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A Design Research Into the Needs of a Sleep Diary for Children

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ABSTRACT

We describe the process and results of a study into the needs of a sleep diary for children that are suffering of insomnia. Applying a methodology oriented on the user we have identified needs of patients and professionals, transcribed them into functional and non-functional requirements, and created a low fidelity prototype.

CCS CONCEPTS

• Human-centered computing ~ Human computer interaction (HCI) ~ HCI design and evaluation methods ~ User studies

KEYWORDS

App, Prototyping Usability, User-centered design, usability engineering.

1 Introduction

Sleep problems are common in children. 30% Of children under the age of 3 have difficulty falling asleep for a period of time or frequently wake up at night, with a major influence on the daily functioning of the child, and certainly also of the parents [1]. For somnologists and pediatricians to be able to treat sleep disorders, capturing sleep data, either objectively or subjectively is essential. To capture subjective sleep data, sleep diaries have been developed, either in a digital or physical format. There have been efforts to standardize sleep diaries (such as the Consensus Sleep Diary [2]). However, a large diversity of sleep diaries are still in use that have been developed for internal use at sleep centers, providing different means and methods to fill in sleep experience in diaries. While sleep diaries for children have been developed, there has been limited research to understand the necessities of sleep diaries for children and what are best practices for assessing children's sleep through sleep diaries. In order to build an adequate sleep diary that will fit into the family context, it is important to know which aspects of insomnia and its consequences are particularly detrimental to the functioning of the child and the parents. In many studies, the total sleep duration, sleep latency or the number of nightly awakenings are used as data to be filled in the diary, but there are many variables and factors which are crucial for better understanding the underlying problems such as sleep routines or the amount of interference of the parents. Arguably a sleep diary that captures the interaction between the child's and the parents sleep, and includes the items (such as: sleep intervals, wake intervals, daily behavior, etc.) that the doctor needs for understanding the problem as well as those that the patients want to discuss with the doctor, could be valuable for the diagnosis and treatment of childhood sleep problems. In order to inform the design of such an application, we conducted an interview based investigation into the aspects that are perceived as important by the child and the parents in relation to the child's sleep, but also by the somnologist who treats and

consults patients. In the following sections we describe the interview study and conclude with a set of requirements for a sleep diary for evaluating children's sleep.

2 Methods

A sleep diary for children has several types of users: patients and professionals making use of sleep diaries. Sleep experts, including pediatricians and behavioral sleep therapists evaluate patients based on sleep diaries. Children or their parents have to fill-in sleep diaries for a given period, usually of two weeks' time. In order to understand the context of use for diaries, patients have been observed during meetings with the sleep experts. Interaction between sleep expert and patient has been observed as well as the interaction of the two with the sleepdiary. Further, interviews have been scheduled with both patients and professionals to better understand the shortcomings of current sleep diaries, but also to understand what are the desires and needs of both professionals and patients. The target group for patients was defined to be children between 1 to 12 years old that suffer of severe insomnia, affecting the daily functioning of the child or the family system around the child. Given the young age, it is the parents who fill in the sleep diary for their child, therefore the interviews were scheduled with the parents. Before the interview, the parents had already used a paper format of a sleep diary. In total 6 parents and 6 professionals have been interviewed during the first step of the design process. The interviews were transcribed and coded and a list of requirements has been created based on the coded interviews. The resulted requirements were both functional and non-functional. While functional requirements describe exactly what the sleep diary should do, the non-functional requirements define attributes of the sleep diary on an experiential level. During a focus group with five professionals these requirements were discussed and the professionals graded the requirements on a scale from 0 to 10, 0 meaning lowest priority and 10 meaning highest priority. In order to prioritize the requirements the grades assigned by professionals per requirement were summed and assigned in five separate categories (Highest Priority - Scores 40-50, High Priority - Scores 30-39 Medium Priority - Scores 20-29, Low Priority - Scores 10-19, Lowest Priority - Scores 0-9). For implementation, only the first three categories of requirements were chosen, as they represent 85.54% of the total requirements, the app would have become too cluttered and complex if everything would be implemented, and the scores of the low and lowest priority requirements reflect the fact that these

requirements are nice-to-have but they are not crucial for the sleep diary. Given that the requirements have already been grouped in three categories belonging to a priority category, an iterative process per priority group will be approached during the development phase.

The three groups of requirements are as follows:

Highest Priority:

Highest priority requirements consist of 23 items with scores ranging between 40 to 48. The highest scored requirement is *<<The sleep diary should have clear instructions>>*. Among functional requirements some of the most prominent are: *<<The sleep diary should capture comments regarding the data filled in>>*, *<<The sleep diary should specify who fills in the sleep diary>>* or *<<The sleep diary should compute parameters automatic (SE, WASO, TST)>>*. Non-functional requirements describe how the system should work, and some to mention are: *<<The sleep diary should be easy & fast to read>>* or *<<The sleep diary should be visual>>* or *<<The sleep diary should be very quick to fill in>>*.

High Priority:

High priority requirements consist of 31 items with scores ranging from 30 to 39. Few of the non-functional requirements discovered through the interviews are: *<< The sleep diary should be digital, a mobile app>>*, *<<The sleep diary should be clear on what is important to track>>* or *<<The sleep diary should be color coded>>* whereas functional requirements mention: *<<The sleep diary should have a timestamp (when the diary was filled in)>>* or *<<The sleep diary should not allow users to fill in data at night>>*.

Medium Priority:

Medium priority requirements amount for a total of 17 items. Just as with the previous two groups, both non-functional and functional requirements have been discovered through the interviews belonging to this category. From the non-functional perspective items like: *<<The sleep diary should be motivational>>* were identified, whereas from a functional perspective some of the items discovered were *<<The sleep diary should capture meal routines>>* or *<< The sleep diary should capture moods during the day>>*.
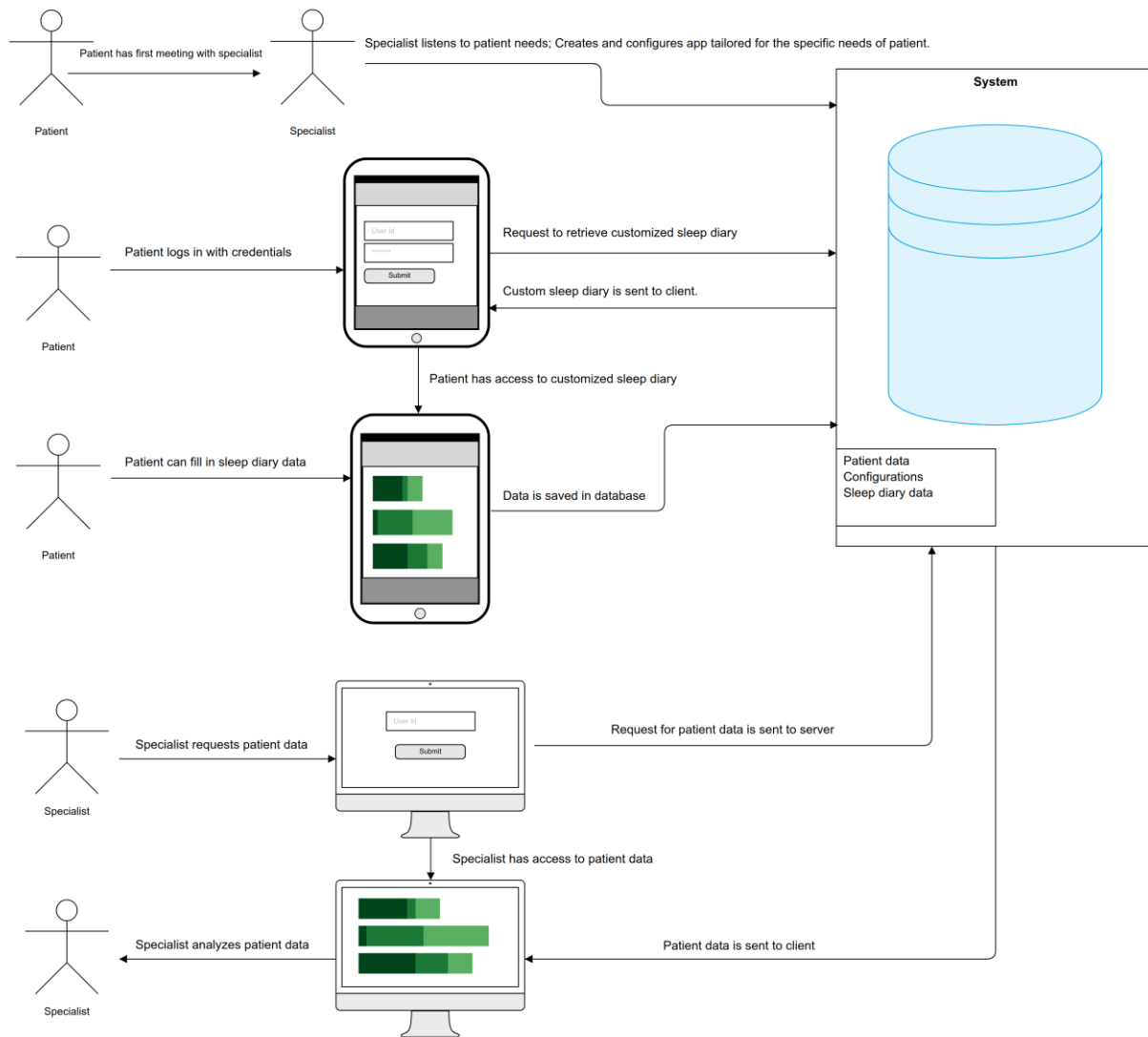
Figure 1: Application workflow.

3 Prototype

Given that 85.54% (71 out of a total of 83) of requirements reside in the top three priority categories, it was clear that with such a vast amount of requirements the sleep diary might become too complex for the user. Therefore, while designing the solution a digital modular approach was conceptualized for the implementation. We have opted for a digital solution because our participants confirmed such a need: "An app would be great", or "When we were on holiday I forgot the diary and then I filled everything in my phone, and I had to put everything afterwards in the diary, which takes a lot of time. So that's the problem, you forget, and then it takes a lot of time, and then you forget". Not all patients have the same needs, therefore we would need to design a basic sleep diary, with a set of basic functionalities.

Many of the requirements thus identified could equally well apply to sleep diaries for adults. We thus assessed the extent to which a sleep diary for adults, called Hypnos [3] satisfies these requirements and we observed that 16 out of 71 requirements have already been implemented in Hypnos. Therefore, we decided to extend the Hypnos [3] sleep diary. A workflow describing how both specialists and patients will interact with the app is depicted in Figure 1, and described further. After a first assessment with the patient, the specialist decides what kind of extra functionalities the sleep diary should encompass. By logging in the application, each specialist that has access to the application, can create a custom sleep diary a certain patient needs depending on his situation.
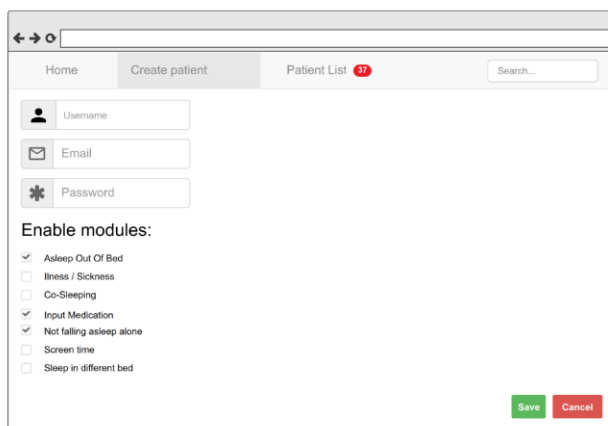

Figure 2: Application Prototype: Screen specialist encounters when configuring patients sleep diary

When the patient logs in for the first time, the mobile app will make a request to the server where the custom sleep diary configuration resides and the app downloads his configuration. For a period of two weeks or more, the patient can fill in the sleep diary as requested for a follow-up meeting with the specialist. The specialist can log-in the system before the meeting with the patient and can interpret the completed sleep diaries in time. During the second meeting, both the patient and the specialist can look at the sleep diary on the computer screen present in the consultation room. This way a discussion can be based on the patient data, which can lead to better diagnosis and quicker patient recovery.

4 Conclusion

In this paper we presented research and insights regarding the design process of developing a new sleep diary for children and also clear outcomes. A list of requirements has been created based on user research and a first iteration prototype is presented. As future work, evaluation against requirements is the natural step to follow. If the evaluation proves to be positive a reflection on the advantages of such a system could uncover interesting facts. Is

such a system useful only for diagnosis or could it serve as a research tool for specialists? Will such a system support the work of specialists, and aid patients to reflect with ease at their sleep experience, or, given the high complexity the diary can be configured to, will it over-complicate the whole experience?
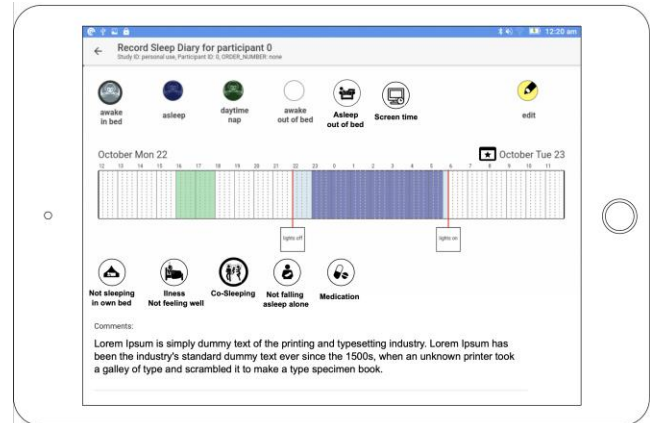
Figure 3: Sleep Diary: Screen user encounters daily to fill in sleep diary data.

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