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Measuring and Communicating Emotions through Game Design

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Abstract
This paper explores how emotion research may inform the design of a playful interactive tool for emotion measurement and communication, called Child Patient Game (CPgame) that has been developed for paediatric patients at a Danish hospital. The CPgame differs from other instruments in that it uses digital narrative and game play as means for self-report. In so doing it integrates play, communication and measurement in one and the same device. First it gives 4-6 year old hospitalized children an opportunity to learn how to cope with their own emotional reactions to medical treatment through game play. Second, healthcare personal and design researchers can use the CPgame to gain knowledge of this patient group as it measures the children’s subjective feelings about their emotions. In the paper we discuss how key theoretical concepts of emotion may help the designer to indentify the basic building blocks of emotions and to distinguish closely related emotions from each other. Further, by comparing various methods and techniques for emotion measurement, we argue that design research offers more sensitive techniques for self-report measurement for children than psychology and the behavioural sciences.

Keywords: Healthcare, User Experience, Game Design, Research & Design Methodologies

Introduction
In clinical settings there is a lack of instruments and methods that can be used to measure emotions and differentiate levels of anxiety experienced by children [1]. The methods most frequently used today are based on questionnaires, semi-structured interviews or observation reports. These methods are insufficient, because children normally have difficulties expressing their emotions through verbal accounts [2]; and observation reports made by an outside observer are encumbered with insecure guesses about how the child actually feels. Ideally, what we need are non-verbal methods for communicating that invite children actively to participate and inform the clinical staff and researchers of their inner emotional life through expressions that they understand so well: play and gaming.

Interestingly, the emergence of emotional approaches to design suggests that design can play an important role as a medium for this non-verbal dialogue between children and the clinical staff. Even though emotional design must still be considered a young discipline, over the last decade or so, we have witnessed a boom in research literature covering almost every aspect of emotions (see e.g. [4-6]). By drawing upon various theories from psychology, cognitive science, aesthetics and philosophy it has been possible for the design research community to work out nuanced understandings of the nature of emotions and not least how we may use design to create conditions for evoking, modulating or prohibiting certain emotions in user experience. In addition, recently non-verbal measurement instruments such as PrEmo [7] and SiSom [8],[9] have been developed that allow people to communicate their emotions through interactive graphic icons or animation. This strongly suggests that
emotional design offers a promising approach for working with children in hospitals, both as a research tool and an end product.

In this paper, we discuss how emotion research in design was used for informing the design of an interactive computer game, called Child Patient Game (CPgame) that has been pilot-tested on 4-6 years old children at the pediatrics department of a Danish Hospital. CPgame is part of a broader trans-disciplinary research project where design researchers, nurses, doctors and psychologists collaborate in order to learn more about children’s emotions and experiences during hospitalization.

The aim of the CPgame was not only to design a self-report instrument for emotion measurement that would provide the hospital staff with more detailed insights into the needs and interests of young patients. More importantly, the CPgame should also allow the children to play and have fun during their treatment at the hospital by combining the self-report function with game play. The CPgame encourages children to play with narratives and through these narratives learn about their own emotions. In this way children will hopefully become more familiar with how they feel and perhaps even capable of handling their own emotional reactions towards the treatments.

As a point of departure for our paper, we will use three observations from our pilot-study for discussing some key concepts from emotion research that will help us to define our view of what an emotion is. Further, we will review some of the recent proposals that have been made as to how we can measure them. This theoretical discussion will serve as a backdrop for demonstrating how emotion research serve as a resource for the design of CPgame and for identifying some directions for future work.

1. Emotional States in a Hospital

The following observations were made during our initial research at three different locations of the Department of Pediatrics at a Danish hospital:

Observation 1, Examination room, 8 am:

Mille, a 4-year-old girl, is having a blood test. She is lying on a bed, with her mother sitting next to her. On the other side of the bed, the nurse is preparing her right arm. Mille is looking away from the needle and maintains the mothers look in a fixed stare. Her lips are firmly pressed together, as if she wants to prevent something from coming out.

Observation 2, Playroom, 11 am:

Mads, a 5 years old boy, is sitting with his father in the TV-corner of the Playroom. He has intestine problems and must drink medicaments that he dislikes. "I refuse to drinks this" he says. After a long discussion with his father, he finally agrees on taking his medicine. "Will the clown then arrive soon?" the boy asks, still holding the full glass in his hand. "If you drink this, he will" reply’s the father with a smile.

Observation 3, Acute Medical Care, 22 pm:

A young couple has arrived in the acute emergency care with their 3-year-old daughter who has just suffered from a severe fever attack. The three of them are brought to the examination-room. Here the father tells what has happened the last 24 hours, while the mother is sitting with the girl on her lab. The nurse makes an attempt to make contact with the girl. She needs to examine her. But the girl clings to the mother’s neck and doesn’t want to face the nurse or lay down on the examination couch. She just wants to stay where she is. Close to the mother. The father gets irritated. Pulls the protesting girl away from the mother and puts her formative on the couch. Later, outside the examination room the father explains, that after four sleepless nights with an ill child, his
"patience is used up". His daughter has been in and out the hospital since she was born, with pneumonia, a broken hip and "other things", he continues. "I just need a break," he says.

Each of these situations is imbued with intense emotions. Notice however how these emotions manifest themselves in very different forms and, that the subjects, who are involved, try to cope with them in their own specific ways. For instance, the little girl’s anxiety of the needle is revealed through her facial expressions and body language (Ob.1), while the boy’s disgusts is expressed through verbal language (Ob.2). In the last situation (Ob.3), the girl’s bodily resistance tellingly informs us that she feels uncomfortable, whereas the father’s irritation is observable through his uncontrollable action followed by his rational reflection that this emotional outburst happened because his patience “was used up”.

Furthermore, it is possible to identify some general aspects of emotions, which finds support from emotion research. First, emotions in hospitals often come in mixed states (cf. [10]). For instance, the boy is disgusted by the taste of the medicine, yet at the same time the prospect of meeting the clown is likely to fill him with positive emotions such as happiness and delight. Second, verbal instructions and social interaction are typically used quite deliberately by nurses and parents to direct children’s emotions in certain directions, for instance, promises can serve as cognitive distractions that modulate negative emotions. Third, the context obviously has an impact on the intensity of emotional reactions: while the playroom is an ideal spot for calmly persuading the boy to take his medicine, the girl in the acute medical care is under considerable stress.

Meanwhile, merely observing in a behaviourist fashion that people have an emotional experience leaves us with an incomplete notion of what emotions are. To deepen our understanding, we can ground our observations in theories developed from cross-disciplinary research into emotions. In so doing, we aim to provide the reader with a more detailed description of the precise nature of emotions and what means we have for measuring them. This will be the focus of attention of the next two sections.

2. What is an Emotion?
Contemporary emotion research has its roots in different theoretical traditions and disciplines, each of which represents a different view of what an emotion is and how it is elicited. The most relevant for our purpose are:

(1) The evolutionary perspective on emotions is associated with Darwin [11] who noticed that emotions are expressed cross-culturally in much the same way through people’s facial expressions and expressive behaviour. Forming such a “biological unity of mankind”, emotions serve a functional purpose for the survival of the species and the individual. They help “organisms to deal with key survival issues posed by its environment” ([12], p.129). For instance, fear initiates an impulse to run in order to survive a threatening situation. Researchers like Tomkins, Ekman and Friesen, Izard and Plutchik, belonging to this tradition, see adaptive behaviour (facial expressions and readiness to respond) as essential to what emotions are [12-15].

(2) The somatic theory of emotion is usually traced back to the founders of modern psychology, notably William James and Carl Lange [16],[17]. According to this theory the experience of an emotion is a direct result of a sensed change in bodily states. This change simply is the emotion: "We do not cry because we are sad, we are sad because we cry” as James is famous for having proclaimed. Recent findings from neuroscience have led to a renewed interest in James’s ideas. For instance, Damasio has demonstrated how bodily evoked feelings and affects are crucial for human’s ability to act and respond meaningfully in the world [18].

(3) The cognitive theory of emotion focus on how emotions are generated by the judgments we make about the world. In order to understand emotions, one must therefore understand, how people make judgments about the
events in their environment. Magda Arnold [19], who is one of the pioneers of the cognitive approach, claimed that the appraisal (the valuation, the direct judgment) is the core of all emotions. More precisely, she argues that emotions should be understood as "the felt tendency toward anything intuitively appraised as good (beneficial) or away from anything intuitively appraised as bad (harmful)" ([19], p.182). Without appraisals, there can be no emotion, since all emotions are the product of one’s judgment of one’s situation. It is not the event itself, but the meaning that we attach to this event, which is responsible for our emotion.

Over the years it has been heatedly debated whether emotions could be reduced to one foundational eliciting component, either bodily feelings or cognitive appraisals (cf. the Zajonc-Lazarus debate). However, as argued in Markussen [10], the somatic and appraisal theories of emotion do not rule out, but rather presuppose one another. Hence, instead of founding one’s view of emotion on one component rather than the other, it seems more fruitful to treat emotions as a multifaceted phenomenon consisting of the following components” (cf. [20], p. 3):

- Behavioural and expressive reactions
- Physiological reactions
- Subjective feelings

This non-exhaustive list includes two components of emotions that were not encompassed by our initial observations, because they cannot easily be observed, namely “physiological reactions” and “subjective feelings”. For the sake of clarity, let us define all three of them, before we move on.

Behavioural and expressive reactions are the facial, vocal and postural expressions that accompany an emotion (e.g. starring, smiling, frowning eyebrows). According to Ekman (1994), each emotion is thus associated with a particular pattern of expression. For example, anger comes with a fixed stare, contracted eyebrows, compressed lips, vigorous and brisk movements and (sometimes) a raised voice or violent behaviour. In our pilot-study, the girl clinging onto her mother’s neck falls under this category.

A physiological reaction is the change in activity in the autonomic nervous system (ANS) that accompanies emotions. For instance, fear is most often physiologically coupled with a racing heartbeat and sweat pouring out from the skin.

A subjective feeling is the conscious awareness of the emotional state one is in. A conscious awareness can be measured through self-report, for instance, asking respondents to reflect on how happy/unhappy they have been over a specific period of time - or how they feel about certain objects. A subjective feeling relies on people’s own evaluation of a specific situation, communicated through verbal or non-verbal channels.

This leaves us with a number of components that can be used, not only for describing what an emotion might consist of, but also for measuring emotions. During the last fifty years or so, many attempts have been made in order to develop refined research techniques and methods useful for measuring emotions in terms of these components. In the next section we offer a brief review of some of these techniques discussing whether they are useful for informing the CPgame.

### 3. Emotion Measurement

The term "emotion measurement" is about gathering emotional feedback. It is about differentiating certain emotions and finding new ways of collecting the emotional traces that people leave behind, detecting negative or positive responses, strong or weak signals [21]. Emotion measurement should embrace both quantitative and qualitative aspects of experience. Naturally, the measurement instrument one use will depend largely on what
one is looking for, i.e. on one’s notion of what an emotion is. This becomes evident from surveying the state of the art:

1) Measuring behavioural and expressive reactions have been attempted by using various measuring instruments. A well-known technique consists in capturing facial expression on video or photographs with the use of facial expression instruments that link expression features to distinct emotions. As an example, one could think of the Facial Action Coding System (FACS, [15]) or the Facial Expression Analysis Tool (FEAT, [22]). An update of FACS was announced in 2003. One of the shortcomings of this method is that expressive behaviour does not always tell the truth. This becomes particularly evident when working with children’s emotional experiences. For instance, as noticed by Schneider & Unzner [23], when children smile their facial expressions are often motivated more by the social interaction they engage in, than by their own happiness. Moreover, children smiles as often after failure as after success (cf. [24]). Facial expression can thus be honest as well as deceptive, and the fact that a person doesn’t show or share any emotion doesn’t mean that a certain emotion is not felt [25].

2) The measuring of physiological reactions (e.g. heartbeat, sweat, pupil dilatation, and brainwaves) is an area, where researchers have been very active since the 1980s developing different digital devices and sensors that can gather physiological signals while people experience an emotion (e.g. The Affective Computer Group, MIT). All kinds of body signals and responses can be measured (temperature, eye movements, brain waves, pulse and skin rates). Identifying emotions with these signals is equivalent to James’s idea of changes in bodily states. An advantage of measuring physiological reactions is, that the subject cannot control them. However, we must be careful with how we interpret data acquired through physiological measuring. For instance, two related emotions such as fear and anger may be decomposed into almost the same physiological reactions without being equal. Furthermore these instruments also pick up signals from non-emotions (sickness, hunger, other reactions) and they cannot access mixed emotions (like when you experience "thrill” and "joy” at one and the same time).

3) Measuring subjective feelings have been attempted through questionnaires, interviews, and self-report. Self-report can be verbal (questionnaires, interviews) or non-verbal (through visual design). One of the shortcomings of these methods is that people evaluate conditions differently depending on their expectations, values and previous experience ([26], s. 427). However, non-verbal methods are interesting when it comes to small children, since expressing emotions through, writing or verbal accounts is difficult for them. It is also interesting to notice that design researchers and not only psychologists have contributed significantly to the invention of such non-verbal methods.

The Self-Assessment Manikin [27] is a pictorial scale allowing for direct ratings of arousal, valence and dominance, where respondents point out the puppets that in their eyes portray the emotion the best way. Even though these puppets only represent highly generalized and standardized emotional states, using expressive pictograms or puppets has many advantages. Pictograms do not require the participants to verbalize their emotions; they communicate emotional content across cultural borders and do not require translation (Darwin’s “biological unity of mankind”).

Desmet’s Product Emotion Measurement Instrument (PrEmo) is a non-verbal, self-report system, developed especially for the emotions elicited by product appearances; it measures up to 14 emotions that are often elicited by product design [7]. Instead of relying on the use of words, respondents can communicate their emotion with
the use of expressive cartoon animations; animations that makes use of dynamic, facial, bodily and vocal
expressions.

Another tool that makes use of subjective feelings, self-report and strong visual means is SiSom [8],[9]. SiSom
is an interactive assessment and communication tool for children with chronic diseases, such as cancer,
congenital heart disorders or diabetes. It is a game-like environment that helps children to report their own
symptoms and problems. SiSom uses spoken text, sound, animations and pictures to depict symptoms and
problems.

Even though SAM, PrEmo and SiSom all deal with subjective feelings and visual means, their scientific goal is
different: PrEmo and SAM is used to measure subjective feeling (towards situations or product appearances)
through non-verbal, self-report, whereas SiSom has been designed to help children to communicate their illness
experiences. How these aspects are related to the instrument we are developing will be discussed in the next
chapter.

4. Discussion: How does emotion research and measurement instruments dealing with emotion
inform the design of a game?

In search for useful starting-points for developing a measurement-instrument based on play and gaming, we
needed to look at what methods would work for small children. Children are not interested in the scientific goal.
They are interested in, what is in it for them. Therefore the scientific goal (measuring emotions, learning about
emotions, lowering fear) must not get in the way of the game goal (having fun, exploring the role as a patient).
Or to put it differently: they should be in balance.

Which choices do we take in terms of "measuring" and "playing", when we want to embrace both quantitative
and qualitative aspects of the emotional experience - and make it sustainable for children?

When it comes to the scientific goal, the choice of emotion measurement is not that difficult to make. Emotion
measurement in the first two instances (behavioural/expressive and physiological reactions) seems to risk
placing the child in an uncomfortable situation. Either the child would have to tolerate video shooting and
observation during examination or have scientific equipment, wires and bodily sensors plastered onto its body.
This is most likely to cause emotions that are even more anxiety-laden than those evoked by the treatment itself.
In contrast, the self-report systems all have the potential of letting the child become an active respondent
whenever it feels in the mood for it.

Instruments such as SAM, PrEmo, SiSom have served as inspiration, in the development of the CPgame
because they all deal with subjective feelings, visual means and the notion of self-report. But as we stated in
Chapter 3, the CPgame is not based the same scientific goal. So how does the CPgame relate and distinguish
itself from these three instruments?

The CPgame relates to SAM and PrEmo, by making use of pictures and animation to portray emotion. The
difference is that the CPgame contextualizes the emotion it is meant to measure - and puts it into a timeframe
(see chapter 5). CPgame also relates to PrEmo by using a small set of emotions that the respondents can use fast
and intuitively. On the other hand, the CPgame must be distinguished from SAM and PrEmo because the game-
goal (having fun, playing with the "role as a patient", playing with emotions, exploring the narrative) is part of
the design. It’s integrated in the narrative structure of the game, and runs parallel with the parameters that
measure emotion.
CPgame also relates to SiSom because it specifically deals with subjective feelings and children in hospital. Sisom does not measure emotion, but it deals with an important question: How can we help children communicate something as complicated as emotion related to illness, symptoms or treatment? In a similar vein the CPgame seeks to get an answer to the question: What emotions do children in hospital express through play? If CPgame can establish a link between the emotions felt during (painful) medical procedures, and the choices children make in the game, we are moving along a similar track as SiSom; they can both be a starting point for fruitful communication between paediatric patients and staff.

5. Designing a Computer Game for Children in Hospital

The Child Patient Game (CPgame) is a computer game prototype for hospitalized children, age 4 to 6, developed in 2009 - and still under development. The concept of the game is developed in cooperation with the the Health Services Research Unit, Lillebaelt Hospital / IRS University of Southern Denmark - and shaped from initial observations and talks with patients, parents and the staff at the Department of Paediatric, Kolding Hospital. The purpose of the CPgame is to design a computer game environment for children that can measure subjective feelings, through the children’s interaction with the characters, narrative structures and game play - and at the same time inform and prepare the children for a hospital-situation.

5.1 Emotional Character Building

The animations in the game are made out of simple line drawing. Everything is black and white. Colors are only added when an emotion is chosen. The main character, a child patient, is always in the centre. The surroundings are reduced to a minimum (e.g. a bed, a table, medical instruments, a window) that just symbolizes if the animation figure is outside, inside, at home or at the hospital, in the patient-room or in the examination-room. The animation figure is tiny and small compared with the open white space that surrounds him. This tininess together with the un-even, not-smooth, pixel based technique makes him somehow look fragile. This minimalistic style is trying to meet the world of a child patient: Feeling small, vulnerable and somehow "not sure of what's going to happen next".

An essential part of the CPgame is to create characters and objects that the player (the hospitalized child) can relate to while being in the hospital. Among these are the child patient, mum, dad, the doctor, the nurse, a bed, medical instruments and objects. These figures and objects are combined with situations that are recognizable for a 4-6 year old. For instance, being examined by a doctor or nurse, not sleeping in your own bed or being in new surroundings. By creating such general starting points we hoped to open up for a world, which is understandable and accessible for small children, whom for different reasons, are being hospitalized.

The CPgame works with a small set of emotions that can be attached to the main character (see below): three negative emotions (sadness, anger, fear), one positive (happy) and one emotion less articulated that the rest (acceptance), which represents a neutral or less active emotion [28]. There is a focus on negative emotions because they appear strongly in hospital-context (e.g. during medical procedures) and seen from a psychological point of view, it is by understanding the choice of negative emotions, that problems such as anxiety can be dealt with.

5.2 Storyline & Game Play
The CPgame itself has a simple storyline: The main animation character becomes sick; he's brought from home to the hospital. Here different things happens to him; he is being measured, weighted, examined, having a blood test and he has to sleep in a patient room (where he falls into a dream). When he wakes up, he is brought back home again. It's like a 24-hour circle, where the end is connected to the beginning.

The player must attach one out of five emotions (sadness, anger, fear, joy, acceptance) that he or she thinks fits to the main character in the story (Fig 2). This action of game play results in the continuation of the story. Thus by adding the emotion that the player feels belongs to the main character, the narrative sequence moves along with a particular story-string. For instance, if the player thinks that the emotion "anger" belongs to a particular situation, the main character in the game will become angry. If the player thinks that "sadness" is more appropriate, the player can change emotion. When the player has arrived at the "right" emotion, the game will continue.

Fig 2: Screenshot from the Child Patient Game (choosing an emotion). © Knutz 2010.

The player chooses emotion visually: Each emotion is visualized through animation (behaviour), sound (vocal expression) and colour. As mentioned above, color is only added (shortly) when an emotion is chosen. The function of color is to create a tension, between the storyline (black and white) and game play (when an emotion is added to the main animation figure). The different colors representing each emotion (blue=sadness, red=anger, yellow=afraid, green=happy, brown=acceptance), enables the children to "see" the change of emotion better on a visual level; a change from angry (red color + angry sound + angry behaviour) to happy (green color + happy sound + happy behaviour).

Apart from emotions the player can also add a "secret power" (an invisible cape, an armor, a teddy bear or a magic drink). The powers represent the emotional needs on the narrative level (the cape for becoming invisible, the armor for being invulnerable, the teddy bear for feeling safe, or one of the magic drinks that lets the animation figure become either small or big. Fig 3). The player can try out the different powers, through game play, and then continue in the game with one of the powers added to the character.

All actions of the player are stored in a database, fixing the players pattern of choices throughout the game.
When the CPgame is being tested further in 2010-11 we will make systematic inquiries into this pattern as well as compare children in hospital with children (of the same age), who are not in hospital. This research will be directed by two key sets of research questions:

A) How do we measure emotions through game play? How does the choice of emotions in the game relate to the emotions felt during examination? (Based on semi-qualitative interviews). Is there a pattern in their choices of emotions and "powers"? Do other children, who are not in hospital, make different choices in the game?

B) How does the game influence the children in hospital? Do they feel more safe or more prepared, when playing before examination?

Fig 3: Screenshot from the Child Patient Game (choosing a "secret power") © Knutz 2010.

5.2.1 Measurement or Communication?

Addressing the first set of questions requires a significant widening of the notion of emotion measurement. Typically, emotion measurement focuses primarily on how people actually feel in response to a given stimuli and what eliciting factors may be responsible for evoking certain emotions. However, in the CPgame it is not so much the actual eliciting of emotional reactions to the treatment that is interesting, but whether the game may offer the child opportunities for communicating and modulating its emotions by playing with fictional characters finding themselves in as-if scenarios similar to that of the child’s own situation. Even though these fictional emotions may not actually be felt or experienced, they are just as important – or perhaps even more important to our research – because they can tell us something about how fictional world-making may act as a modulation process to the actual situation. It is the relation between actual and fictional emotions that are central for our purpose.

Imagine, for instance, that a boy feels anxious about the blood test he is going to have in half an hour. While sitting in the waiting room, he is playing the CPgame choosing an emotion for the character that is not identical to his own anxiety, but which instead symbolizes an inner emotional state he would prefer to his anxiety or which simply relieves him from thinking about the blood test for a minute or two, for instance joy. Would it be legitimate then to say that we have measured a joyous feeling in the boy, because this is what is indicated when we look into the pattern of his game play stored in the database? Or is it more appropriate to say that the boy has communicated an emotional state that he would like to be in?

This is not just a question of semantics. What we measure according to the data may never have happened or
occurred as an actual emotional experience. Yet, the knowledge about the children’s choices that we gain from the database may be crucial for helping children to express emotional states that can somehow be taken as indirect tokens or signs of how they wish to go through the situation. For instance, during our initial observations we noticed that some children patients were not communicative about their emotions (e.g. the girl Mille in observation 1). When talking to these children they tended to provide answers, which they thought were expected from them rather than telling us how they actually felt. However, there could be no doubt that these children felt very frustrated and experienced intense emotions.

The CPgame is designed deliberately in order to encompass fictional opposites as key measurement factors for making assumptions and judgments about emotions that cannot be communicated by other means. If it turns out, for instance, that there are certain as-if scenarios in the game that are chosen more often than others then inquiry into such patterns will obviously be of much value for shedding more light on what children may find difficult to express through words. Attaching joy to the figure in the game can be a sign of suppressed anger. Moreover, as the CPgame offers various "secret powers" for resisting and counteracting negative emotions, the interplay between these powers, on the one hand, and the actual felt emotions, on the other hand, will also be taken into account.

The concept underlying the CPgame is based on an attempt to embrace the tension between measurement and communication, reality and fiction, patterns and meaning. It accepts the existence of potentialities as having a significant influence on our behaviour, and it attempts to deploy these potentialities as means for making children more familiar with their inner emotional lives. This leads us to the second set of questions, namely whether playing the game will actually have an impact in the sense of minimizing children’s negative emotions thereby making the treatment more tolerable.

5.2.2 Informing and Preparing

Through animation and game play, the CPgame aims to prepare hospitalized children for emotional experiences and emotionally motivated actions, which they can perform "in a given situation". It’s about simulating (in an artistic, visual, non-verbal form) an emotional experience in such a way that the simulation prepares the children for the different emotional (and usually unpleasant) situations that can occur during hospitalization. These situations children normally have to go through unprepared. However, our basic assumption is that being unprepared is to a large extent what makes them nervous or irritated. Being prepared would on the contrary make them feel more confident, less afraid. At least that is what we would like to prove.

Even though the "preparing part" can never be the same thing as the "real thing", it allows the player to replay certain situations, repeat certain emotional circles: Going forward - trying out - going backwards - changing the action - going forward again - experience what happens. In doing so the player gets an opportunity to explore possibilities and counter-factual worlds. Its about "seeing" emotions as a set of reactions that the player can apply to the animation figure "as if they where him". Consider a girl that is afraid of being examined or afraid of needles. What would happen then if that girl imagined herself putting on an invisible cape before having a blood test taken or if she played with the idea of having a magical drink? Imagination and simulation consists essentially in thinking about the future and in this future some things are given, but there are also some things that are changeable. They can be modified.
By identifying themselves with the main animation figure the children can prepare for such changes and actions, when seen from different perspectives. For instance, if that and that happened then I will become really angry. But what if I did that and that instead, then I will just become "a little bit angry". Through the game play emotions are inserted into action sequences and concrete situations in order to explore how they would potentially evolve over time. By integrating temporality and modulation as parameters for emotion measurement CPgame adds dimensions that usually lacks in standard measurement tools.

In the process of emotion modulation even very small changes in emotional intensity may be important for the child, and the challenge is of course how to measure and document these changes. However, we are convinced that this scientific goal can be achieved by analysing game patterns stored in the CPgame without compromising the game-goal itself: Playing with the "role as a patient", playing with emotions, playing with narrative forms. Actions such as having fun, solving things, controlling things, random or obscure elements, play a major role in making the scientific goal and the game-goal somehow equal and transparent.

6. Conclusion and Future Perspectives

In this paper we have demonstrated that emotion research can be used not only for understanding the complex nature of emotions, but also for informing the design of an experimental computer game for hospitalized children. By integrating emotional expressive behaviour and game play into narrative sequences, the CPgame offers children new opportunities to explore emotional reactions to various situations over time. The purpose of this is to give these children a chance to make themselves more prepared for emotions that are likely to be evoked during their treatment. At the same time, the CPgame serves as a measurement instrument capable of informing clinical staff and researchers about the complex emotional states experienced by hospitalized children.

On the basis of the design of the CPgame we have argued that emotional design offers a promising approach for working with game design and paediatric patients. More specifically, we have contended that CPgame contributes with dimensions of emotion measurement that are lacking in existing self-report instruments. Whereas existing instruments and tools may contain one or more of these dimensions, CPgame attempts to merge all of them in one and the same product. First, the CPgame is based upon the idea that fictional and counter-factual emotions should play a critical role in emotion measurement, because such emotions may influence and modify actual emotions. While PrEmo and SAM are primarily interested in the eliciting of actual emotions, SiSom in fact works with fictional emotions, but its capability of measuring the relation between these fictional emotions and actual emotions is relatively undeveloped. Second, the CPgame contextualizes emotions whereas other instruments such as PrEmo and SAM work with isolated facial expressions. Third, the CPgame combines game play, measurement and self-report, while existing instruments tend to keep them separate.

One of the most important challenges directing our future research will be that of elucidating the link between the game-pattern (the choices made in the game) and the emotional lives of children in hospitals. To achieve this research goal we need to develop a much better understanding of the relation between emotional experience, narratives and game play, which will be the central focus for future work, which include the remaining development and testing of CPgame (planned to take place in 2010-11) as well as data analysis. After this has been done, we hope to be able to provide new results for emotion research.

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