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Supporting Self-Efficacy in Children with ADHD through AI-supported Self-monitoring: Initial Findings from a Case Study on Tiimood

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Abstract. This study explores and presents initial findings from a case study on the potential of intelligent mood tracking in a wearable assistive technology app Tiimo as a way to support children with ADHD and their families by facilitating motivation, increasing self-awareness and supporting self-efficacy.

Keywords: mood tracking, persuasive wearables, assistive technology

1 Introduction

Persuasive mobile applications have shown potential to support structure and self-efficacy in daily life activities for children with Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) [1-2] and research in technology-supported data acquisition shows that monitoring mood and overall mental health can increase self-awareness and motivation [3]. However, limited research has been conducted on the potential of wearable assistive technology utilizing self-monitoring and mood tracking in relation to these specific user groups. Launched in Denmark in 2018, the research-based Tiimo app is an assistive smart watch application designed to provide structure and visual guidance for children with ADHD. To explore the potential of self-monitoring and –assessment in Tiimo, a case study was conducted on mood monitoring as a way to help users and their families learn more about their mental well-being and need of support throughout the day.

This paper presents the background and current status in persuasive technology for children with ADHD, initial findings from the case study as well as directions for future work within AI-supported self-assessment in ADHD therapies.

2 Background

ADHD is a neurodevelopmental disorder affecting 5-7% of children and 3% of adults globally [4], resulting in a group of behavioral symptoms including hyperactivity, impulsivity and/or inattention, strongly impacting the development, education, social interaction and family life of people with this condition. Research shows that children with ADHD feel significantly more frustrated at school compared to neurotypical children and have a three times higher risk of reading disabilities as well as social problems persisting into adulthood [5].

Traditional techniques to support children with ADHD include analogue tools such as pictograms, calendars and timers, however those are often time consuming and less portable. Thus, research shows that children living with ADHD may benefit greatly assistive digital tools [1] and particular persuasive strategies such as tunneling, suggestion and self-monitoring show potential to assist, motivate and enable focus and participation e.g. in learning and social activities [6].

2.1 Tiimo

Tiimo is a persuasive assistive technology for smartwatches, supporting children and families in their daily life planning and management. It is designed to provide an overview and structure with visual guidance and persuasive reminders such as "go to soccer practice" or "do homework". The primary Tiimo system is composed of: 1) an app integrated within smartwatches to help children stay on track in daily life activities in a discrete and non-invasive manner; and 2) an online dashboard accessible via smartphone, tablet, computers or home smart devices, enabling parents to set up content to be shown on the watch app. Parents can also decide to share or show content to therapists, teachers, etc. to get feedback on how to better plan their child's activities. Through the dashboard they can also interact and leave comments on the therapy follow-up, using it as a shared coordination tool. Two years of trials have shown that micro-interactions with Tiimo on the watch is enough to provide the needed guidance as well as persuasive visual reminders and by this facilitate confidence and structure for the children and families living with ADHD [7].

The next step has been to design an adaptive feature to explore the potential of AI-based self-monitoring and –assessment in Tiimo (Tiimood) as a way to allow children to provide feedback on their mental well-being after key activities and aid parents and therapists in tracking progress and understanding needs of support throughout the day.

Fig. 1. The Tiimo app and the initial designs of Tiimood.

3 Case study design

Based on input from existing users, two workshops were conducted with researchers, health care professionals, teachers and parents to identify scenarios and develop potential designs for an adaptive mood measurer, as well as highlight potential challenges in implementing AI-based mood tracking in everyday life and practice. Based on this feedback, a simple prototype was developed ('Humør Måleren'/ Tiimood) and tested for three months with ten families, five of which had never used Tiimo before. The contextual test was initiated with a pre-survey and concluded with individual follow-up interviews with parents.

4 Preliminary findings

During the three-month trial period, the families all reported positive experiences with the general features (structure, visual guidance) in Tiimo, particularly in relation to morning routines, which the pre-survey revealed was one of the main challenges for most families in the study. Specifically in relation to mood tracking, all families could see potential in the added functionality; however, some parents reported initial challenges in the process of deciding what to track, when and how. A suggestion here from some of the interviews was a start-up guide with different scenarios and suggestions to help families decide when mood tracking was relevant in their particular family and with which facilitating questions.

Additionally, some parents reported having implemented a practice of weekly 'mood assessment meetings' where they would talk about data from the past week and set goals for the coming week, thus facilitating reflexive dialogue and collaborative exploration and learning between child, parents and school supported by Tiimood and giving the child more agency in decision-making processes related to their own mental health. Some parents reported both surprise and relief in seeing their child's mood more stable throughout the day than what they had anticipated, however this also posed the question of whether prompts for self-assessment (e.g. "How are you?") were specific enough, with the risk of the self-assessment becoming too general and thus imprecise or superficial. Some interviews also highlighted difficulties in children verbalizing mood and mental health, prompting ideas from the parents for more automatic ways of tracking mood (e.g. heart rate and sleep patterns); more individualized ways of self-assessment since some children experience anxiety as bodily sensations (e.g. as pain located in the stomach or restlessness in the legs); and finally new ways to visualize changes in mood (e.g. moving away from smileys/icons to a color-based scale/spectrum).

Interviews with families new to Tiimo also highlighted uncertainties related to whether the child's initial interest is mainly prompted by technical novelty and thus how to facilitate long-term motivation for using the feature. This emphasizes the importance of self-assessment features to provide valuable information and structure considered useful and perhaps even essential to its users, which is supported by interviews with existing Tiimo users, who all emphasized how specific features in Tiimo have become essential in particular daily life activities such as morning routines.

5　　Conclusions and future work

The case study on the Tiimood prototype showed a potential in technology-based self-monitoring and mood tracking in persuasive wearables for children with ADHD. However the study also highlights that the design and practice revolving around mood tracking and self-assessment must be aligned with and adaptable to each family's needs, e.g. through highly individualized ways of tracking mood and visually present mood changes. Based on initial findings, new designs for mood tracking in Tiimood were generated as well as new ideas for AI-supported self-monitoring in Tiimo in general.

Future research includes the testing of these new designs as well as exploring the potential of integrating adaptive and AI-based tools in the Tiimo solution. Machine learning and big data analysis has the potential of enabling informed decision-making and personalization of ADHD therapies, using correlations between the user's feedback and big data analysis to improve the integration of different educational, behavioural and medical therapy approaches. By correlating direct end-user feedback in Tiimo with the activities performed, tracked physiological and big data inputs, it is the aim to provide AI-based observations and recommendations both for enhanced treatment of individual children living with ADHD and to gather more in-depth and quantified knowledge about ADHD variations and how to support the diverse needs of children and families affected by it through assistive and persuasive wearables.

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