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EXPLORING AND EVALUATING THE EFFICACY OF CURRENT DESIGN INTERFACES FOR ADHD

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ABSTRACT

About 7-11% of children in the ages between 4 and 17 are diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Despite this alarming rate and its deleterious effects on children in the academic as well as social settings, the current research in designing for ADHD is found wanting. The study here seeks to delve in depth about the need for designers to develop domain knowledge about ADHD, some key points to keep in mind while designing for children as well as evaluating the current applications in terms of how they cater to their ADHD audience, culminating by offering a design-thinking approach which could help alleviate some of the aforementioned flaws.

Keywords—ADHD;Emphatic Approach; Design-thinking; User Experience; Cognitive Behavioral Therapy;

INTRODUCTION

Attention Deficit/Hyperactivity Disorder is a state of inattentiveness or persistent impulsivity and hyperactivity in children that usually manifests in an academic or a social setting [1]. It leads to children making careless mistakes, digressing easily from studying, inability in keeping track of things, ultimately making them restless and anxious [2]. The symptoms become arduous to discern in a situation where a child can concentrate in one environment such as playing video games or watching television, but unable to do the same in a backdrop like that of a classroom. Not all children show the same pattern in behavior. Some might be characterized by impulsivity, whereas other children may be affected by inattentiveness. Oft times it may translate into aggression and defiance, in worst cases difficulty in performing the most quotidian of tasks. Apart from the likely effects of ADHD there may be a reduction in tolerance, belligerent behavior, and an adverse impact on family relationships are also known. At other times, people who are not familiar with its actual cause tend to ascribe it to certain misconceptions, which can be as quixotic as stating dietary habits culpable for ADHD, or believing that inability to perform

academically is an undeniable proof that the child has ADHD. Besides, there are other unsubstantiated facts which state that effects of ADHD tend to diminish with age and children usually outgrow them by adolescence.

All this domain knowledge becomes pivotal when designing specifically for an audience that goes through all these effects. Nearly 5.4 million children between the age group of 5 and 14 suffer academically as well as socially due to impulsivity, inability to concentrate and restlessness[3]. Furthermore, they become more prone to outbursts, tantrums, aggression, and are also afflicted with learning disorders, which ultimately leads to increased dropout rates, more failed grades. It can lead to social impairments as well, leading to more conflicts amongst peers, parents and maintaining friendships etc. As a result, the subjects become more intractable to test upon, leading to few valuable types of research on education methods for children with ADHD.

Applications that try to curb these symptoms of ADHD tend to disregard the fact that these children are to be attended in ways different from the conventional ones. One size fits all approach cannot produce the same effect in this scenario as it may produce in normal children. The research here aims to establish what the fundamentaltenets to keep in mind are, and what are some ineffective practices which should be avoided when developing for ADHD. Furthermore, it also establishes the importance of empathy when designing for people with special needs, and compares the design interfaces of current applications that employ methods to remediate the adverse effects of ADHD. The organization of the paper is as follows – section II gives a high-level view of the process of diagnosing and treating ADHD along with the description of different applications that perform those tasks. Section III delineates the results of analysis of varying application designs aimed at treating ADHD and an overview of a design-thinking approach. The paper is concluded by discussing the scope of the respective study.

BACKGROUND STUDY

A. Diagnosing ADHD in Children

A child showing any of the symptoms mentioned above can fall under any of one or both the categories of ADHD [4]–Hyperactivity/Impulsivity and Inattentiveness. Hyperactivity is characterized by restlessness, blabbering and blurting out random words, aggressive demeanor, difficulty being patient and waiting for turn and minor to significant fidgeting or squirming. On the other end of the spectrum, inattentiveness is typified by the inability to perform simplest of tasks, easy distraction, more prone to making careless mistakes, unable to pay close attention to detail, unable to listen when spoken to directly and unable to follow instructions with ease. In addition to these, a child may exhibit either one of the above. The symptoms are only pertinent if they satisfy these conditions [5]–

- The signs should be apparent in one or more sets, such as school and home etc.
- There must be a clear evidence of social, academic, or occupational dysfunction.
- Some of the symptoms above should appear when the child was 7 years old or younger.

There is always a possibility of over-diagnosing ADHD in children, as many parents and teachers tend to misattribute one symptom alone as its corollary. For instance, inability to perform well in academics alone is not considered to be confirmed diagnosis of ADHD.

B. Treatment for ADHD

The most proven and well-accepted method for treating children with ADHD is using medication, such as Vyvanse, Concerta and Adderall, which are known to work and give conclusive results in about 70-80% of children [6]. The medical treatment is always controversial due to the side-effects they ensue. Moreover, the explanations and effects of medical treatment are beyond the scope of this paper. The second option for treating children is using Behavioral Therapy that is centralized around the concept of reinforcements, i.e. the frequency of desirable behavior decides a positive or negative reinforcement [7]. Cognitive Behavioral Therapy (CBT) is a combination of behavioral therapy as well as psychotherapy that focuses on changing the behavioral patterns and thought process of a patient with ADHD. CBT has become increasingly important and working in tandem with medical treatment, it can significantly reduce the dosage of stimulants required otherwise. Also, a handful of research has been going on in computer-aided CBT. The basic premise of CBT is how thoughts about a certain situation directly affect our emotions, which then define our actions and physical feelings, described in Figure 1.

C. Applications treatingADHD

There is a myriad of applications out there, for both web as well as mobile platforms that seek to mitigate the problems that ADHD stems. These are not a panacea by any means, however, if implemented with some guidelines in mind, they can significantly improve learning skills, awareness of time and reduce anxiety or depression. A common drawback that plagues the majority of the alternatives available includes lack of empathy and requisite information while designing them, their restriction to one platform (specifically Apple iOS) and a large fraction of those being paid. Secondly, many of them adopt a hasty approach towards designing the interfaces, which rarely take into consideration the special needs of children with ADHD. Descriptions of the most popular applications are described below:

- **Beating the Blues:** Helping manage anxiety and depression by offering ways to understand the underlying condition better. It comprises of 8 weekly sessions, of 50 min each. It employs computer-aided cognitive behavioral therapy (CCBT) with each session

providing insight into topics such as downward arrow technique for challenging inner beliefs, distraction techniques, thinking errors and a plethora of case studies about the same [8]. It is entirely reliable on CCBT, which has little to no substantial evidence of how effective it is in the absence of medical treatment like stimulants. In addition, it equips more of a pedagogical approach rather than a pragmatic hands-on one that iteratively tests its users and helps them track their progress.

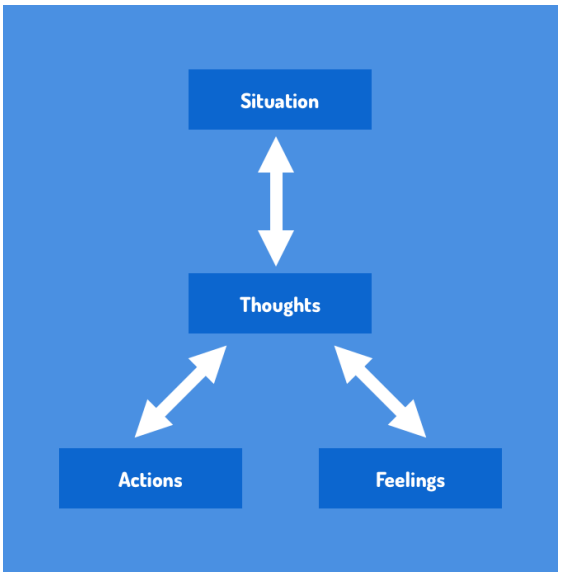

Fig. 1 Cognitive Behavioral Therapy cycle

- **ADHD Treatment:** Uses Neuro cognitive therapy to improve executive functions in a time period of several months. Aims at reducing medical treatment, increasing attention and controlling impulsivity and is designed for both children and adults [9]. The application revolves around using brain training games to improve cognitive function. The games themselves claim to be backed up by scientific evidence to enhance learning, however many people reported having difficulty getting past level 14. As a result of getting stuck, a natural concomitant for an ADHD patient is getting impatient. In addition, the application is restricted to being paid only on one platform (iOS).

- **MindNode:** What a lot of ADHD patients suffer from is the inability to focus on the right thing and connect thoughts with their actions. MindNode provides the ability to create mind maps that in turn helps to brainstorm, organize and share thoughts in a lucid way[10]. It can be used as a communication mode between a teacher and a child, where a child can create his mind map helping teachers construe the intent behind it. Unlike other alternatives, the application has cross-platform support on Macintosh and iOS but it is still a paid application.

- **Neuro Nation:** A brain training application that seeks to improve recall, learning ability and focus in the user. It follows the concept of 'Use it or lose it'– citing that what applies to muscle is also applicable for the brain as well. It is not specifically targeted towards ADHD patients, but checks most of the boxes regarding of design [11]. It comprises of 29 exercises and 8 curated courses that help track progress, highlighting strengths and weaknesses on the way and offering positive reinforcements as well. The application is free, however a sum of $4.99 for the paid version can significantly increase the number of assignments.

- **Pacifica:** The concept being similar to 'Beating the Blues' discussed above, Pacifica is a cross-platform application available for iOS, Android and web, that employs the concept of Mindfulness – practice of focusing one's mind attention and awareness on a specific target [12]. In addition, it proffers computer-aided cognitive behavioral therapy and a number of tools to track mood and health habit such as sleep, caffeine effect etc. The application has been put forward after numerous researches was conducted for using CCBT in helping with disorders such as bulimia, anxiety, insomnia and depression. It can work with or without a therapist [13].

RESULTS AND DISCUSSION

Table 1 Comparative Analysis of current applications for ADHD

Guidelines	Beating the Blues	ADHD Treatment	MindNode	NeuroNation	Pacifica
Uncluttered interface without distractions	✓	×	×	×	✓
Placid environment with soothing and muted colors;	×	×	✓	×	✓
High reinforcement environment for good behavior and task completion	✓	×	×	✓	✓
Using boldface and highlight to signify important information	×	✓	×	✓	✓
Large print with a clear typeface like	×	✓	×	×	×

sans-serif					
Minimal or brief instructions; gentle learning curve	✓	×	✓	×	×
Ample rest periods and exercise breaks in between sessions/exercises	✓	×	✓	×	×
Recapitulating previous sessions before commencing new ones	✓	×	×	×	✓
Avoiding timed exercises and sessions, in order to divert attention of user away from clock	×	×	✓	×	✓

Despite the number of applications available, a large fraction on them focus entirely on one kind of ADHD patient – one that falls in the inattentive group. The pith of all the applications is divided on the basis of whether they offer time management, CCBT, or aim to improve learning ability. Subsequently, timely updates, as well as improvements along with a confluence of all of the above is still missing. From the little research that exists in this domain, many of the researchers have been successful in sketching a number of guidelines after conducting a cornucopia of experiments in both academic and social settings. Based on those guidelines, the applications are evaluated and Table 1 outlines which applications tend to comply with them. A cross mark in the cell denotes the application not adhering to that particular guideline, whereas a tick mark indicates otherwise.

While the guidelines have been empirically evaluated in various scenarios, they are by no means an exhaustive set of rules to be followed, instead a general rule of thumb that improves as more research is conducted in this area, serving as a reference for designers while designing for ADHD audience.

D. Comparative Analysis

As it is evident in Table 1, most of the applications fail to inculcate something as rudimentary asa muted background along with a clutter-free user experience, which is the bare minimum when designing for ADHD. This is because of adopting an empathic approach instead of data-driven approach. An empathic approach always leaves room for *confirmation bias*– Designers put themselves in the shoes of users to define the basis of their applications. A lack of data coupled with incomplete knowledge regarding the wants and needs of ADHD users pervades all these applications, as a result of which a lack of accord among the ADHD community still persists.

Children with ADHD require more frequent feedback about how they are doing/performing the task. Furthermore, they tend to do better with short-term goals than long-term goals. They require more frequent reminders about what is expected and what can they get on performing it rightly. They also require frequent changes in the program to remain engrossed.

E. Design Thinking Approach

Design thinking is the process of using creative design strategies that goes well beyond the professional design practices to solve problems of the end user. A solution based focus rather than a problem-based focus is the key to design-thinking. Understanding the user needs, reframing the issue by adopting a more human-centric approach in various brainstorming sessions and then finally employing a hands-on approach using a prototype and testing on real users are some of the high level involved in a design-thinking process.

There may be a couple of intriguing reasons to adopt a design-thinking approach instead of a traditional product development process. Firstly, it is a human-centered approach which means it caters to real user needs by gathering user data, creating design artifacts and testing them on actual users. Secondly, it establishes a common language and congruity amongst the teams, thereby leveraging mutual prowess across different roles. Finally, it fosters innovation by extrapolating more than one alternative for a problem.

Design thinking is often used interchangeably with the term ‘design-based learning’ in the field education. In modern pedagogy, design-based learning needs to go through the following steps, described diagrammatically in fig. 2 as well –

- *Identify the problem*: This can be done in a group or alone, which involves finding why the question needs to be solved, followed by choosing someone who is personally affected by the problem. In this case, children with ADHD or even their parents/caretakers can be a good source.
- *Design Process*: After reviewing the user stories in the above step, the next step is to brainstorm a glut of possible solutions. In this case, the guidelines mentioned in Table 1 can be used as a reference when brainstorming solutions.
- *Prototype*: Focusing on one aspect of the problem, it is essential to review the ideas put forward in brainstorming. Subsequently, moving to other aspects of the problem, checking the viability of the solution.
- *Feedback*: Presenting the solution to the end-users as well as one or more external experts for feedback. In this case, getting insight from children as well as their parents and teachers, their attitudes towards the prototype etc.
- *Scale and Spread*: From the feedback gathered in the previous step, continuing to improve upon the proposed idea and working on it until the best solution is found.

CONCLUSION

For a designer, it is evident that a clear understanding of the usability principles is a must, for instance, a cluttered interface might be bearable for a normal audience, but for an audience that suffers from attentional difficulties, it might be tantamount to being completely unusable. The criteria used for evaluation above not only serves to people with ADHD, but in general leads to a better user experience for ordinary people as well. Moreover, the so-called guidelines are to be taken with a grain of salt as they are not entirely exhaustive.

Besides, it is essential for a designer to immerse themselves in the lives of the user itself, deeply understand their needs, thereby adopt a more human-centric approach towards solving their problems. It is also worth mentioning that different users might have different needs, whether they have ADHD or not. The requirements may vary significantly with users from different culture, region and even age. The study here also begs for a more detailed user testing to evaluate the suitability of the application for target. Finally, design-thinking allows non-designers (teachers, caretakers, etc.) to tailor the system to their own needs; therefore its scope is untrammeled.

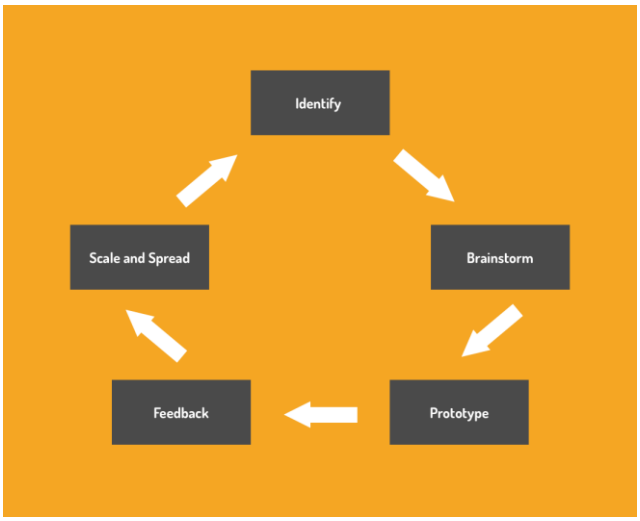

Fig.2 Design-Thinking process

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