actor	Statements	Source
Designer	**(3a)** The first step will be to evaluate children's previous knowledge and their attitudes towards the space. Building on the outcome, we analyse the requirements for the prototype.	Meeting with museums experts and designers
Designer	**3b)** Children's contributions guide us in relation to aspects we would not have thought of. This enriches our work very much.	Meeting with museums experts and designers
Designer	**(3c)** … this is because it has not been explained to them. When I was young, sometimes they explained me a lot, but there were others who did not explain anything (about the Spanish Civil War to their children).	Meeting with museums experts and designers
Designer	**(3d)** Our observations confirmed that the guided visit had already a high educational potential in introducing the learning topic to the children. However, we saw several opportunities to complement it through a VH experience (…) by taking advantage of children's situatedness and combining this experience with the augmentation of "invisible" aspects of the environment. On the other hand, the promotion of specific interactions in the physical space could support children's meaning making process of the learning contents.	Conference Paper

Designer	*(3e)* ... it stimulates user collaboration in actions that help to reveal layers of the experience that would not have been discovered on their own.	Conference Paper

d) *Children's own perspectives*

In our study, we also analysed statements expressed by children related to their interests, understanding, values, and to how they perceived their own agency during the workshop. We observed that the children always adopted a very participative (21 statements) and curious attitude (Table 5.4a). Moreover, they got easily bored by activities that required a passive participation only, e.g. listening to the guide (4b). In the re-design activity and during the interviews they pointed out that the visit should include more "fun activities" (enjoyment: 5 statements), e.g. a treasure hunt or a bomb attack drill. They were particularly interested in topics that were concerned with empathy (17 statements) and solidarity (14 statements) such as aspects related to the well-being of family members, animals and other children (4c). These are values which they can connect and compare to previous experiences in their own lives. Being in the physical space and experiencing certain characteristics of the shelter helped them to understand other people's feelings in the past (4d). In contrast, they had difficulties to empathize with situations that were very different from their "comfortable" living conditions (4e). On the other hand, the children explicitly expressed how they wanted to be treated the same way as adults (empowerment: 2 statements) by being confronted with reality (4f, 4g). In contrast, when we asked the children to "re-design" the guided visit, most of them mentioned that they liked the visit as it was or proposed only small modifications (incompetence: 3 statements) such as using photos to illustrate explanations. One child pointed out that they could not think of any new ideas because they had no previous experience in this task (4h).

Table 5
Selection of statements related to children's own perspectives

Role of actor	Statements	Source
Museum Expert	**(4a)** The children from primary school are so participative that we do not know where to cut children's questions. It is good that they engaged and have interest.	Meeting with museums experts and designers
Designer	**(4b**) After a few minutes of the guided visit, the children get distracted, start playing with their peers or look around the shelter.	Observation during guided visit
Child	**(4c)** One day in 1937, a father and a mother died in the war and their daughter was left all alone.	Storyboard
Child	**(4d)** The infirmary because if you must heal so many injured children with such a small amount of material, make surgeries... that is very difficult.	KidReporter Activity

Child	**(4e)** Guide: One day without food, you'd eat a plate with fish bones. Children: But not things we don't like to eat!	Guide Tour
Child	**(4f)** It's good that they tell us this because we need to know it but it is very sad.	Interview during PD workshop
Child	**(4g)** … because this way they do not treat us like children and simply tell how things are.	Interview during PD workshop
Child	**(4h)** Because the guy who did it (the tour guide) has more experiences in guided visits than us.	Interview during PD workshop

4. Discussion

We compared the assumptions of stakeholders regarding the notion of childhood and children's roles in our project. Our findings showed that the aforementioned views on childhood strongly influenced the underlying assumptions of adult stakeholders, as well as their expectations on children's designer skills and roles in the design process. During the first design stage, to orchestrate all stakeholders' needs and expectations, we tacitly agreed to treat children from a standpoint that combined the unconscious and immanent child perspective; i.e. we listened to their opinions but their participation and the selection of the final contributions were dominated by adult experts. In this section, we will reflect upon the reasons for this decision and provide strategies to achieve stronger involvement of children in future design stages.

Looking back at this design context, we note that children's participation was very much limited to a role as informants. Children's capacity to take an active role as design partners was also restricted by the requirements of the project. We had to respect the procedure of the existing guided visit and were only allowed to complement specific learning contents. Furthermore, the museum experts and our design team had the strongest divergence of opinion. Curators and museum educators were used to hierarchical models in which the educator had the control over children's participation and the learning content. They assumed that children were not capable of expressing their interests or make valuable contributions in the design process. In a sense, they believed that the children should only "learn from us" whereas our design team also assumed that we could "learn from the children". The museum's design practices for guided visits and learning materials were grounded on a top-down model based on content-driven strategies [35]. Instead, our design team considered the analysis of children's interests and behavior as the starting point for the design process (design-based research strategy [36]). As a consequence, during several meetings, the museum experts pointed out that they had difficulties to imagine the educational goals of our learning experience. These shortcomings, on the one hand, had an impact on the flow of the design process. On the other hand, it limited our possibilities to give children a voice in the modification of the learning contents of the guided visit. At the same time, during the PD workshops children

themselves reported that they had difficulties thinking of improvements and novel proposals due to their lack of "professional" knowledge or training in designing guided visits. This seems to show that some views on children's roles are very much rooted even in the children themselves.

To find a common ground in the design of the VH experience, we propose strategies that are based on the notion of relational expertise and symbiotic agreement [9] aimed at balancing each stakeholder's professional knowledge, values and power relations. This ability requires designers and researchers to facilitate negotiations through open dialogue between different viewpoints and objectives among stakeholders. These negotiations may concern expectations and assumptions on each stakeholder's participation, values they bring into the design process, collective learning goals and technical solutions of the learning experience, etc. Commonly, values and roles are continuously evolving and being redefined during the design process. The approach directs, among other aspects, decision-making processes about how goals and expectations should be communicated between stakeholders, but also determines the choice of elicitation and evaluation methods used during PD workshops.

Based on our findings, in future design stages we envision stimulating an open dialogue among the participants to negotiate a shared vision on childhood and children's skills of the VH experience. One strategy could be to involve museum experts actively in the design sessions with the children. On the one hand, this could give museum experts the opportunity to observe children's participation and to better value their contributions as potential design partners. On the other hand, it would permit museum experts to observe how designers introduce the historical context, instruct and employ design techniques. Thus, museum experts' involvement in the design sessions would open them the possibility to give feedback and recommendations for improvements on the design activities. This procedure could also allow involving the museum experts stronger in the evaluation of the outcomes of the design sessions.

Furthermore, it would be beneficial to provide design techniques that facilitate mutual reflection between the participants. For instance, Halskov and Dalsgaard [37] proposed using concept posters to guide the emergence of design ideas. Smith et al. [38] showed how this technique was also a successful strategy to establish a collective vision in a design workshop between teenagers and adult stakeholders. We propose to use this design technique not only to negotiate design ideas but also to openly discuss emerging values and assumptions derived from outcomes of a critical analysis on individual viewpoints.

Moreover, in our workshops we mainly focused on understanding children's interests and knowledge around the learning topic and the emergence of design ideas. However, we did not interview them directly about their own involvement and experience during the workshops. In future studies, it would be beneficial to focus

also on this aspect. On the one hand, it may motivate children to participate in the design process because they feel that their opinions are equally valued as those posed by adult stakeholders. Moreover, views of childhood in society can influence children's perception of their own agency and political power [7]. In this sense, the use of the inadequate technique can foster the possibility that power relations between children and adult facilitators influence children's contributions [39] and their own perceptions of their capabilities in the design activities.

On the other hand, interviewing children about their participation could help reveal deficiencies in using certain techniques and procedures in the study. For instance, we observed that children had difficulties to design from "scratch" [40]. We assumed that children's previous experience with the guided visit and the elicitation techniques provided during the PD workshop would be sufficient to inspire their imagination. Despite our expectations, children's contributions revealed only a general desire for more participative activities during the visit. In this context, recent studies argue that researchers often report that children were unable to make some contributions, as opposed to reporting that the design methods used might have been inadequate to elicit the required insights. Iversen and Dindler [1] suggest that researchers working with children need to make a greater effort to adapt techniques to children's capabilities and to explore new methods that help them to reflect upon the task and to express their ideas. In our research context, we believe that the instruction to re-design the guided visit was probably too openly formulated. Thus, in future design stages, we will use techniques that help children to better reflect upon the visit and potential design ideas, such as providing additional visual references of the shelter, revisiting the cultural heritage site to brainstorm ideas and exploring those with different media in situ. Particularly, techniques based on student-centered learning approaches [16,41] could help children construct meaning through new knowledge obtained during the guided visit, prior experience in their personal lives and connecting these aspects with potential design concepts [41].

Limitation of approach
Our evaluation approach has proven to have potential as well as limitations. It was mainly based on the analysis of statements of oral or written contributions because interviews with experts were only audio-recorded. Future work should include the assessment and evaluation of multimodal resources (such as gaze, posture or gestures). These can provide insights into underlying meanings of statements and allow grasping a holistic picture of stakeholders' values and attitudes towards their assumptions on children [42]. In addition, to further elaborate assumptions on children's own agency in this research area, future studies need to include children from different social backgrounds and evaluate a holistic view of children's perspectives.

5. Conclusions
We contrasted stakeholder's assumptions on children's participation in the design of a VH experience. We showed how the roles assigned to children influenced the design

process and which tensions may arise during the collaboration of different stakeholders in these contexts. We use the outcomes as a starting point for defining strategies to establish collective values among stakeholders and better involve children in the design process. We plan to apply the proposed strategies in future design stages to balance the power relations between the stakeholders and to improve children's participation within the design process. With this approach, we hope to stimulate the discussion in the community about how different views of childhood affect procedure and outcomes of the design process. Furthermore, we aim to encourage researchers in the child-computer interaction community to explore suitable strategies to achieve symbiotic agreement on children's participation in a design process.

Acknowledgements

References

[1] O.S. Iversen, C. Dindler, A Utopian agenda in child-computer interaction, Int. J. Child-Computer Interact. 1 (2013) 24–29. doi:10.1016/j.ijcci.2012.08.002.

[2] M.-M. Schaper, L. Malinverni, N. Pares, Participatory Design Methods to Define Educational Goals for Full-Body Interaction, in: Proc. 11th Conf. Adv. Comput. Entertain. Technol., ACM, New York, NY, USA, 2014: p. Article no. 50. doi:10.1145/2663806.2663867.

[3] S. Allen, Designs for learning: Studying science museums exhibits that do more than entertain, Sci. Educ. 1 (2004) 17–33.

[4] G. Taxén, Introducing Participatory Design in Museums, in: A. Clement, P. Van den Besselaar (Eds.), Proc. Eighth Conf. Particip. Des. Artful Integr. Interweaving Media, Mater. Pract. - Vol. 1, ACM, New York, NY, USA, 2004: pp. 204–213.

[5] C. Dindler, O.S. Iversen, R. Smith, R. Veerasawmy, Participatory Design at the Museum: inquiring into children's everyday engagement in cultural heritage, in: Proc. 22nd Conf. Comput. Interact. Spec. Interes. Gr. Aust. Comput. Interact. (OZCHI '10), ACM, New York, NY, USA, 2010: pp. 72–79. doi:10.1145/1952222.1952239.

[6] M. Roussou, M. Ave, Children Designers in the Museum: Applying Participatory Design for the Development of an Art Education Program, Proc. 6th Int. Conf. Interact. Des. Child. (2007) 77–80. doi:10.1145/1297277.1297292.

[7] L. Smith, Taking the children – children, childhood and heritage making, in: Child. Child. Cult. Herit., Routledge, 2012. doi:10.4324/9780203080641.

[8] B. Mayall, The sociology of childhood in relation to children's rights, Int. J. Child. Rights. 8 (2001) 243–259.

[9] C. Dindler, O.S. Iversen, Relational expertise in participatory design, in: Proc.

13th Particip. Des. Conf. Res. Pap. - PDC '14, ACM, New York, NY, USA, 2014: pp. 41–50. doi:10.1145/2661435.2661452.

[10] T.A. van Dijk, Principles of Critical Discourse Analysis, Discourse Soc. 4 (1993) 249–283. doi:10.1177/0957926593004002006.

[11] H. Jenkins, The innocent child and other modern myths, in: H. Jenkins (Ed.), Child. Cult. Read., New York University Press., New York, NY, USA, 1998: pp. 1–31.

[12] J. La Fontaine, An Anthropological Perspective on Children in Social Worlds, Polity, Cambridge, UK, 1986.

[13] B. Mayall, Children's Childhoods: Observed and Experienced, Routledge, 1994.

[14] P. Aries, Centuries of Childhood: A Social History of Family Life, Jonathan Cape, London, UK, 1962.

[15] K. Darian-Smith, C. Pascoe, Children, childhood and cultural heritage, Routledge, Abingdon, Oxon, 2013.

[16] E.K. Ackermann, Constructing Knowledge and Transforming the World, IOS Press, 2004. http://web.media.mit.edu/~edith/publications/2004-Constructing_Knowledge.pdf.

[17] L.S. Vygotsky, Mind in society: The development of higher psychological processes, Mind Soc. Dev. High. Psychol. Process. Mind in So (1978) 159. doi:10.1007/978-3-540-92784-6.

[18] M.J. Muller, A. Druin, Participatory Design : The Third Space in HCI, in: Human-Computer Interact. Dev. Process, 2003: pp. 1–70.

[19] A. Druin, The Role of Children in the Design of New Technology, 21 (2002) 1–25.

[20] N. Iivari, M. Kinnula, L. Kuure, With best intentions: A Foucauldian examination on children's genuine participation in ICT design, Inf. Technol. People. 28 (2015) 246–280. doi:10.1108/ITP-12-2013-0223.

[21] M. Scaife, Y. Rogers, F. Aldrich, M. Davies, Designing for or designing with? Informant design for interactive learning environments, in: Proc. SIGCHI Conf. Hum. Factors Comput. Syst. - CHI '97, ACM Press, New York, NY, USA, 1997: pp. 343–350. doi:10.1145/258549.258789.

[22] H.M. Skovbjerg, T. Bekker, W. Barendregt, Being Explicit about Underlying Values, Assumptions and Views when Designing for Children in the IDC Community, in: Proc. 15th Int. Conf. Interact. Des. Child., ACM, New York, NY, USA, 2016.

[23] J.C. Read, P. Gregory, S.J. MacFarlane, B. McManus, P. Gray, R. Patel, An investigation of participatory design with children-informant, balanced and facilitated design, Interact. Des. Child. (2002) 53–64. doi:10.1.1.109.1324.

[24] L. Malinverni, J. Maya, M.-M. Schaper, N. Pares, The World-as-Support: Embodied Exploration, Understanding and Meaning-Making of the Augmented World, in: Proc. 2017 CHI Conf. Hum. Factors Comput. Syst. (CHI '17)., ACM, New York, NY, USA, 2017. doi:http://dx.doi.org/10.1145/3025453.3025955.

[25] M. Sakr, C. Jewitt, S. Price, Mobile Experiences of Historical Place: A Multimodal Analysis of Emotional Engagement, J. Learn. Sci. 25 (2016) 51–92. doi:10.1080/10508406.2015.1115761.

[26] K.. D.T.. K.F.. I.S.. T.M.. H.T.. Y.M.. Tarumi H.a Yamada, KEI-Time Traveler: A Virtual Time Machine with Mobile Phones for Learning Local History, in: Trans. Edutainment II, Springer, Berlin, Heidelberg, 2009: p. pp 258-281. doi:10.1007/978-3-642-03270-7_18.

[27] L. Serra Oliva, A. Mura, A. Betella, D. Pacheco, E. Martinez, P. Verschure, Recovering the history of Bergen Belsen using an interactive 3D reconstruction in a mixed reality space the role of pre-knowledge on memory recollection, in:

Digit. Herit., 2015: pp. 163–165. doi:10.1109/DigitalHeritage.2015.7413860.

[28] J. Müller, R. Rädle, H. Reiterer, Virtual Objects as Spatial Cues in Collaborative Mixed Reality Environments: How They Shape Communication Behavior and User Task Load., in: Proc. 2016 CHI Conf. Hum. Factors Comput. Syst. (CHI '16), ACM, New York, NY, USA, 2016: pp. 1245–1249.

[29] M.-M. Schaper, M. Santos, L. Malinverni, N. Pares, Towards the Design of a Virtual Heritage Experience based on the World-as-Support Interaction Paradigm, in: Proc. 35th CHI Conf. Hum. Factors Comput. Syst. (CHI '17), 2017.

[30] T. Bekker, T. Universiteit, KidReporter: A user requirements gathering technique for designing with children, Interact. with Comput. 5438 (2003) 7–9. doi:10.1016/S0953-5438(03)00007-9.

[31] K. Spiel, C. Frauenberger, G. Fitzpatrick, Experiences of autistic children with technologies, Int. J. Child-Computer Interact. (2016). doi:10.1016/j.ijcci.2016.10.007.

[32] A. James, C. Jenks, A. Prout, Theorizing Childhood, Polity Press, Cambridge, 1998.

[33] L. Malinverni, M. Schaper, N. Pares, An Evaluation-Driven Design approach to develop Learning Environments based on Full-Body Interaction, Educ. Technol. Res. Dev. (2016) 1–24. doi:10.1007/s11423-016-9468-z.

[34] L. Malinverni, N. Pares, The Medium Matters: the Impact of Full-Body Interaction on the Socio-Affective Aspects of Collaboration, in: IDC '15 Proc. 2015 Conf. Interact. Des. Child., ACM, New York, NY, USA, 2015. doi:10.1145/2771839.2771849.

[35] N. Pares, R. Pares, Interaction-Driven Virtual Reality Application Design (A Particular Case: El Ball del Fanalet or Lightpools), Presence Teleoperators Virtual Environ. 10 (2001) 236–245. doi:10.1162/105474601750216830.

[36] F. Wang, M.J. Hannafin, Design-based research and technology-enhanced learning environments., Educ. Technol. Res. Dev. 53 (2005) 5–23.

[37] K. Halskov, P. Dalsgaard, The emergence of ideas: the interplay between sources of inspiration and emerging design concepts, CoDesign. 3 (2007) 185–211. doi:10.1080/15710880701607404.

[38] R. Smith, O. Iversen, C. Dindler, Digital Natives: Creating Emergent Exhibitions through Digital Technologies, Rethink. Technol. Museums Emerg. Exp. (2011) 13–25. http://forskningsbasen.deff.dk/Share.external?sp=Se5ed4731-0aae-4a96-9dd1-9221d9581416&sp=Sau.

[39] O.S. Iversen, R.C. Smith, Scandinavian participatory design, in: Proc. 11th Int. Conf. Interact. Des. Child. - IDC '12, ACM Press, New York, NY, USA, 2012: p. 106. doi:10.1145/2307096.2307109.

[40] M.-M. Schaper, N. Pares, Making Sense of Body and Space through Full-Body Interaction Design: A Case Study, in: Proc. 15th Int. Conf. Interact. Des. Child., ACM, New York, NY, USA, 2016. doi:10.1145/2930674.2935992.

[41] B. Rogoff, Apprenticeship in thinking: Cognitive development in social context, Oxford University Press, Oxford, n.d.

[42] L. Mondada, Multimodal resources for turn-taking: pointing and the emergence of possible next speakers, Discourse Stud. 9 (2007) 194–225. doi:10.1177/1461445607075346.