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Design a Digital Interactive Device X-Mind Based on the ADHD Patient User Experience

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Abstract. Children with attention deficit hyperactivity disorder (ADHD) are difficult to maintain focus and complete daily tasks due to impaired executive function, ultimately leading to a negative self-image. We conducted patient-family experiments to evaluate the positive effects of positive digital equipment on ADHD patients in their families by contrast models. And optimize to equip the scene design and prototype design of digital equipment with active voice system to improve the results. We found that after interacting with the digital gear X-mind designed for positive experience, work was considered more positive, natural, and presented more positive content and provided potential therapeutic benefits for ADHD patients compared to traditional digital gear with the same function.

Keywords. Artificial intelligence, attention deficit hyperactivity disorder (ADHD), experience design

1. Introduction

Today, 5% of the global people with attention deficit hyperactivity disorder (ADHD), a [1] of about 300 million. Children with ADHD focus on a given task, as well as designing a behavioral plan and completing their [2]. In life, equipment, teachers, and families may give negative feedback to children with ADHD for frequent failures in tasks, which eventually leads to extended problems such as negative self-image formation in children, [3]. But because of this, the need for digital equipment to help patients' complete tasks.

At the same time, AI digital equipment has become a trend as advances in machine learning [4] have increased the possibility of AI applications. There are many differences between artificial intelligence, digital equipment and traditional machine and equipment interaction. AI follows the hybrid active method, where users can actively initiate task demands from AI systems, while AI can also actively interact with [5] with users, based on program Settings and user behavior habits. So the interaction between users and AI is based on the concept of common growth. In the interaction process, in terms of user and task-related aspects, AI digital equipment can sort out the task list, establish the optimal solution between the user's behavior habits and needs, and finally assist users to complete the expected target [6].

Therefore, we are developing a digital device to help children with challenging daily tasks (e. g., preparing them for the next day of school). This paper aims to illustrate the

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design process in which using active digital equipment prototypes more satisfies treatment and user experience-related attributes.

2. A User Home Study for patients with ADHD

The execution of this project consisted of a pediatric psychiatrist, an ADHD therapist, and a user-experience designer majoring in human-computer interaction. The team discussed the whole process.

2.1. Family experiment

In this experiment, we start on whether the digital interaction equipment can create a powerful user experience for ADHD patients. We decided to test to what extent this is possible by designing two prototypes for ADHD patient families where -one supports only the general user and the other has exactly the same functionality, but also aimed at the possibility of creating a positive experience with [7] using the experience category [8] when facing patients with ADHD. Subjects consisted of a patient with ADHD and their family members and were asked to jointly plan an art design exhibition.

In order to ensure the authenticity of the experiment, we have built a false realistic background, so the participants must also go through a negative process (their art and design exhibition planning meeting will be postponed by the staff for epidemic prevention and control). Later, they were interviewed to learn about their psychological activities and their families and answered a series of questionnaires. In order to restore the real scene of the patient's life, the experimental field was selected in a residential property center with six patient families, with the subjects sat in front of a table with two kinds of digital equipment. We used the module II of the MeCUE questionnaire [9], which, in addition to the qualitative questions, measures the emotional responses to the product to assess how the digital interaction gear is perceived.

The experiment is divided into two groups, which only supports traditional digital equipment for ordinary users. 1: Traditional digital equipment has no name. It can read out the information content but does not independently raise notes for this activity in past social experience, record family member ideas but does not provide better value advice, emphasize the subject task but does not ask whether they have previous experience of participating in organizing exhibitions.

Digital interactive equipment 2: The digital interactive equipment object specifically for the particularity of ADHD patients is called X-mind. It introduces itself to patients and tells the special abilities they have, but also independently reads out or suggests review methods, uses relevant review methods to record agenda topics, inform subjects whether they have interesting ideas and point out that it will remember them. It reminds ADHD patient user tasks, as well as asking about previous experiences in, Art Design exhibition planning sessions. It also provides feedback to ADHD patient users about the planning steps. At the suspension of the ADHD Patient Design Exhibition Program, X-mind preserves historical processes for use by future ADHD patient users themselves or by family members. Through these aspects, this device solves different categories of experience ([7], [8]) (security, receiving feedback, memory, creating things together, completing tasks) to meet the needs of ADHD patient users.

Note that most of the more detailed experimental descriptions are attached at the end of the text.

2.2. Experimental results

The positive and negative aspects of the ADHD patient families mentioned in the process are listed in Table 1. Although the two, the digital equipment function is the same, but their views are very different. Most strikingly, even with the same text-speech generator, the sounds are considered very different, and they share about 75% of their sound files. The score of interaction with digital gear also reflects this that —— interaction with X-mind is described as naturally interacting almost three times as often than interaction with traditional digital gear. This means that subjects prefer to do more on digital equipment and lack of guidance (see Figure 1).

Figure 1. Experimental description

Table 1. Positive and negative aspects of the prototype interaction mentioned with the subject

Positive face	**X-mind**	**Ordinary digital equipment**
Was considered positive when working with the family	88.6%	40%
Subjects felt that the interaction with X-mind was unfree	76.7%	11.4%
Subjects mentioned that the advice provided by digital equipment was positive	76.7%	70%
Digital equipment participates in all stages of art and design exhibition planning	80%	66.7%
The mention of voice control is designed to facilitate their thinking	56.7%	30%
downside	**X-mind**	**Ordinary digital equipment**
More control over the system	57.2%	35.7%
I think the voices of my peers were negative	14.3%	42.9%
Mention the dislike of the topic content	35.7%	21.4%
Disliking these contents (e. g., available methods and their explanations)	23%	58%

2.3. Quantitative results

MeCUE: The MeCUE's module II evaluates both positive and negative emotions about the prototype. Compared with traditional digital equipment, subjects working with X-mind had higher positive emotions and lower negative emotions (X-mind: positive emotions: x =3.90, SD=1.19, negative: x =3.02, SD=1.19; ordinary digital equipment: positive: x =3.75, SD= 1.23, negative: x =3.28, SD =1.37; multiple ANOVA: F=0.20; p = 0.70).

3. Design and production

3.1. Determine the interaction mode and development scope of digital equipment

Based on the above experimental results and the frequent use of digital equipment (through smartphones, TV, etc.) for a 10% increased risk of future ADHD symptoms, including [10]. We chose voice interaction to convey information about digital equipment, and the interaction mode also considered the cultivation of parent-child relationship when guardian help their children use digital equipment. We have selected nine tasks from Table 1, and our digital interaction device, X-mind, will help children and patients complete their daily activities efficiently (e. g., preparing for the next day of school, doing homework alone, etc.). (See Table 2)

Table 2 X-mind, designed to address the following experiences and needs of patients with ADHD:

Safeguard	X-mind reminded the patients and guardians that the task has not yet been completed.
Receive feedback	X-mind commented on the subjects' plans and said that he liked the idea.
recording of information	X-mind asked him about his previous experiences.
Create together	X-mind also suggests planning for art design exhibitions and can brainstorm with the subjects. X-mind can add methods so that subjects not only provide methods but also assist in patient planning. The X-mind finds patients with new methods, comments, and opinions when they propose a new or interesting idea.
Complete tasks / meet challenges	After completing an art and design exhibition plan, it will be closed on, the digital interaction system. X-mind noted that once the entire art design exhibition plan is planned, the program will be preserved in full, so that ADHD patients or families can use it in the future.
Test	The task was to plan an art and design exhibition. Subjects were told that the Art Design Exhibition planning would be involved by a CAFA design team that supports a professional level on this topic and that they should plan to introduce the high-level group into this meeting on the Art Design Exhibition planning. In addition, ADHD patients write an invitation for social media channels to make art and design exhibitions attract more interesting people to participate. When planning art design exhibition planning sessions, ADHD patients can work with their families, and the closeness of this collaboration depends on themselves.
Pilot experiment	Initially, a pilot experiment was conducted to test both versions. A total of six families living with ADHD participated in the pilot study. After each test, the new findings (e. g., regarding the test structure) were directly incorporated into the concept and review guidelines, and were examined during the next study.
Attendee	Six children were under 12 years, and six pairs of guardian aged 40 – 45 years

3.2. Prototype design

In this study, we developed a Raspberry Pi-based digital kit for young patients with ADHD. At the same time, to connect to the X-mind used by the child, we also developed a smartphone application for ADHD patient guardians to provide monitoring of their child's task completion process (see Figure 2). The exterior design of the X-mind is a cylinder, finished with CNC digital carving node. The js server is used to present the designed scenario prompt, and adopts the DialogflowAPI compatible with Raspberry PI, able to analyze the language intention of ADHD patients and adjust the conversation mode. The application can previously input their daily activities as task data, and then import the input data into the X-mind for the task to be activated within a specified time.

The X-mind is designed to help young patients with ADHD complete their daily activities while enjoying a good experience process.

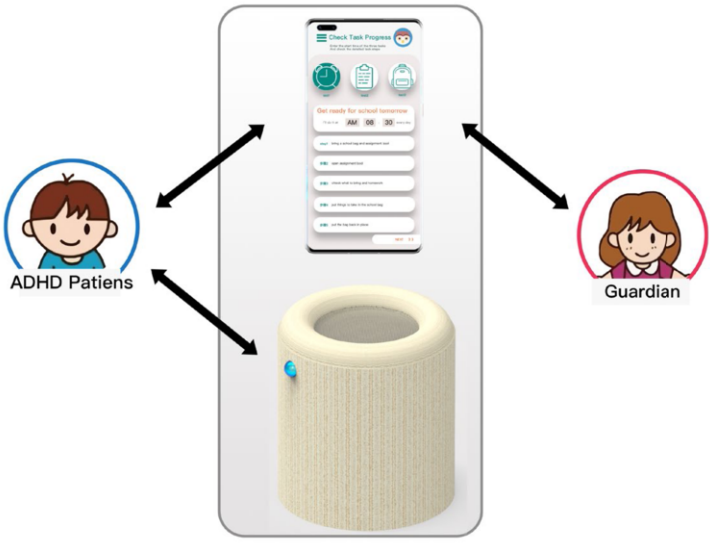

Figure 2. The interaction relationship between the prototype and each user

-Goal-Plan-Do-Check

The X-mind design process does not use mandatory measures, where ADHD patients can well regulate their behavior [11] by performing tasks independently. Especially during the problem-solving phase, they make children more familiar with the process through self-taught steps of language, internalization, and recall tasks. This eventually enables them to apply the same behavioral process to daily life or other special scene [12]. In the cognitive orientation of daily life performance, this is a method based on one of the self-directed steps called goal-plan-execution-check, where ADHD patients set task time and target activities at their will and use cognitive strategies to achieve it, [13]. This approach to this intervention encourages goal-oriented behavior to optimize daily performance [14] in patients with ADHD. Our digital interaction device X-mind uses the self-study-based goal-plan-execution-check process as its basic communication structure, into which the tasks that patients perform daily at home are uploaded and serve as the core content of the interaction (Figure 3).

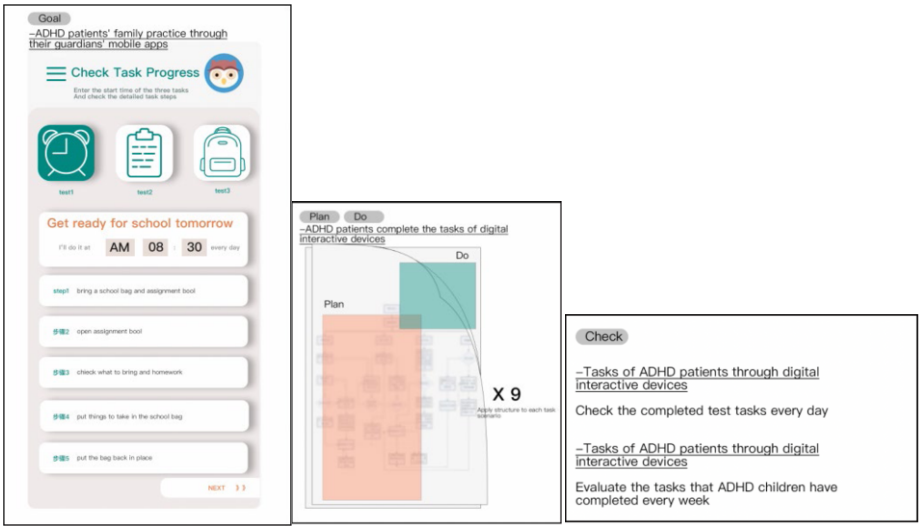

Figure 3. Goal-Plan-Do-Check

Goal: ADHD patients and, the guardian to jointly determine the target task. Clearly use the tasks within one month required to perform in the X-mind digital interaction equipment, the patients and their guardians enter the task goals, steps, and time according to the requirements, and can check the detailed steps of each task in the application.

Plan: ADHD patients develop their own scheduled tasks and conceived detailed steps. First, the digital device asks the child what tasks he should do at the specified time, and then verifies them by answering the question. As an alternative, the child proposes his own core information indicating each task, and the X-mind guides the steps by voice.

Do: ADHD patients perform detailed steps through voice interaction with the digital device. X-mind helps the child to successfully complete the task and interact appropriately about each step of the task.

Check: Confirm the completed task. Each night, ADHD patients can talk to X-mind about the same-day activities and tasks. Patients with ADHD also have the option of jointly weekly assessing their performance with his or her guardian and addressing the dilemma.

-Language scaffolding factor

Vygotsky proposed "Scaffolding" as an accelerator [15] for AI development learning. In the context of task execution, it means that when the child solves alone while performing a task, and he or she can achieve a higher achievement [16] with appropriate help or guidance provided by others. The three language brackets behind the digital gear scene are compliments, prompts, and attractions, referring to the previous study [15,17].

Praise: Praise the patient's correct behavior when performing the task list. X-mind praises the child after they complete the steps of each task.

Tip: Help patients with ADHD with the difficulties encountered in the task list. What the patient thinks about to do independently is one of the most important parts of the goal-plan-execute-check process. When the patients do not understand the X-mind problem, the X-mind tells them in more detail about the method and path of processing. If the patient does not respond to the X-mind, it details the previous question to gain the patient's understanding.

Attraction: Improve prompt language usage and / or participation. Attention control is the [18], an ability to maintain focus on the task uninfluenced by external stimuli. To enhance the patient's cognitive flexibility, the X-mind was allowed to switch to the new task or the next small step, the [18], of the described task. In this experiment, we aimed to support ADHD patients to follow up during the task, informing them about the remaining steps and encouraging them to participate, even if they did not respond.

4. Discussions and conclusions

In summary, our results suggest that we can indeed design digital equipment to give ADHD patients a positive experience. By optimizing the experience quality of digital equipment (by the use of positive experience categories), patient perception changes significantly. Traditional digital equipment (see Figure 2) is even less popular for patients, and one explanation could be considered in contrast to the positive impression of the digital interaction equipment X-mind. So, we believe that digital interactive devices like X-mind demonstrate a new potential for positive experiences in AI-expanded living environments. Experiments like this allow us to generate guiding pathways or patterns that support digital interaction equipment to generate positive experience designs for treating diseases.

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