Designing Play to Support Hospitalized Children

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ABSTRACT

Play as a form of complementary care is increasingly considered to support sick children with their hospital experience. Prior work around digital play is mostly focusing on distracting the child from the hospital experience. In contrast, we propose an alternative approach. We seek to engage the children with the hospital experience through play that utilizes the hospital environment and materials. We present findings from two hospital play workshops with 23 children with severe diseases. Based on these findings, we derive four lenses (reframing, ownership, privilege, body) through which researchers can examine these types of play experiences. We then use these lenses to articulate six practical strategies to aid designers in developing play that supports hospitalized children. Ultimately, our work extends our understanding of how play can be designed as a form of complementary care.

Author Keywords

Children; hospital; play; games; complementary care

ACM Classification Keywords

H.5.2. [Information Interfaces and Presentation]: User Interfaces - Miscellaneous.

INTRODUCTION

In this paper, we explore how play can be used to support the hospital experience for children with severe diseases such as cancer. While hospitals have the ability to offer specialized medical treatment to support children's recovery, the hospital experience itself can be very stressful: hospitalized children often experience anxiety and fear which can intensify their illness and negatively interfere with medical treatment [15]. In response, complementary care programs have emerged that aim to support patients from both a medical and experiential perspective. Complementary care is aimed at enhancing the wellbeing of patients and often used in conjunction with specialized medical treatments such as chemotherapy. Examples of complementary care are meditation, acupuncture, and music therapy. Research has shown that these approaches can support a patient's wellbeing and speed up the recovery process [36].

A range of complementary care approaches exist specifically for children: for example the humor therapy program, made famous by the Clown Doctors [9], and play therapy, renowned due to the work by Axline [3]. We believe emerging interactive technology can offer further benefits to complement these programs. For example, practitioners are introducing commercial game consoles into the children's ward while researchers are designing games specifically for children in hospital [38]. We find that these approaches predominantly work with the assumption that they can help the children by distracting them from the hospital environment [16, 38, 47, 49]; an extreme example of this approach is the work using head-mounted displays to detach patients from the hospital environment through alternative virtual realities [11]. We propose a complementary approach through which we aim to engage the children directly with the hospital environment to support them in experiencing the hospital not as a space of diseases and illness that contrasts their prior playful life outside, but rather as another place for play that is part of life. Our work aims to carve out a niche between purely entertaining games and toys that distract children from the hospital experience and serious games that educate children about their hospital experience. The games we present are related to both but are not explicitly either of the two. Instead, we aim to focus on the hospital experience itself and propose games that are integrated into the hospital experience. As such, our approach takes a holistic play perspective that engages the children's families, the hospital staff and environment and is conducted in a play workshop format. The play workshop includes craft activities (as suggested by prior work [32]) in which children and their families create play elements out of hospital materials in order to interact with two novel play systems we developed specifically for the play workshops. We present the results of two play workshops from two different hospitals with 23 inpatient children.

We note that although parents and hospital staff reported these play workshops impacted positively on the children's

wellbeing and their recovery process, it is difficult to assess to what extent (as with all complementary care approaches [7]). Nevertheless, we provide results from the workshops that suggest the children embraced the opportunity to play; were able to reframe their relationship with the hospital; showed signs of claiming ownership of their hospital experience; were able to experience a sense of privilege; and also experienced their body as a resource for play rather than just a source of illness.

We use these results to derive four lenses through which researchers can examine play for hospitalized children. We then draw on the lenses to articulate six practical strategies based on our craft knowledge to aid designers developing play for hospitalized children. Our work makes the following contributions: it presents a novel holistic play approach of aiming to engage children with their hospital experience. It exemplifies this approach through the design of two novel play systems. We also present four lenses for analysis for researchers and six practical strategies for designers interested in our approach. Our work is useful for game designers and complementary care staff interested in utilizing digital play for young patients. Furthermore, game design practitioners interested in applying their existing play and game systems to support children in hospital could also benefit from the work. Ultimately, our work extends our understanding of how play can be designed as a form of complementary care.

RELATED WORK: CHILDREN, HEALTH AND PLAY
Prior work has contributed significantly to our understanding of how to design interactive systems for children [8, 19, 28]. However, existing works do not offer much guidance on how to design for sick children suffering from severe diseases such as cancer. A notable exception is the work by Hoiseth et al. [17] who find that health games should elevate the "child as expert"; a strategy we applied in our play workshops. Contrasting our approach, this prior work highlights the importance of distracting the child; however, their focus is on utilizing games to support specific treatments, rather than considering the specific intricacies of the hospital experience.

We also learned from emerging complementary care programs in children's hospitals [15, 16], especially those who aim to assist children in realizing the potential of play. We are inspired by Stagnitti and Copper who say: "If a child is admitted into hospital it is important that their play is not left behind [...] Play facilitates comprehension, enhances coping and provides emotional support for children undergoing medical procedures" [44]. Past research has demonstrated that play can be effective when it comes to managing a child's anxiety resulting from the hospital environment [25]. An example is the "ChildLife Program" [27] that aims to help children cope with the emotional and bodily changes caused by medical procedures. Other complementary care programs such as

"Payasospital" [37] and "Therapeutic Clowns" [25] aim to support children through the use of magic, props, and physical play. Research around these programs suggest that clowns performing with children who require surgery can be effective for managing their anxiety [44]. The most well-known of these programs is the "Clown Doctors" [9] who bring laughter to hospital wards [25]. The Clown Doctors inspired our work, including the use of crafting activities to inform play, building on work in art therapy [7]. According to Rubin [40], hospitalized children can find crafting an opportunity to organize their thinking and to express and cope with the powerful feelings experienced during illness. Furthermore, our play workshop facilitator (first author and artist, dancer and actor with a certification in laughter therapy), with prior experience developing therapeutic projects with children, performed as a clown character during the play workshops.

Interactive technology, children and health
We know from previous research that children respond well to digital technology [38] and engagement with new media provides them with an enjoyable platform to engage their imagination and creativity [6]. In particular, hospitalized children can find emotional and physical relief through virtual play [13]. Consequently, organizations such as "Juegaterapia" [20] supply digital game consoles to sick children to alleviate their anxiety. Supplying children with commercial digital games can successfully distract them from painful treatment procedures [41]. While these and related approaches [47, 49] focus on using play to distract the child from the hospital experience, we in contrast are aiming to engage the child with the hospital experience.

A few researchers have designed games specifically for sick children, such as "Operation IBD" [46], "Bronkie the Bronchiasaurus" [24] and "Glucoboy" [42]. These games aim to help children understand their treatments [46]. Such games can be useful as part of complementary care [43, 46]. While these games focus on supporting specific treatments, our work aims to support children's overall hospital experience, regardless of an individual treatment. Prior research has also begun to support patients by going beyond screen-based interactions. Watters et al. combined digital media with physical objects for emotional recovery treatment [46]. "Elements" [48] is an interactive tabletop that can be placed in hospitals to support rehabilitation. The biofeedback "BrightHearts Project" [23] uses heart rate and aesthetic visuals to help children manage the anxiety experienced during medical procedures. Similarly, Bucolo et al. designed a tangible device to alleviate anxiety in paediatric burns patients [5]. "Magic Land" [38] combines toys with a smart table to help children overcome feelings of anxiety. These works suggest that combining digital and physical elements can be beneficial to therapeutic play [38], and in response, we also drew on both physical and digital play activities.

In sum, prior works highlight the potential of play to support sick children's experiences in hospital. However, most projects did not consider digital play or only utilized play as a distraction method. There appears to be a lack of knowledge on how digital play can support children with their hospital experience. In response, we ask: how do we design digital play to support sick children's hospital experience?

THE PLAY WORKSHOPS

Fig. 1. The workshops' crafting activities (faces obscured)

We conducted our play workshop (which ran for two days, lasting three hours each) twice in two different hospitals. With the support of the hospital administration, we used flyers to invite all 7-13 year-old inpatients and their families. Before the play workshops, the children and parents were given a short questionnaire (i.e. when they are available, how many family members will join, etc.) and asked for consent as per our ethic guidelines. Supporting the social environment is key for children in hospital [30], we therefore were eager to include the children's families. This contrasts prior work that has focused on stand-alone applications (such as [47, 49]), however, we see our work not replacing, but complementing existing work around children's solo play in hospital. We recruited 23 children and 17 family members (40 participants in total). The children were between 7 and 12 years (average: 8 years). The children's health conditions were considered severe, with the most common disease being cancer (13), but the children also had different traumatic injuries (6) as well as neurological diseases (4). There were a total of 6 families, with 10 parents, 1 grandmother, 1 aunt and 5 siblings present. All participants were encouraged to engage equally in all activities.

The games were designed through an iterative process, where early mock-ups where shown to children, game designers and researchers to elicit informal feedback. We did not have access to the sick children at this stage, so this is a limitation of our work, however, one of the authors has worked with sick children before so we drew on this expertise. We presented the games at the beginning and asked participants to explore them before starting the crafting activities. This initial step included a short tutorial that explained the key elements of the games. We then showed the crafting materials that allowed participants to create their own play elements. Once these play elements were created we incorporated them into the games. We did not explicitly encourage the children to interact with each other; however, we observed the children and family members starting to create and play together without being prompted. Also, the children and parents helped each other during the activities. Conducting play workshops in hospital means considering that treatment always takes priority, hence attendance was rather fluid: two children had to cancel at the last minute as they were too unwell, and three children had to leave early to undergo medical treatment.

Doctor Giggles

Fig. 2. Doctor Giggles

On the first day, the focus was on "Doctor Giggles", which we designed inspired by laughter therapy (Fig. 2). Playing with Doctor Giggles means to first create the play characters (drawing on the benefits of crafting for wellbeing [32]): we invited our participants to create play characters out of X-ray sheets to be used in the digital play system (Fig. 1, 3 & 4). Instead of simply providing the players with a ready-to-go game, we aimed to support their autonomy in play [39] by allowing them to create their own personal play characters. Thus enabling the children to engage with hospital material frequently encountered as part of their hospital stay through the act of crafting (instead of seeing such material only being handled by doctors).

Fig. 3. X-ray play characters

We brought along some examples we had created to inspire our participants and guide them in how they could use the X-ray shading as a way to create texture for their play characters. The children were invited to use their own X-ray sheets of their bodies, which the staff helped provide. Then the X-ray play characters were quickly scanned in order to use them in the digital play system. We used a large touch screen accommodating multiple children to support social play (Fig. 4&5).

In the game, the children see a virtual operating room, with a doctor character (whose face is one of the doctors from the hospital), dressed in children pajamas who jumps up and down and around the room. In the virtual operating room there are various items the children know from their hospital experience, such as a hospital bed, an operating light, a table with medical tools and an X-ray machine.

Fig. 4. Setup in the hospital

The aim is to make the doctor laugh as much as possible (indicated through visuals and sound). To achieve this, the children are invited to freely explore the elements in the operating room: for example, if the child operates the X-ray machine, the X-ray play characters appear on the screen, bouncing around. If the child touches those characters, they make silly sounds. The children can then use the characters to perform a medical procedure with the tools from the table, however, the tools have different functions in the game than they normally would: the scissors are made from feathers that tickle rather than cut; the syringe is a magic wand that changes the color of the room's lighting; and the gas mask releases perfume to relax the doctor. The typical functions of the hospital tools are swapped such that the real patient (the sick child) is in control, while the virtual doctor is the patient that needs to be treated with laughter.

X-Safari
The second day was similar to the first, but the focus was on creating play characters in the form of hand puppets to play "X-Safari". The play characters were made out of familiar medical equipment, for example medical gloves, cotton, bandages, band-aids, and medical tape. Again, we

brought along examples to inspire the children. "X-Safari" uses an augmented glove system we developed (Fig. 6). The children put it on and then slide their gloved hand into their characters to play. Although glove control input devices already exist, our system is novel as it is low-cost and allows for a "dressing up" with the play characters; the benefits of being able to "dress up" technology with personalized material has previously been highlighted [21].

Fig. 5. The virtual world of X-Safari

Our intention was to enable the children to perceive that they are crafting (at least a part of) their play interface controller out of hospital material (Fig. 7). Using the glove, the children are able to control a horse avatar in a 3D virtual fantasy world.

Fig. 6. The play characters are put on top of this augmented glove to control the game

The virtual world is connected to an Arduino that controls the avatar's movement, direction and speed based on sensors attached to the inner glove's fingers and palm. When the children move their fingers in a walking fashion the avatar moves. By tilting their hand, the child controls the direction the horse moves. The children use their virtual horse to explore a fantasy island through their play characters; on this fantasy island the children can explore and encounter additional characters that are the play characters created the day before.

Fig. 7. Glove play characters

Data collection & analysis

We invited all participants for an interview right after the play workshops and were able to speak to 17 children and five parents (the other children and parents had to leave for treatments and prior commitments). We also captured pictures of the play characters the children made (Fig. 7), documented the play workshops by camera and video and took notes. The first author analyzed the data using an open coding process [35] to derive analytic categories. We were interested in how our designed play engaged children with their hospital environment and if, and how, it supported their hospital experience. The resulting categories were discussed with two senior researchers and then further refined using affinity diagrams to identify key groupings. We then described these groupings in an elaborative language to facilitate "thinking through writing" [35], which allowed us to derive four lenses we describe below. This approach is similar to other qualitative work in hospitals [45], providing intermediate-level knowledge [18] that is aimed to be readily applicable to designers.

RESULTS

Overall, the participants appeared to enjoy the play workshops with the hospital materials. The children answered they felt creative, happy, "normal" again and had fun (referring to their "normal" life outside the hospital). An indicator the play workshops were a success could be that many asked unprompted if they could take part in more. We now articulate key groupings of our results to describe how the play workshops engaged the children with their hospital environment and in consequence supported their hospital experience.

Engagement in and with the hospital environment
Laughter in the hospital
An important element of each play workshop and a key factor to their success was the laughter that emerged out of them. There were many jokes told and much laughter present throughout the play workshops. The children told jokes to each other about their play characters and their digital play experiences accompanied by the laughing sounds from Doctor Giggles. Similarly, X-Safari elicited much laughter through the horse-movement control. The parents commented positively that they enjoyed seeing their

children laugh, which contrasted their usual hospital experience: firstly, laughing is inexplicitly inhibited due to the "mute" hospital environment and secondly due to the seriousness of the health context. Parents described it as a relief that they were able to laugh with their children *in* the hospital environment, and also laugh with them *at* the hospital environment and the associated medical tools that were now encountered from their "*silly*" side in the virtual world.

Children decorated their hospital environment with the play characters
After the conclusion of the workshops, the children continued to engage with the play characters they had created to decorate their hospital environment. They set them up in their rooms and attached them to their hospital equipment such as their wheelchairs and IV-drips (Fig. 8). Others gave their play characters as gifts to their families, other patients and hospital staff. Maribel (12) described how the play characters facilitated an interaction with her brother, and furthermore, how the play character, coming out of the hospital, became part of her home environment: *"I've shown my giraffe puppet to my brother and he really liked it. He studies visual arts. We have put it in my bedroom."*

Fig. 8. IV-drip and wheelchair decorated with play characters

Children enjoyed being able to use hospital material
The children enjoyed using items for play such as the virtual medical scissors and physical X-ray sheets. The hospital environment usually does not allow children to interact with such material, as they "belong" to hospital staff and are generally seen as a symbol of illness. The children described the use of hospital material as *"nice"* and considered it *"different" (Pau, 10)*. Pilar (12) noted that: *"I like [the play characters] because they are funny and because we have used things from the hospital".* Similarly, Maribel (12) said that *"it was very interesting to use the bones from people to make shadow puppets".*

Children seeing hospital material and treatment as a resource for play
The sick children appeared to really enjoy the fact that they had knowledge and expertise of hospital materials and equipment that their family members, especially their non-sick siblings, had not, and as such were able to be in a more guiding position during the play workshops.

Children explained hospital material

One particular way this guiding position unfolded was through the children explaining the hospital material to the other participants. For example, with Doctor Giggles, we noticed children explained to family members the names and uses of the virtual hospital materials, just to burst into laughter when the tools in the virtual world performed very different functions. It appeared to empower children placing them in a position where they could explain to family members aspects of the hospital experience that often their siblings did not know about, which filled them with pride. We noticed this especially when explained to an older sibling, as it appeared to elevate the sick child to a superior position.

Children were proud of being able to contribute to the virtual play system

The children found the virtual operation room of Doctor Giggles fun and engaging: they liked being able to interactively change the color of the lights in the operation room and triggering the different sounds the IV-drip in the game made: *"It is like a room for medical procedures but it is a little bit crazy... Haha... It is fun" (Maribel, 12)*. Such enjoyment of interactive opportunities was expected, however, the children also reported enjoying seeing their own play characters coming out of the *"crazy"* and "*silly*" digital X-ray machine. When asked about the use of the play characters within the play system, all children confirmed that they found Doctor Giggles more engaging when they saw their own characters appear. It seemed the children were proud that they were able to contribute to the play system's content and manipulate their physical characters in the virtual world. The connection between the physical and virtual environment was not always immediately apparent (as others have previously observed [4]), probably due to the delay caused by the scanning process. As such, we note that reframing a physical hospital environment is a complex design process that goes beyond simply reproducing it in the virtual world. However, children enjoyed much more their contribution in designing and playing a game set in a hospital, which contrasts their usual video game experience, where all visual game content is usually pre-created and set in environments different to the child's.

Children seeing treatment as a resource for play

The children began seeing treatments as opportunities to collect hospital material for play

Being in hospital means treatment occurs frequently. As a result of the play workshops, the children began to see their treatments as an opportunity to gain access to hospital material that later could be used for play. For example, when Pilar was taken for an X-ray examination during the play workshop, one of the other children exclaimed: *"Ask for the X-rays for the puppets!"* Similarly, Abdul received his usually stressful and painful dialysis treatment during the play workshop. However, this time, he started clapping his hands and shouted: *"Party, party! Yes, yes, let's do puppets!" (Abdul, 7)*. During the treatment, he asked for more bandages for later play: *"I want more bandages for my dolphin!" (Abdul, 7)*.

The children's excitement interfered sometimes with treatments

However, the heightened engagement and excitement the children experienced made administering treatments like demo-dialysis more difficult. A nurse complained about the play workshop because when the children shouted and clapped, the machines for treatment had to be readjusted several times. Usually, administering treatments benefit from the patients being calm and still, so the nurse explained to us that she felt uncomfortable with the amount of extra work involved to set up treatments for excited children.

Children engaged bodily with the hospital environment

Although the children had illnesses that affect their bodily abilities, we found they still engaged very much using their bodies, as you would expect from children that age. Besides moving around the hospital environment, the children embodied their play characters' behavior. The parents were excited to photograph their children embodying such behavior, contrasting it with the non-active behavior the children usually exhibit when back in their hospital beds.

Moving around

The opportunity to leave their hospital beds and move to another part of the hospital to attend the play workshop was welcomed. The children also enthusiastically moved around the workshop room to go back and forth between the craft table and the screen setup. In particular, the parents appreciated this opportunity to help their children leave their room and move around the hospital motivated by play.

Embodying behavior

We observed how eight children embodied the behavior of the characters they created out of hospital materials. For example, Javier, while playing with his hospital vampire character, was trying to bite the workshop facilitator, which resulted in a lot of shouting and laughing. Similarly, the children reported to like playing X-Safari because they were able to move their avatar with their hand. However, we also observed some challenges: four children found the glove difficult to operate. The others, though, said they liked the glove input because, even though it was difficult, they enjoyed the challenge.

Picture-taking

The parents enthusiastically took pictures of their children during and after the play workshops and shared them with relatives through social media. Medical staff also helped to send photos of the play workshops to the children's friends, relatives, and teachers. It appeared the parents enjoyed photographing their children "doing something nice" related to the hospital experience, which highlights the

child being active and engaged, compared to the pictures they usually take with the child being "inactive" or lying in bed, which highlights the illness, rather than the child.

Children can be exhausted

Due to their illness and treatments the children were often exhausted. We observed one child falling asleep during the play workshop as a result of her cancer treatment. In another case, a girl became so tired that two nurses had to pick her up to return her to her room. The bodily engagement during the play workshops probably only amplified such exhaustion. From our experiences with children, we know that children can get exhausted during play workshops, however, this exhaustion can occur much quicker in hospital. Luckily, our format was structured in such a way that it could accommodate such situations easily, for example it did not require two players to play in the virtual world simultaneously, so that if one player would drop out, the play would not end.

Children might not want to go back to their rooms

The bodily engagement resulting from the play workshop also led to challenges: Some children enjoyed the play workshops so much that they did not want to leave the play space and go back to their rooms. They enjoyed moving around (and of course being in a social environment with their families etc.) that they would have rather stayed there than return to their rooms (which is associated with boredom, pain, stress etc.). Although the children knew that the room would be vacated after the play workshops, they wanted to stay, even after knowing they were allowed to play digital games on their consoles in their rooms.

Reversing roles in the hospital environment

The children enjoyed being able to "treat" their doctor in Doctor Giggles and to help family members with their knowledge of hospital material, highlighting how reversed roles contributed to the success of the workshops.

Experiencing hospital authority in an alternative way

The children reported that they enjoyed Doctor Giggles especially because the patient was an adult, in particular their doctor, rather than a child (which is the usual role they are accustomed to) and that they were able to manipulate, i.e. tickle, the adult: *"Look, he is an adult!" Javier (7)* said, while the other children laughed. Although the doctor in the game was not familiar to all children, those who knew him recognized him and referred to him and his practice as a doctor, often imitating some of the ways they encountered when he treated them.

Helping others

We observed that the children eagerly helped their siblings and parents with making the play characters. It appeared that both the children and especially their parents enjoyed this opportunity of a reversal of the usual roles where the parents and the doctors are in control; in contrast, here the child felt more in control as they had prior knowledge about the hospital material and therefore knew more about what can and cannot be done with it during crafting and play activities. The child's ability to help others due to this knowledge appeared to result in feelings of empowerment.

Diverting attention from the everyday hospital reality

The participants appreciated the play workshops facilitating a diversion of attention away from the everyday hospital reality, allowing them to talk about something other than sickness and form as well as strengthen social bonds beyond the common denominator of illness.

Talking about something other than sickness

The parents appreciated meeting other families and talking about being creative and playful, which was a welcomed relief compared to the usual discussions about the health of their children. Instead, the parents talked about the materials and the play systems while laughing and helping each other with the play workshop activities. Having their parents enjoy talking with other parents about the hospital environment appeared to have contributed also to the children's positive experience of the play workshops.

The play workshops facilitating social bonds

The parents thanked us after the play workshops, congratulated us on its execution and asked if there would be more. Furthermore, the parents from the first play workshop invited other families to come to the second. One father highlighted how the play workshop was not only a success for his child, but also for him. He was enjoying it more than he expected and described the experience as "*very relaxing*". He found that playing with hospital materials with his daughter could relieve some of the family stress that comes with having a hospitalized child. Similarly, Pablo's mother expressed delight how the play workshop supported her son's relationship with his sibling: *"Many times siblings don't know how to feel [...] they don't understand. This is a way to make things much more personal and easygoing [...] I like it very much [...] all the activities we did."*

LENSES

Based on our findings, we derive four lenses through which researchers can examine the design of play that aims to engage children with the hospital environment to support their hospital experience. We then use these lenses to articulate six practical strategies to aid game designers developing such play systems.

Reframing

Our first lens provides a perspective of examining play for hospitalized children through the notion of reframing. Our play workshops successfully supported a reframing of the hospital experience by allowing the children to engage with medical materials, the hospital environment and tasks in a different way, here it was a playful way that contrasted with their usual hospital experience that focuses on disease and

illness. This reframing helped the children reimagine what the hospital experience can be for them. This was achieved through three key ways:

- by reframing various hospital materials commonly associated with illness, e.g. turning X-rays, bandages, and other hospital items into crafting resources for play;
- by reframing the hospital environment through reversing the role of the patient and doctor in the virtual world; and
- by reframing hospital tasks into a resource for play, for example the children perceived that through participating in treatments, they could control the operating theatre light switch illuminating the theatre with night club lighting.

As such, game designers should think about reframing the hospital materials and swapping medical staff roles, both in the physical and virtual world. We now describe such thinking as strategies in more detail.

Strategy: Opportunities for reframing can be found by exploring the hospital environment
The participants enjoyed using the hospital materials as a craft resource, partially because the children were very familiar with the materials. Using materials from the hospital was not an act of convenience or of minimizing cost, but rather an opportunity to reframe the hospital material through turning it into craft resource for play. Opportunities can be found by exploring the hospital environment. For example we examined if medical material could be turned into craft material, but other approaches could include exploring the hospital bed as a theatre stage or the corridor as playground. The children also enjoyed how the hospital material became a resource for digital content, allowing them to feel like junior game designers when their creations appeared in the virtual world. Virtual worlds are usually designed by adults, so being able to contribute to Doctor Giggles was a welcomed change for the children.

The reframing of hospital material reminds us of the desensitization methods that are often employed in hospitals. Desensitization refers to the presentation and use of a frightening object so that it becomes less stressful [40]. Prior work has shown that a hospitalized child who familiarizes themselves with a medical object can in response have a less emotionally disturbing relationship with it [31]. It appears that by reframing the hospital material through play our participants experienced a desensitization effect, resulting in a less stressful relationship with the material that in consequence positively affected the hospital experience as a whole. Furthermore, the reframing of the hospital material led to a reframing of the treatment task: the children saw their treatments as a resource to generate and gain access to play material. For example, by undergoing an X-ray scan, they would gain material for one of the X-ray shadow characters.

However, although the play workshops facilitated a reframing of the hospital tasks that the children experienced as positive, it made administering the treatments more challenging for the staff: sitting still is a requirement for many medical procedures, which is not easy to achieve with an excited child. As such, it is important for designers to consider not only the positive effects reframing can have on children, but also any consequences for medical staff.

We highlight to designers that our approach was to reframe the hospital tasks as a resource for generating play material, however, we can also envision other approaches where the task itself becomes a resource for play; for example reframing a dialysis treatment into an activity that is experienced as a form of play could be an exciting area of future work.

Strategy: Reframing the hospital environment by reversing roles through play
Doctor Giggles supported a reframing of the hospital environment as the play system allowed the children to take control of the virtual hospital environment reversing the role of the patient and doctor. This reframing supported the children's fantasy to imagine opportunities for play throughout the hospital experience: what role could nurses and parents take on in their play, for example?

The digital aspect of our play workshops played to its strength here: it was relatively easy for us to change the face of the virtual doctor in Doctor Giggles to elicit a fantasy of the doctor being the patient, in contrast, changing the "face" of the play workshop facilitator, i.e. dressing up as a clown, took much longer (and we doubt the senior medical staff would dress up for the children, for example). As such, reframing the hospital environment by reversing roles through play lends itself to the virtual world, as we know from game design research that one of the strengths of digital games is their ability to support the fantasy element [26].

Ownership of hospital experience
The play workshops facilitated the children gaining a sense of control over their hospital experience, as evident by them showing their siblings what some of the hospital material is for. This sense of control can lead to feelings of ownership of the hospital experience, which we believe is a positive development. Therefore we propose examining play for children in a hospital context as an opportunity to promote this feeling of ownership. As a result of the play workshops, the children were able to gain confidence in moving from a more passive role (in which the doctors have all the say) to one in which they can see themselves as having (at least partial) ownership. Two key strategies facilitated this: supporting autotopography and supporting autonomy.

Strategy: Supporting autotopography
Miller [33] explains that people like to express themselves with material artifacts that embody their lives, personalities,

emotions and achievements. The children were no different: they expressed themselves by decorating their rooms, wheelchairs and IV drips with the play characters they had created. Such an arrangement of material artifacts as physical signs to spatially represent the identity of an individual is known as "autotopography" [14]. An autotopographical collection of material artifacts put on display not only becomes the public representation of the self and craftsmanship [12], but also serves as a memory landscape to the owner allowing for the triggering of reminiscence.

Opportunities for hospitalized children to express themselves are often very limited, as such, the opportunity to decorate their rooms with artifacts they had created was very welcomed. We note that this opportunity to support autotopography existed for the physical play characters but not the virtual ones: they disappeared with us dismantling the screen setup, and were also not able to travel to the children's room and could not be put on display there. As such, we highlight that the physical play artifacts were supporting autotopography, however, the digital elements were not. We believe there is an opportunity for physical-digital material such as tangibles to support hospitalized children's desires to engage with autotopography (similar opportunities have been expressed in related work with dementia patients [45] and children with limited physical activity [1]). For example, we can envision utilizing 3D printers to print 3D objects based on children's play as personalized decorations to be placed in their rooms to support this experience of autotopography (inspired by prior work around 3D printing and autotopography [22]).

Strategy: Supporting autonomy
The play workshops appeared to facilitate the children gaining a sense of ownership of the hospital experience, especially as it provided the children with control over their play, for example they could use the play characters any way they wanted, and both digital components supported open-ended play. The sense of control during play has been previously described by Rigby et al. as "autonomy" [39], it refers to people's innate desire to take action based on personal volition, and not because one is "controlled" by circumstances [39]. Hospitalized children in particular might feel "controlled" by their sickness, and as such, we feel offering experiences of autonomy might be a welcoming and beneficial contrast. Studies have shown that if young people feel their autonomy is supported, rather than feeling they are being controlled, there is greater sustained engagement and an improved sense of wellbeing [39]. Similarly, the play workshops supported autonomy by creating activities that were non-prescriptive and allowed the children to control the direction of their play. This included a) having no predefined desirable game states, b) having no winning or losing condition, c) supporting open-ended play, d) us being responsive to the participants during play (as suggested by [32]) and e) allowing children to

pause play anytime, for example when they felt exhausted or when a treatment was due. When play was stopped for whatever reason, children were able to re-enter the play environment easily. However, it is important to note that supporting autonomy can interfere with the constraints of the hospital: the example of the children who did not want to go back to their rooms suggests supporting autonomy could be a source for conflict that designers need to keep in mind.

Feeling privileged
The play workshops facilitated the children feeling privileged, as shown through the enjoyment the children felt in knowing something about the hospital environment and tools (both physical and virtual) they could then teach other family members as part of play. It appeared to make them proud and put them in a privileged role; in other words, they became the experts who controlled the proceedings. This parallels the recommendation by Hoiseth et al. [17] who find that health games for children should elevate the "child as expert" in digital play. The feeling of being privileged contrasts with the sick child's usual situation. The play workshops facilitated this feeling of being privileged through a strategy of asymmetrical play.

Strategy: Asymmetrical play
The play workshops featured asymmetrical play [29] in which the children had prior intimate knowledge about the hospital material, environment and tasks that their siblings and parents often had not. As such, the play participants were not treated equally, which contrast the current trend of game balancing, where game designers aim to balance players with different abilities. For example, Gerling et al. balanced a game in order to give children with and without wheelchairs an equal chance to win [10]. Here, we work against this trend by highlighting that identifying (and stressing) advantages of the hospitalized child could be a valuable resource to enable asymmetrical play, so that the sick child has an opportunity to inhabit a privileged position.

The body as resource for play
It appeared the play workshops were an affirmation that the children were able to bodily engage in play despite their illnesses: they were moving around, clapping and generally being very active, seemingly forgetting that this is not how a sick child "is meant to" behave. We suggest the children realized that even though their bodies are affected by disease, they could still draw on their bodies as a resource for play. The fact the parents photographed their children engaging in physical play seemed to underline the notion of the body as a resource for play despite being ill. The play workshops aimed to facilitate this notion of the body as a resource for play through a strategy of supporting embodied play.

Strategy: Embodied play

The play workshops facilitated seeing the body as a resource for play – rather than primarily as a source of disease – via embodied play. This was facilitated by a) throughout all the activities the children engaged with physical materials that were concerned with bodily aspects of the hospital experience, b) the artifacts they crafted had embodied characteristics (i.e. all play characters were either animals or people), reminding them of bodily aspects, c) the location of craft tools and the large display required the children to get up and move about, d) the horse character in X-Safari was controlled using the children's hand movements, e) the characters in Doctor Giggles were controlled via big arm movements along a large touchscreen, aiming to bodily engage with (i.e. tickle) a virtual doctor, and f) the virtual worlds featured 3-dimensional embodied characters. This embodied play focus contrasts prior work highlighting cognitive-focused play (e.g. [47, 49]) to accommodate the limited bodily abilities of children in hospital. We note that our play workshops were designed with the knowledge that the children would not be able to engage in intense exertion activities as part of gameplay (as, for example, afforded by games like Remote Impact [34]), however, we promoted engagement with embodied activities as much as possible. The benefits of embodied play to support children has been previously highlighted [2], however, we point out that embodied play for hospitalized children means making a shift from seeing the body as a source of disease to a resource for play, not only significant for the children, but also their families and medical staff.

LIMITATIONS

Supporting children in hospital is multifaceted and therefore riddled with challenges; as such we acknowledge that our work has several limitations. So far, we have only conducted two play workshops, and we also do not have conducted comparisons with workshops that facilitate "generic" or non-hospital specific play. Extending the target age and the number of play workshops could reveal further insights. Furthermore, we have yet to test our lenses with other designers to examine their utility.

We believe that supporting the development of emotional wellbeing can positively affect a child's physical recovery. Our work focused on highlighting knowledge for the design of play to support such wellbeing, however, this needs to be complemented with evidence-based research into the efficacy of play as part of complementary care. This is required to ensure the continuation and increased support of such complementary care programs in hospital and is therefore an important avenue for future work.

CONCLUSION

We have presented the results of two play workshops designed to support hospitalized children. Our approach was to engage children with the hospital environment through play in order to support them to experience the hospital not just as a place of distress and diseases, but as another space for play that is part of life. The work therefore contrasts prior work that has sought to use play as a method of distraction from the hospital experience. Although measuring the success of complementary care is always challenging, we believe our results provided indicators that our play workshops were successful in supporting the children's experience in hospital. Through our results, we derived four lenses through which to see the design of play for hospitalized children, which we complemented with a set of strategies that designers can hopefully readily apply to future work.

Although we do not have data from outpatient children, we believe our contribution might also be useful to them and other user groups such as disabled children, children who need to undergo rehabilitation treatments and children who need to regularly see a GP as they might also benefit from reframing the experience of being sick. We also believe our work furthers our understanding of the design of play that aims to support hospitalized children from a perspective of complementary care. In particular, our work complements existing approaches by providing an interaction design perspective on the potential of interactive technology to support existing non-technical approaches such as play therapy. Our work is aimed at designers interested in creating interactive technologies and play for children in hospital, and hospital staff and medical practitioners interested in the power of digital play to support complementary care. Furthermore, we believe our work through its four lenses is useful for researchers to analyze approaches that aim to support complementary care for children and compare different approaches. Lastly, our work through its six strategies might be useful for game designers and researchers who want to utilize their design knowledge to support hospitalized children and contribute to their wellbeing.

Overall, our work aims to inspire other designers and researchers to consider supporting play as complementary care so that ultimately more children and their families can profit from its benefits.

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