




Support for Families of Children and Adolescents with Attention-Deficit/Hyperactivity Disorder: A Technological Solution Based on Persuasive Strategies

Caroline R. S. Jandre   [Pontifical Catholic University of Minas Gerais | caroline.jandre@sga.pucminas.br]

Fernando C. S. Dal' Maria  [Pontifical Catholic University of Minas Gerais | fernandocsdm@gmail.com]

Débora M. de Miranda  [Federal University of Minas Gerais | debora.m.miranda@gmail.com]

Cristiane N. Nobre  [Pontifical Catholic University of Minas Gerais | nobre@pucminas.br]

 Institute of Exact Sciences and Informatics, Pontifical Catholic University of Minas Gerais, R. Dom José Gaspar, 500, Coração Eucarístico, Belo Horizonte, MG, 30535-901, Brazil.

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Abstract Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by inattention, hyperactivity, and impulsivity. The disorder can directly impact the organization, focus, and self-regulation of children and adolescents, posing challenges for both diagnosed individuals and their families. Although several technological interventions exist for this population, many are abandoned before their benefits are realized. Given this scenario, this study investigates the difficulties families experience in organizing their routines in the context of ADHD and explores how Human-Computer Interaction (HCI) principles, combined with persuasive strategies, can make these solutions more effective. The research gathered data from the literature and from interactions with parents/caregivers and children/adolescents with ADHD, identifying daily challenges, reward strategies used, and desired features in a routine support app. The findings guided the design of a functional prototype with elements such as reminders and positive reinforcement, which was used to assess its usefulness and relevance from the perspective of the participating families. The contribution to the field of HCI lies in the explicit application of theoretical models of persuasive technologies in a context of neurodivergence, offering conceptual and practical guidelines for the design of digital solutions that are more engaging, ethical, and aligned with the family care ecosystem in ADHD.

Keywords: ADHD, HCI, UCD, Persuasive Technology

1 Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in childhood, affecting between 3.4% and 14% of the world's population, depending on the country [Ayano *et al.*, 2023]. According to Babinski [2024], the diagnosis is more prevalent among boys, possibly because they tend to present externalizing symptoms, such as agitation and impulsivity, which are usually more easily identified in school and family settings. ADHD can significantly compromise academic performance, social relationships, and the emotional well-being of diagnosed individuals [Minder *et al.*, 2018; Thennakoon *et al.*, 2020; Silva *et al.*, 2023].

In daily life, children with ADHD often experience difficulties with activities considered simple, such as brushing their teeth or organizing their school bags, in addition to presenting challenges related to emotional regulation and recognizing social cues [Coghill *et al.*, 2008; Shuai *et al.*, 2017; Groves *et al.*, 2022]. These behaviors directly impact family dynamics, often requiring parents or caregivers to constantly supervise task completion or even take over the execution of such tasks [Frisch *et al.*, 2023; French *et al.*, 2024]. This impact can

be further amplified by the high heritability of ADHD, as it is common for caregivers themselves to present traits of the disorder, even at subclinical levels [Faraone and Larsen, 2019; Wiel *et al.*, 2022]. When these shared difficulties are not identified, they can hinder the adoption of organizational strategies, increase stress in the home environment, and compromise the effectiveness of parental interventions [Wiel *et al.*, 2022].

With the advancement of digital technologies, a variety of tools have been developed to support children with ADHD, such as mobile applications, serious games, and virtual assistants [Silva *et al.*, 2023; Stefanidi *et al.*, 2025]. However, a systematic review conducted by Păsărelu *et al.* [2020] found that, although there is a growing number of ADHD-focused apps available in digital stores, most lack solid theoretical foundations, empirical validation, and evaluations proving their long-term effectiveness. Furthermore, the authors point out that these applications tend to focus on educational features or symptom monitoring, but rarely promote sustained behavioral changes or consider the child's family context. The absence of this family perspective is particularly concerning because, as highlighted by Claussen *et al.* [2024], parental factors and home conditions directly influence a child's de-

velopment and well-being. The lack of strategies that actively involve caregivers can compromise the effectiveness of these technologies, since ADHD support depends on the ongoing engagement of the family and social circle. [Ciesielski *et al.*, 2020; Frisch *et al.*, 2023].

Another relevant challenge in the effective use of technologies is the difficulty in sustaining the engagement of people with ADHD over time [Musullulu, 2025]. Strategies such as rewards and task lists, while initially effective, are often abandoned before they can foster meaningful and lasting change [Park *et al.*, 2020]. Many technological solutions fail to sustain this continuous engagement, which compromises their impact and limits their adoption in real-world contexts [Alhasani *et al.*, 2022; AISlaity *et al.*, 2022].

In this context, methods and techniques from the field of Human-Computer Interaction (HCI) become essential for designing systems that are more intuitive, responsive, and aligned with the specific needs and motivations of this audience. As stated by Dix *et al.* [2003], HCI is a subfield of Computer Science that studies the interaction between people and computers to design, evaluate, and implement interfaces adapted to the habits and demands of users. Additionally, persuasion strategies applied to technology can increase user engagement and encourage the ongoing adoption of positive behaviors. Persuasive technology uses interactive systems to influence users' attitudes, decisions, and behaviors [Fogg, 2002; Taj *et al.*, 2019]. In this sense, integrating HCI principles and persuasive methods enables the development of more effective technological solutions, which can promote experiences that meet users' needs and maintain their engagement over time.

Given the above, this study has two main objectives: (1) to identify the main challenges faced by families of children and adolescents with ADHD in organizing daily routines, and (2) to investigate technological strategies that promote the continuous engagement of family members in managing these routines. Based on this investigation, a functional prototype of a digital application is being developed, featuring functionalities aimed at routine organization and family engagement. In this paper, we present the process of requirements gathering, prototyping, and validating the prototype interface designed for parents and caregiver. This prototype was used as a tool to assess, together with participants, how well the proposed features and strategies meet the families' real needs, allowing for adjustments and improvements.

This article is an extended version of the work by Jandre *et al.* [2024], published in the Proceedings of the XXIII Brazilian Symposium on Human Factors in Computing Systems (IHC). This version expands the research by including results from interactions with children and adolescents with ADHD, aged between 8 and 14, exploring their reward preferences, daily challenges, and expectations regarding the use of technologies to organize their routines. It also presents the evaluation data of the prototype designed for parents and caregivers. The data were analyzed using Thematic Analysis (TA) [Braun and Clarke, 2006], enabling the identification of relevant patterns and categories in the participants' reports.

This work contributes to the HCI field by investigating how well-established design principles and theoretical models of persuasion can be systematically applied to the development

of technologies aimed at supporting routine organization in families with children and adolescents with ADHD. The approach acknowledges the complexity of the family context, addressing the needs of parents/caregivers and those of the children/adolescents themselves in distinct ways. By adopting complementary theoretical models to inform the design, this research aims to advance methodologically beyond previous studies that employ persuasion implicitly or in a loosely structured manner. The combination of theoretical foundation, sensitivity to the neurodiversity context, and attention to the care ecosystem can generate practical and conceptual contributions to guide the development of more ethical, helpful, and engaging solutions in the field of HCI.

The remainder of this article is organized as follows: Section 2 presents the theoretical background, addressing ADHD in daily life, existing technological interventions, and the foundations of persuasive technology. Section 3 reviews related work, highlighting their contributions and limitations. Section 4 describes the methodology adopted, based on the extended User-Centered Design (UCD) model and TA. Section 5 presents the results obtained. Section 6 discusses the findings in light of the literature. Finally, Section 7 presents the conclusions, limitations, and directions for future work.

2 Theoretical Background

2.1 ADHD and its effects on daily life

ADHD is categorized into three clinical presentations¹: *predominantly inattentive*, when symptoms related to inattention are more prominent; *predominantly hyperactive-impulsive*, characterized by a greater presence of hyperactivity and impulsivity; and *combined*, which includes inattentive, hyperactive, and impulsive behaviors [Association, 2013]. Although they share some characteristics, these presentations manifest differently and may be associated with distinct comorbidities and treatment responses, significantly influencing the disorder's development [Musullulu, 2025].

Among the most frequent symptoms are constant distractibility, difficulty with organization, and low persistence in tasks [Musullulu, 2025]. Children with the inattentive presentation tend to lose objects, forget appointments, overlook details, and abandon activities before completing them [Mitrpanont *et al.*, 2018; Berrezueta-Guzman *et al.*, 2020]. Those with the hyperactive-impulsive profile often exhibit motor restlessness, difficulty waiting for their turn, and hasty behaviors [Berrezueta-Guzman *et al.*, 2021]. The combined presentation combines characteristics of both [Musullulu, 2025], which can exacerbate daily challenges and further impair the daily functioning of the diagnosed individual.

The characteristic behaviors of ADHD are strongly associated with deficits in executive functions, such as working memory, inhibitory control, and planning, which are fundamental for self-regulation, organization, and the completion of daily tasks [Groves *et al.*, 2022]. These deficits affect children's ability to initiate and complete tasks, plan actions, and

¹In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM), the term "subtype" was replaced by "presentation" [Association, 2013].

cope with situations that require sustained mental effort [Irwin et al., 2021; Groves et al., 2022]. Executive dysfunction also compromises learning from past experiences, contributing to the repetition of impulsive or disorganized behaviors and increasing frustration levels for both the child and their caregivers [Shuai et al., 2017; Rapport et al., 2020; Musullulu, 2025]. Research shows that interventions aimed at strengthening these functions can improve the academic, social, and functional performance of children with ADHD [Shuai et al., 2017; Rapport et al., 2020; Irwin et al., 2021].

The impact of the disorder, however, is not limited to the child or adolescent, directly affecting the family and influencing home dynamics. Parents of children with ADHD report greater parental distress and dysfunctional patterns in family interactions [Claussen et al., 2024]. Routine activities, such as taking a bath, brushing teeth, or organizing school materials, can become sources of constant stress, particularly in a daily routine where children with ADHD often ignore rules, procrastinate or forget tasks, act impulsively, and demonstrate low frustration tolerance [Benczik and Casella, 2015]. These challenges lead many caregivers to experience growing frustration, increased supervision, and, in some cases, either take over their children's tasks directly or allow them to remain incomplete [French et al., 2024].

Over time, this exhausting routine can lead to significant emotional overload for parents and caregivers. When the behavioral strategies adopted do not produce the expected results, it is common to see an increase in the use of stricter disciplinary measures, such as physical punishment or the removal of privileges, in an attempt to control the child's impulses [Nieterau et al., 2025]. However, such practices can further compromise the child's emotional and social development, which depends on parental support to regulate their emotions, cognition, and behavior [Groves et al., 2022; Silva et al., 2023]. As noted by Silva et al. [2023], parental support assists in task and goal management, fosters learning, establishes healthy boundaries, and keeps children motivated, offering support during challenging times and encouraging their pursuit of autonomy.

Furthermore, genetic and intergenerational factors further aggravate this scenario. With an estimated heritability of between 70% and 80%, ADHD is considered one of the psychiatric disorders with the highest identified genetic component to date [Faraone and Larsson, 2019]. Parents with a history of the disorder, or with undiagnosed symptoms, often present difficulties similar to those of their children, such as problems with organizing routines, setting boundaries, and maintaining consistency in family interactions [Faraone and Larsson, 2019; Wiel et al., 2022]. This overlap of challenges can compromise the effectiveness of interventions and increase stress levels within the family unit. Therefore, as highlighted by Wiel et al. [2022], intervention strategies must consider the family as a whole. Beyond providing support to the child, technological solutions aimed at routine organization should also be accessible, clear, and adaptable for adults who share similar cognitive difficulties.

Another relevant factor is the role of gender in both the diagnosis of ADHD and the way the disorder is experienced within the family environment. In the case of children, girls tend to be underdiagnosed, especially when they present inter-

nalized symptoms such as inattention or withdrawal, which can hinder early identification and delay appropriate interventions [Martin, 2024; Babinski, 2024]. In the context of caregivers, gender impacts the day-to-day experience with ADHD. Studies indicate that mothers generally assume a greater share of household responsibilities and the monitoring of their children's academic and behavioral demands, which leads to greater emotional overload and reinforces inequalities in the distribution of parental care [Craig, 2006]. This imbalance can compromise the consistent implementation of management strategies and make family life more exhausting and less collaborative. Thus, both the child's gender and that of the caregivers affect how ADHD is perceived, addressed, and managed in the home environment.

In this multifaceted context, early intervention is essential, as when initiated in the first years of life, it can prevent feelings of inadequacy, frustration, anxiety, and depression, thereby reducing long-term negative impacts in academic, social, and emotional domains [French et al., 2024; Claussen et al., 2024]. It is important to highlight that the challenges experienced by children with ADHD are not limited to the school environment: every stage of the day, from waking up to bedtime, may require structured and continuous support [French et al., 2024; Musullulu, 2025].

2.2 Technology-based interventions for ADHD

Considering the effects of executive dysfunction on the daily lives of children and adolescents with ADHD, it becomes evident how the challenges they experience can reduce their autonomy and increase parental stress [Cunningham, 2007]. In this context, digital technologies have been widely explored as complementary tools to traditional care. Such solutions have the potential to strengthen, from childhood, skills related to self-regulation, planning, and organization, core components of executive functions, thus fostering more adaptive and sustainable behaviors throughout development [Liu et al., 2024; Hosseinnia et al., 2025].

In this context, a variety of technological solutions have been developed to support families with neurodivergent children, acting as extensions of executive functions and parental support. According to Stefanidi et al. [2025], mobile applications, serious games, wearable technologies, and virtual assistants help organize tasks, monitor emotions, send reminders, and track progress toward daily goals, fostering more stable routines and more positive family interactions. Many of these technologies adopt playful approaches to support family life, strengthening daily routines and promoting more positive interactions between children and caregivers [Stefanidi et al., 2024]. Such interventions have demonstrated tangible improvements in children's autonomy in daily activities, as well as reducing parents' frustration levels during morning and evening routines [Sonne et al., 2016b]. Technologies such as smartwatches have also been employed to promote self-regulation while simultaneously alleviating caregivers' burden by providing real-time alerts on signs of distraction or impulsivity and enabling more efficient monitoring of activities [Berrezueta-Guzman et al., 2021; Silva et al., 2023]. Finally, recent findings highlight the importance of tailoring these systems to families' needs, showing that customizable

interfaces and caregiver-centered features contribute to well-being and daily engagement between adults and children [Graf et al., 2023; Stefanidi et al., 2025].

Thus, it can be seen that technological interventions have been consolidating themselves as important allies in addressing the challenges associated with ADHD, promoting significant improvements in children's autonomy, the quality of family interactions, and reducing parental stress. More than simply behavioral control tools, these solutions function as extensions of executive functions and emotional support, offering viable and personalized pathways to strengthen self-regulation, planning, and organization skills. In this context, it becomes essential to analyze how these technologies can be designed to maintain user engagement and encourage lasting behavior changes.

2.3 Foundations and applications of persuasive technology

Understanding the theoretical foundations of persuasive technology is essential for guiding the design of effective and ethically responsible solutions for children and adolescents with ADHD. The term persuasive techniques refers to strategies or methods employed to motivate changes in behavior or attitudes, as well as to influence the adoption of specific viewpoints [Fogg, 2009; Oyebode et al., 2021]. Persuasive technology, in turn, refers to systems designed based on these techniques, to shape users' behaviors, attitudes, or decisions [Fogg, 2002; Taj et al., 2019].

Several theoretical models have been employed to support the design of persuasive technologies, offering principles and strategies for promoting behavioral change. Among them, the Fogg Behavior Model (FBM) establishes that a behavior occurs when motivation, ability, and a trigger manifest simultaneously [Fogg, 2009]. The Persuasive Systems Design (PSD) organizes design principles into four categories and emphasizes that systems should be transparent, easy to use, and capable of sustaining attitude or behavior changes over time [Oinas-Kukkonen and Harjumaa, 2009]. Cialdini's Principles of Persuasion (CPP) comprise six strategies grounded in psychological mechanisms that influence decision-making [Cialdini, 2001]. Finally, the Behavior Change Technique Taxonomy (BCT V1) presents 93 techniques grouped into 16 categories, offering a standardized and consistent classification for the development and evaluation of behavior change interventions [Michie et al., 2013]. An overview of these four models, which are widely adopted in HCI, is presented in Figure 1.

In addition to these theoretical models, review studies indicate that strategies such as suggestions, rewards, feedback, reminders, and personalization are among the most common in persuasive solutions aimed at changing behavior [Matthews et al., 2016; Adaji and Adisa, 2022; Alhasani et al., 2022]. In the case of reminders, generic messages or those sent at inappropriate times tend to cause frustration or disengagement, especially among less active users [Sporrel et al., 2021; Karlsson et al., 2022]. Aesthetic aspects, such as the visual appeal of the interface, also influence user motivation and engagement [Matthews et al., 2016].

Within the context of ADHD, Sonne et al. [2016a] pro-

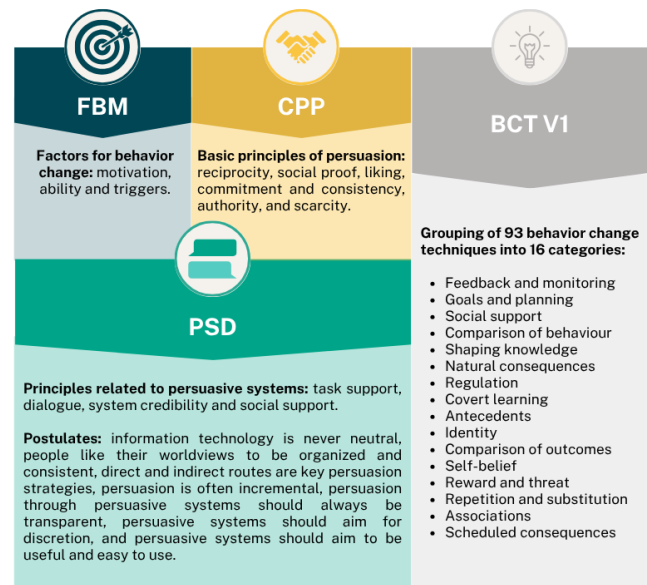


Figure 1. Fundamental principles of FBM, PSD, CPP, and BCT V1.

posed a design framework that connects technological strategies, such as reminders, gamification, and emotional regulation support, to the symptomatic characteristics of ADHD. Recent studies corroborate and expand these approaches by including features such as mood tracking, self-reflection, goal personalization, and positive reinforcement systems [Stefanidi et al., 2023; Liu et al., 2024; Hernandez-Capistran et al., 2025; Hosseinnia et al., 2025].

Although persuasive strategies are widely adopted in applications aimed at individuals with ADHD, there is still a lack of studies that explicitly discuss the role of persuasion in these designs. In general, the reviewed works merely describe how such features operate within the system, without examining their role as persuasive mechanisms, nor justifying design decisions based on formal theoretical models. For instance, Stefanidi et al. [2023] present an approach that includes motivational and engagement elements aligned with the needs of children with ADHD and their caregivers, yet do not explicitly frame these features within persuasive frameworks. Similarly, Gabarron et al. [2025] highlight this gap by identifying the lack of methodological standardization in digital interventions for ADHD. In the broader field of persuasive technologies, a systematic review found that only 40% of the interventions analyzed made explicit reference to a behavioral model [Taj et al., 2019].

This methodological gap compromises both the clarity and reproducibility of projects, making it difficult to conduct precise analyses of their effectiveness and safety. The systematic adoption of a theoretical model strengthens the planning of persuasive design by aligning behavioral objectives with the strategies employed [Taj et al., 2019; Aldenaini et al., 2020; Alhasani et al., 2022]. Thus, these models enable the assessment of potential impacts, such as cognitive overload or manipulative use of resources, in addition to promoting scientific transparency by explicitly stating their principles.

In the context of vulnerable populations, such as children and adolescents with ADHD, the application of persuasive technologies demands rigorous attention to ethical considerations from the earliest stages of development. Researchers have warned of risks related to manipulation, lack of trans-

parency regarding the system's intentions, and violations of user autonomy [Berdichevsky and Neuenschwander, 1999; Jacobs, 2020]. Therefore, it is recommended to adopt principles of explainability, allowing users and their caregivers to clearly understand how and why specific persuasive strategies are being employed [Calvaresi *et al.*, 2025].

In this scenario, the use of well-founded theoretical models supports more thoughtful design decisions that take into account specific characteristics such as impulsivity, cognitive maturity, and individual preferences. Furthermore, these models encourage participatory approaches, ensuring functional relevance, ethical alignment, and suitability to the real context of use [Yarosh and Schueller, 2017; Graf *et al.*, 2023; Angelöw and Psouni, 2025]. Consequently, a rigorous conceptual basis is established for developing safer, more effective, and responsible digital interventions, in which strategies such as personalization, feedback, suggestions, and rewards are applied in a balanced and contextualized manner, promoting positive engagement, respecting user autonomy, and avoiding manipulative practices.

3 Related Work

Digital inclusion of people with neurodevelopmental disorders has emerged as a relevant area for both HCI and health, enabling interventions that enhance autonomy and promote the well-being of these individuals [Batista *et al.*, 2022; Hernandez-Capistran *et al.*, 2025]. In this context, involving users in the design process is essential for developing solutions that address their specific needs, promoting social integration, and improving the quality of life of both diagnosed individuals and their families [Sonne *et al.*, 2016a; Stefanidi *et al.*, 2023]. Building on this foundation, for the present study, we selected mobile solutions that have been previously tested with families in ADHD-related, in-home contexts, focusing on routine management, communication, emotional regulation, and collaboration between caregivers and children or adolescents.

Among the solutions designed to support the daily lives of families with children with ADHD, one notable example is MOBERO [Sonne *et al.*, 2016b], an Android application for organizing morning and evening routines, developed in collaboration with psychiatrists, psychologists, medical researchers specializing in ADHD, and families. The study involved 13 children (aged 6–12) who participated in a four-week intervention, with two weeks of actual MOBERO use. The system employs visual task lists with simple images, virtual and physical rewards, and a visual timer that graphically represents the time available for each task, helping children understand the passage of time, a common challenge for those with ADHD. However, parents reported that, while the timer helped maintain focus in some situations, it also caused stress when the allotted time expired before the task was completed, particularly for children with greater difficulty maintaining pace or during more hectic mornings. Nevertheless, the results indicated increased child independence, reduced parental frustration, improved sleep, and fewer conflicts during transitions between activities.

Another example is CoolTaco [Silva *et al.*, 2023], a co-

regulation system for iPhone and Apple Watch designed to support children with ADHD and their caregivers in the home environment. In this context, co-regulation refers to the interactive process in which parents and children share responsibility for managing behaviors and tasks, adjusting their actions according to mutual needs, for instance, parents easing demands when noticing signs of overload in the child, or children responding to positive reinforcement. The study involved 10 families, including 10 children (aged 8–15) and 17 caregivers, who used the system for an average of three months. CoolTaco enables parents to configure personalized tasks and rewards, while children record task completion on the smartwatch, accumulating points to exchange for prizes. In addition to functioning as a reminder, the system facilitates parent-child collaboration even at a distance. Findings indicated increased child autonomy but also highlighted the need for constant parental involvement to validate tasks, which may lead to caregiver overload. Furthermore, the binary logging model (“done”/“not done”) proved limited, as some activities were only partially completed.

In the field of personalization and collaboration, MATS [Graf *et al.*, 2023] stands out as an iPad application focused on self-regulation (the child's ability to manage behaviors, emotions, and attention in response to everyday demands) and on strengthening parent-child relationships. The system offers personalized training divided between children and caregivers: children engage in games aimed at training executive functions, while parents watch videos on supportive strategies and apply them with their children in daily situations, such as homework and backpack organization. The study involved 10 families (children aged 7–10) who used the application at home for periods ranging from 32 to 173 days. Analysis of audio diaries and final interviews revealed several key findings: the need for adaptive resources, a gradual introduction to the application to allow children and caregivers to familiarize themselves with its functionalities without overload, active parental engagement, and the use of games as motivational tools. These findings resulted in seven design recommendations and four pedagogical principles grounded in self-determination theory: competence, autonomy, relatedness, and psychoeducation.

Additionally, REMEMO [Stefanidi *et al.*, 2025] is an application designed to foster communication and well-being among children with ADHD and their care ecosystems. The system is compatible with both Android and iOS platforms and features an interface adapted to three user profiles (children, caregivers, and therapists/educators). It enables the recording of experiences and emotions through multiple modalities (text, voice, image, and drawing), with options for either sharing or keeping entries private. In a longitudinal study involving 18 participants, including 7 children aged 8 to 13, data were collected from diverse sources, such as application usage logs, standardized questionnaires, interviews, and session notes. Findings indicate that REMEMO supported emotional expression, affectionate communication, reflection, and therapeutic engagement, with distinct usage patterns according to user profile: children primarily focused on expressing feelings, parents alternated between recording their own experiences and those of their children, and professionals prioritized therapeutic monitoring.

Given the above, it is evident that, although MOBERO, CoolTaco, MATS, and REMEMO offer valuable contributions to supporting children with ADHD and their families, each maintains specific focuses and limitations that the present work seeks to overcome. MOBERO organizes morning and evening routines through visual lists and rewards, but is limited to particular moments of the day and does not include prior mapping of the most meaningful tasks. CoolTaco facilitates co-regulation using binary tasks recorded via a smartwatch and rewards, yet it requires constant validation by caregivers and does not explore the most valued rewards. MATS emphasizes executive function training and parental psychoeducation, fostering self-regulation and family bonding, but without integrating the overall organization of daily routines. REMEMO, in turn, focuses on emotional communication among children, caregivers, and professionals, but overlooks the management of practical tasks and the structured use of rewards.

In a broader context, recent reviews indicate that most ADHD-oriented applications still exhibit methodological limitations or lack robust validation [Liu *et al.*, 2024; Gabarron *et al.*, 2025]. Furthermore, although many approaches implement strategies such as positive reinforcement, progress visualization, and reminders, no studies were found in the ADHD context that explicitly draw on theoretical models of persuasive technologies.

Accordingly, this work advances the state of the art by empirically mapping the most relevant daily tasks and preferred rewards, considering the perspectives of both caregivers and children/adolescents with ADHD. These findings will serve as a foundation for future research and will enable our digital application prototype to offer a predefined list of tasks, simplifying the registration of daily routines. The design process adopted in this study aims to address the specific cognitive and affective demands of each group, recognizing caregivers not only as mediators of technology use but also as individuals facing organizational challenges and emotional overload. In response, we propose a unified and integrated environment that enables the coordinated management of tasks for both caregivers and children/adolescents, with the goal of alleviating the complexity of managing family routines. Distinguishing itself from previous approaches, this work explicitly bases its design decisions on established theoretical models (FBM, PSD, CPP, and BCT V1), applying persuasive strategies in a planned and contextualized manner, aiming to support adherence and continued use, enhance practical applicability, strengthen methodological rigor, facilitate replication, and allow more consistent comparisons with other approaches in the field.

4 Methodology

This study adopted UCD as its methodological approach, as it is an iterative process that prioritizes users' needs by involving them in different stages of the design [Abrams *et al.*, 2004; ISO/TC 159/SC 4, 2019]. To structure the activities, we employed the Extended UCD model proposed by Mithun *et al.* [2018], which organizes development into five main stages: context, elicitation, design, build, and evaluation. In

this study, four of these stages were carried out, as illustrated in Figure 2, which presents the participants involved, the data collection methods used, and the analysis procedures applied. The **build** stage, corresponding to the full implementation of the system, was not performed, as this work focused on the design and validation of the proposed solution to ensure its alignment with users' needs before moving forward with final development.

Due to the importance of ethical aspects, the research related to this work was submitted and approved by the Research Ethics Committee (*Comitê de Ética em Pesquisa - CEP*) of the Pontifical Catholic University of Minas Gerais, with CAAE 68271523.0.0000.5137.

To ensure transparency and compliance with ethical standards, all research participants signed the Informed Consent Form (ICF), which details the study's objectives, procedures involved, possible risks and benefits, and participants' rights and duties. They were assured that their answers would be kept confidential and used exclusively for research purposes.

In the case of children and adolescents with ADHD, participation required authorization from parents or caregivers. In addition to the ICF being signed by caregivers, the child/adolescent's consent was obtained through an Assent Form written in accessible language.

The documents guaranteed that the data would be stored for five years and, after that period, would be destroyed. It was also emphasized that when the results were released, the responses and personal information, such as names and photos, would be anonymized to protect the identity of the participants. In addition, it was stated that participation was voluntary and that participants could stop participating at any time without personal harm.

Therefore, the research was conducted with methodological and ethical rigor, with special attention to the vulnerability of the participant group. The following sections detail the stages of the extended UCD process carried out in this study, highlighting its application throughout the work.

4.1 Context: contextualization and preparation of the research

In the **context** stage, a literature review was conducted to identify the main challenges experienced by families of children and adolescents with ADHD, as well as the most common activities in their daily lives. Guidelines for developing a persuasive application aimed at fostering continuous user engagement were also examined.

To collect these data, the following sources were used: 1) scientific articles in digital libraries of the Association for Computing Machinery (ACM), Institute of Electrical and Electronics Engineers (IEEE), Sage Journals, PubMed, Brazilian Computer Society (*Sociedade Brasileira de Computação - SBC*), among others; and 2) the DSM-V manual [Association, 2013].

Also during this phase, research instruments were developed, including questionnaires, questions for participant activities, data collection planning, and an observation script for prototype evaluation. The creation of these materials, as well as the design of the activities, was carried out in partnership with the medical specialist and co-author of this work, based

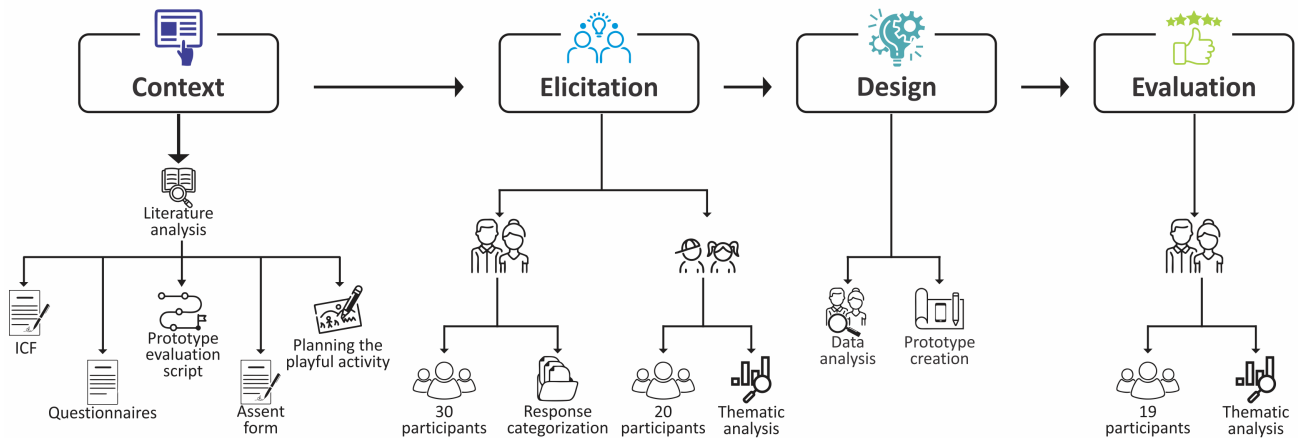


Figure 2. Stages of methodology.

on the literature review findings and the central research questions. Ethical documents required for the study, such as the ICF and Assent Form, were also prepared.

4.2 Elicitation: meeting with participants

During the **elicitation** stage, in-person meetings were conducted with parents/caregivers and children/adolescents with ADHD. The objective was to gather data on family dynamics, daily challenges, and preferences regarding rewards and a technological tool for routine management.

The data collection was supervised by a doctor specializing in ADHD, co-author of this study, and took place at the Center for Research on Impulsivity and Attention (*Núcleo de Investigação da Impulsividade e Atenção - NITIDA*) of the Hospital das Clínicas at the Federal University of Minas Gerais (*Universidade Federal de Minas Gerais - UFMG*), which is recognized for the services provided in outpatient psychiatric care for cases of ADHD and Oppositional Defiant Disorder (ODD).

A total of nine visits were conducted at the hospital between March and September 2024. The first four visits, between March 21 and April 19, involved only parents and caregivers. The subsequent five visits, between July 25 and September 5, included children and adolescents with ADHD. Contact with participants occurred gradually, taking place in the hospital waiting room. Interaction time was not timed, allowing each participant to use as much time as needed, with breaks permitted for medical appointments. Notably, despite the breaks, all participants completed their contributions.

Regarding parents and caregivers of children and adolescents with ADHD, the research objectives and data collection procedures were explained to all individuals present in the waiting room at each meeting. Those who expressed interest in participating signed the necessary consent forms, and some also authorized the use of photographs documenting their participation for dissemination of the study results.

Interactions were conducted individually, one caregiver at a time, in the waiting room, and took place in two phases, as detailed in Table 1, which lists the applied questions. In the first phase, each participant completed a paper questionnaire consisting of 14 questions regarding demographic data and information about the child or adolescent with ADHD,

without any intervention or dialogue with the researcher.

In the second phase, a dynamic activity was conducted in which the researcher read aloud five pre-defined questions concerning family aspects and preferences regarding a routine management application. To make the activity more interactive and visually engaging, each caregiver received an envelope containing five colored cards, one for each question, encouraging active participation. During this moment, participants recorded their responses in writing and, in dialogue with the researcher, commented on their statements and provided additional explanations, which the researcher himself duly noted. Methodologically, this phase constitutes an in-person administration of an open-ended questionnaire with mediation, characterized by verbal interaction between the researcher and participant.

For qualitative analysis of caregivers' responses, the collected data were processed in two stages: digital recording and categorization. In the first stage, all responses from the questionnaires, both structured and open, were manually entered into a .csv spreadsheet. Subsequently, during the categorization phase, techniques such as synonym grouping, frequency analysis, and thematic organization were applied. The research team collectively reviewed these techniques to ensure consistency and reliability of the results.

The data collection with children and adolescents with ADHD aimed to identify their preferences for rewards, daily challenges, and interests regarding a technological tool to support routine management.

Only children and adolescents aged between 8 and 14 years participated in the study. This age group was chosen because it exhibits cognitive, metacognitive, and social development characteristics that favor active participation in HCI research. Despite age-related variations, individuals in this group generally possess essential skills for the study's objectives, such as understanding simple instructions, completing structured tasks, and interacting relatively autonomously with mobile interfaces.

According to Piaget [1952], children between approximately 7 and 11 years old are in the stage of concrete operations, characterized by the development of logical thinking and the ability to follow structured instructions, key skills for interacting with digital technologies. Complementing this, studies indicate that from age 8 onward, children begin to

Table 1. Questions included in the questionnaires completed by parents and caregivers.

Type	No.	Question
Structured questionnaire	Data on parents and/or caregivers	
	01	Age: Free text field.
	02	Gender: Female, Male, Prefer not to say or Other.
	03	Marital status: Single, Married, Living together, Common-law marriage, Separated/divorced, or Widowed.
	04	Education: Elementary - Completed/Incomplete, High school - Completed/Incomplete, College - Completed/Incomplete, or Postgraduate.
	05	Occupation: Free text field.
	06	Participation in Parent Training: Yes or No.
	07	Availability for future contacts: Yes or No;
	7a	First and Last Name: Free text field;
	7b	WhatsApp Number or Email: Free text field.
	Data on children and adolescents with ADHD	
	08	Age: Free text field.
	09	Gender: Female, Male, Prefer not to say, or Other.
	10	School: Public or Private.
11	School Year: Free text field.	
12	School Period: Full-time, Morning, Afternoon, Night, or Other.	
13	ADHD Presentation: Inattentive, Hyperactive-Impulsive, Combined, or Other.	
14	Personal cell phone use: Yes or No.	
Open questionnaire	01	What are the challenges you typically experience daily with a child or adolescent diagnosed with ADHD?
	2a	What activities related to house, self-care, and school does he/she find the most challenging to complete or remember to do?
	2b	Of the listed activities, mark with an asterisk (*) those you believe have the greatest consequences when he/she forgets to do them.
	03	What tasks in his/her routine do you usually have the most difficulty remembering?
	04	What strategies do you usually use to motivate him/her to complete daily tasks?
	05	If an application were developed to help organize his/her daily activities, what do you consider important to be considered?

demonstrate initial levels of reflection and decision-making that enable them to participate ethically and actively in participatory processes, provided these are appropriately adapted to their developmental stage [Montreuil *et al.*, 2021; Angelöw and Psouni, 2025]. Furthermore, during childhood and adolescence, particularly between 9 and 15 years, there is significant progress in executive functions such as self-regulation, planning, and task monitoring [Anderson *et al.*, 2001], abilities directly related to engagement with interactive systems and performing structured tasks in research contexts. In this sense, extending the age range to 14 years allows inclusion of this continuous maturation period, which also encompasses early adolescence, generally considered between 10 and 14 years, marked by more complex cognitive, emotional, and social transitions [Vijayakumar *et al.*, 2018].

To ensure ethical participation of minors, parents or caregivers of children and adolescents within the defined age range were previously informed about the research objectives and data collection procedures. If the child or adolescent expressed interest in participating and formal consent was granted by the caregiver, the consent forms were signed. Some caregivers also authorized photographic documentation of the activity for scientific dissemination purposes.

Interactions with children and adolescents were conducted individually in an open area with a table available for use and mediated by a researcher. To make the experience more

engaging and accessible, a dynamic consisting of three questions was proposed, as presented in Table 2, with responses recorded on poster boards. For the first two questions, participants could freely choose from 32 cards with predefined options covering daily tasks and types of rewards. These cards were simultaneously available and could be affixed to the poster boards according to the child's or adolescent's understanding and preference. Participants also had the option to create new responses through drawing or writing, using colored pencils, crayons, or regular pencils. The third question was open-ended and answered exclusively via free drawing or writing. Although interactions were not audio or video recorded, spontaneous comments and observations made by participants throughout the activity were manually documented by the researcher.

After data collection, the data were organized and analyzed based on TA, as proposed by Braun and Clarke [2006], using MAXQDA software, an extensively used tool for organizing, coding, and interpreting unstructured qualitative data². The responses recorded on the poster boards, along with the manually noted observations, were transcribed into a text document, consolidated, and imported into the software, where they underwent subsequent coding and analysis.

Following the stages of TA, the project team aimed to iden-

²For more details, see <https://www.maxqda.com/>

Table 2. Questions used in the dynamics with children and adolescents with ADHD

No.	Question
01	What activities in your day do you find tedious, complex, or that you tend to forget to do?
02	What do you like to get or do after you finish your activities? Or what can your parents promise you that makes you super excited to do the tasks they asked you to do?
03	What do you think would be cool to have in an app that would help you in your day, reminding you to do your tasks in a fun way?

tify patterns related to daily activities, rewards, and desired app features. The analysis combined both deductive and inductive approaches: categories of activities and rewards were partially predefined on the cards, but participants were also encouraged to suggest new ideas, allowing for the emergence of unforeseen themes. For the app features, the approach was predominantly inductive, based on participants' spontaneous reports. Moreover, the analysis adopted a latent focus, exploring not only explicitly mentioned preferences and difficulties but also the underlying motivations, feelings, and contexts implicit in the responses. Thus, while guided by initial categories, the analysis remained flexible to include new perspectives.

4.3 Design: tools and methods for app prototyping

Based on data collected from interactions with parents and caregivers regarding daily activities, challenges, and engagement strategies, the **design** phase was initiated. The objective was to translate identified needs into features for a functional prototype of a digital application aimed at organizing the routines of families with children and adolescents with ADHD. The proposal focuses on assisting in daily structure and fostering more effective communication among family members, contributing to habit formation, stress reduction, and a more balanced coexistence.

Although the study also aims to serve children and adolescents, this phase addresses only the initial version of the interface designed for caregivers, adopting a progressive approach to better adapt to the specific needs of each group.

Based on the analyses, the research team defined the core functionalities of the prototype and included persuasive strategies widely recognized in HCI literature, such as FBM [Fogg, 2009] and those described in studies like [Lentferink *et al.*, 2017]. The development process included paper sketches, low-fidelity digital prototypes created in Figma, and the creation of a medium-fidelity functional prototype using Flutter, a cross-platform framework for the Dart language that enables code reuse across Android, iOS, web, and desktop [Google, 2024], facilitating ongoing app development. The research team reviewed all stages.

The decision to develop a mobile application was based on three main factors: 1) widespread adoption of mobile devices: global data indicate that approximately 85% of adults use smartphones [Wike *et al.*, 2022]. Additionally, research suggests high ownership of these devices among children

and adolescents within the studied age range [Cetic.br, 2021; Martín-Cárdaba *et al.*, 2024; Gerosa *et al.*, 2024]; 2) native mobile device features: functionalities such as push notifications can be exploited to provide reminders, positive reinforcements, and contextual alerts, supporting routine organization; and 3) mobility and accessibility: a mobile app enables family routine monitoring across various contexts and times of day, making the solution more practical and integrated into daily life.

The interface developed for caregivers includes an integrated view of personal tasks and those assigned to the child or adolescent, organized in a single space. Routines are segmented by different colors for each user, and switching between profiles occurs via a dedicated button, facilitating shared activity management.

Personalization of routines and tasks was implemented as a core feature, allowing users to create, edit, and organize recurring or one-time activities with customizable titles, descriptions, and frequencies (daily, weekly, or monthly), providing flexible monitoring adapted to the family's reality. To optimize the initial registration process and reduce cognitive load, the system offers a predefined task list based on data collected from participating families.

Additionally, segmented visualization and activity filtering mechanisms were implemented, enabling task prioritization by periods of day or category, which contributes to clearer and more efficient management of routines.

The prototype includes persuasive elements grounded in recognized theoretical models, including continuous feedback, reminders, and visual cues (colors and icons), aimed at supporting users' organization, engagement, and self-regulation. Thus, in addition to being functional, the prototype was designed to motivate sustained use and facilitate routine management.

4.4 Evaluation: validation of the prototype with parents/caregivers

The **evaluation** stage of the prototype developed was conducted during the last five visits to the hospital (July 25 to September 5, 2024) and consisted of individual mediated exploration sessions. During these sessions, parents and caregivers interacted with the prototype displayed on the researcher's smartphone.

Before each session, the research objectives and data collection procedures were explained to those present in the outpatient waiting room. Interested individuals signed the necessary consent forms, and some also authorized photographic documentation of their participation for scientific dissemination purposes.

Interactions took place individually in the waiting room. After a brief explanation of the app's functionality, participants were invited to explore the prototype freely. During this interaction, the researcher carefully observed system use, asked informal questions about the user experience, and collected feedback on the features, while avoiding direct interference.

Spontaneous statements, suggestions, and behaviors indicating ease or difficulty of navigation were manually recorded by the researcher in a notebook. No audio or video recordings

were made during these sessions.

For the analysis of this phase, TA as described by Braun and Clarke [2006] was followed, and the MAXQDA software was used. Textual records were imported into the tool to identify themes related to impressions of the application. The analysis was conducted inductively, as no predefined categories existed, allowing themes to emerge directly from parents' and caregivers' reports. Additionally, a semantic approach was adopted, focusing on the explicit meaning of responses and the organization of similar perceptions, without attempting to interpret the reasons behind each opinion.

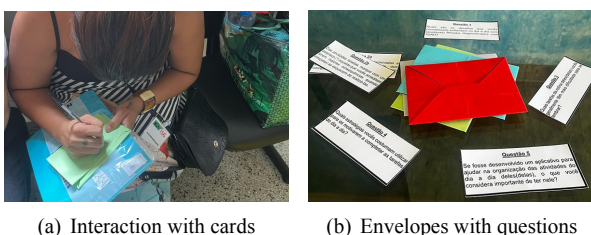
Furthermore, a semantic approach was adopted, focusing on the explicit meaning of the responses and the organization of similar perceptions, without seeking to interpret the reasons for each opinion.

5 Results

5.1 Parents and caregivers: daily challenges, family strategies, and expectations for technology

Data collection involved 30 parents and/or caregivers of children and adolescents with ADHD, most of whom were women (76.7%), aged between 35 and 44 years (40.0%), and with a high level of education (60.0% with a completed or incomplete undergraduate or graduate degree). Half of the participants were married, and 46.7% had previously participated in a Parental Training program, a psychoeducational intervention offered by UFMG to guide caregivers in managing challenging behaviors and strengthening positive parenting practices. The most frequently reported occupations were homemaker, pedagogue, and occupational safety technician. Regarding the children and adolescents under their care, 86.7% were male and 50.0% were between 8 and 10 years old. Most attended public schools (73.3%) and were enrolled in elementary education (86.7%), split between morning (40.0%) and afternoon (40.0%) shifts. The combined presentation of ADHD was the most prevalent (40.0%), followed by the inattentive and hyperactive-impulsive presentations (23.3% each). In addition, 73.3% owned a mobile phone. All demographic information was reported directly by the parents and caregivers, both about themselves and about the children and adolescents in their care, and is summarized in Table 3.

Beyond sharing sociodemographic information, parents and caregivers took part in an interactive activity, as illustrated in Figure 3.



(a) Interaction with cards (b) Envelopes with questions

Figure 3. Dynamics with parents and caregivers. Source: research data.

Table 3. Demographic profile of parents and/or caregivers and children and adolescents with ADHD. Data on children/adolescents were reported by the caregivers.

Data on Parents and caregivers	N	%
Gender		
Female	23	76.7
Male	07	23.3
Age group		
25–34 years	06	20.0
35–44 years	12	40.0
45–54 years	07	23.3
55–64 years	02	06.7
65+ years	03	10.0
Marital status		
Single	06	20.0
Married	15	50.0
Living together	01	03.3
Common-law marriage	01	03.3
Separated/divorced	07	23.3
Education		
Elementary Education - Completed or Incomplete	04	13.3
High School - Completed or Incomplete	08	26.7
College/University - Completed or Incomplete	09	30.0
Postgraduate - Completed or Incomplete	09	30.0
Participated in Parent Training		
Yes	14	46.7
No	16	53.3
Data on Children and Adolescents		
Gender		
Female	04	13.3
Male	26	86.7
Age group		
6–7 years	01	03.3
8–10 years	15	50.0
11–14 years	08	26.7
15–17 years	06	20.0
School		
Public	22	73.3
Private	08	26.7
School year		
Elementary Education I	14	46.7
Elementary Education II	12	40.0
High School	04	13.3
School period		
Full-time	05	16.7
Morning	12	40.0
Afternoon	12	40.0
Night	01	03.3
ADHD Presentation		
Inattentive	07	23.3
Hyperactive-Impulsive	07	23.3
Combined	12	40.0
Still under investigation	04	13.3
Own cell phone		
Yes	22	73.3
No	08	26.7

When invited to share the main challenges experienced in

their daily lives with children and adolescents with ADHD, the caregivers frequently mentioned behavioral difficulties, such as inattention, hyperactivity, stubbornness, and resistance to rules and instructions. Disorganization was another recurrent theme, ranging from tidying clothes and school materials to behaviors during mealtimes. Reports also included difficulties in performing tasks autonomously, interacting with family members, and managing time. Some participants additionally mentioned the social stigma associated with the disorder, reflected in a lack of acceptance by others. Symptoms such as lack of concentration, anxiety, irritability, and low frustration tolerance were identified as obstacles affecting both academic performance and social interaction, as well as the household routine, as illustrated by the statement: “He usually gets very upset when things don’t turn out the way he imagined.” (Respondent 11).

The caregivers were invited to report school-related, self-care, and household responsibilities that require greater effort or are often forgotten by children and adolescents with ADHD. Their responses were organized into five categories: *School Tasks*, *Personal Care and Hygiene*, *Household Routine*, *Organization and Autonomy*, and *Time Management*. Table 4 presents examples cited for each category, accompanied by references from the literature. When asked to indicate which of these tasks has the most significant consequences when not performed, the caregivers expressed greater concern about *School Tasks* (45.71% of the responses), followed by *Organization and Autonomy* (20%) and *Personal Care and Hygiene* (17.14%).

Regarding the family routine tasks that parents and caregivers themselves most often forget, *School Activities* were the most frequently mentioned, accounting for about 36% of the responses. This category appeared frequently in both individual reports and among different participants. Next, *Daily Routine* stood out, with approximately 24% of the mentions. Together, these two categories represented around 60% of the tasks most often forgotten by caregivers. Figure 4 presents a consolidated list of the activities most frequently forgotten by them, organized into the themes: *School Activities*, *Complementary Activities*, *Hygiene*, *Medication and Appointments*, and *Daily Routine*.

Regarding the strategies adopted by parents and caregivers to encourage the completion of daily tasks, the reported approaches ranged from the use of rewards to the establishment of rules and limits. Among the most frequently mentioned were incentives such as outings, additional screen time (e.g., mobile phone and video games), treats, or favorite foods. Practices such as removing items and privileges in cases of non-compliance, as well as using exchanges, offering something of interest to the child or adolescent in return for completing the activities, were also mentioned. Open communication appeared frequently in the reports, highlighting the role of dialogue, praise, and emotional support in motivating task completion: “I use dialogue to ensure that the tasks are completed, and I give praise at the end.” (Respondent 14).

When invited to suggest essential features for an application aimed at supporting the daily routine management of children and adolescents with ADHD, caregivers primarily emphasized the need for alarms and reminders to assist with time management and task execution: “When designing an appli-

cation for my son, it is essential to include visual reminders, as he usually disables the sound alerts.” (Respondent 05). In addition, many participants suggested including playful and educational strategies to engage children and adolescents, such as games, levels, and rewards: “Routine planner with reminders, linked to a game that advances through stages.” (Respondent 14). Routine organization itself was also identified as a central feature, covering household, school, and extracurricular activities: “Home routine; school routine; extracurricular routine (activities to help at school); reminder calendar; nighttime routine [...]” (Respondent 02). Finally, some responses highlighted the importance of fostering family interaction: “Communication between child and caregiver.” (Respondent 07).

5.2 Children and adolescents: challenging activities, motivating rewards, and feature suggestions

Data were also collected from 20 children and adolescents diagnosed with ADHD, 19 of whom were boys and 1 was a girl. Ages ranged from 8 to 14 years, distributed as follows: three aged 8, three aged 9, six aged 10, six aged 11, one aged 13, and one aged 14. Figure 5 shows moments of the participants’ interaction with the materials used for their responses.

The activities were segmented on the cards: (1) Brush teeth (Brushing); (2) Making the bed (Bed); (3) Do homework (Homework); (4) Take out the trash (Trash); (5) Wash the dishes (Dish); (6) Read a book (Book); (7) Cut nails (Nail); (8) Brush hair (Hair); (9) Take a shower (Shower); (10) Tie shoes (Shoelace); (11) Put away toys (Toys); (12) Take care of pets (Pets); (13) Put away school supplies (Materials); (14) Pack backpack (Backpack); (15) Tutoring class (Tutoring); (16) Putting on clothes (Dressing); (17) Bedtime (Sleep); and (18) Tidy up the room (Room), in addition to two spontaneous responses: (19) Take medicine (Medicine) and (20) Go to school (School).

The rewards were segmented into the cards: (1) Watch TV (Television); (2) Play video games (Game); (3) Swimming, which children and adolescents associated with places that had a pool, such as a club (Pool); (4) Win a snack (Snack); (5) Go on an outing (Outing); (6) More screen time on the phone (Phone); (7) Candy and sweets (Treat); (8) Play together (Play); (9) Compliments (Praise); (10) Receive a gift (Gift); and (11) Go to the movies (Movies), in addition to spontaneous responses: (12) Draw (Draw), (13) Post videos on my YouTube channel (YouTube), (14) Go to a friend’s house (Friend), (15) Spend a few moments in silence (Silence), and (16) Free time (Free).

Finally, the response options (1) Play ball (Ball), (2) Ride a bike (Bike), and (3) Receive money (Money) were interpreted differently by the children and adolescents, with some seeing them as activities and others seeing them as rewards. While some saw “playing ball” and “riding a bike” as physical activity or motor coordination challenges, others associated them with a moment of leisure. The option “earning money” was perceived as a difficulty, in the sense of saving money, and as a reward for receiving it from someone.

In the question regarding daily activities that children and

Table 4. Categorized tasks with examples, according to reports from those caregivers and literature.

Category	Interview	Literature
School Tasks	Difficulty understanding activities and some school subjects; Doing homework is a challenge; They don't want to do schoolwork; Reading school books is difficult; They forget to study for tests.	Difficulty doing homework [Coghill <i>et al.</i> , 2008; Benczik and Casella, 2015] and distraction during homework [Shuai <i>et al.</i> , 2017]. They may make careless mistakes in schoolwork [Weisberg <i>et al.</i> , 2014]. Difficulty maintaining focus during lectures, conversations, or prolonged reading, and cannot easily finish schoolwork, tasks, or homework [Association, 2013].
Personal Care and Hygiene	They forget to brush their teeth, cut their nails, wash and comb their hair; They have difficulty taking a shower and putting on and tying their shoes.	Tasks such as brushing teeth [Benczik and Casella, 2015; Irwin <i>et al.</i> , 2021], bathing [Benczik and Casella, 2015], getting dressed [Irwin <i>et al.</i> , 2021], cleaning oneself [Irwin <i>et al.</i> , 2021], acting safely [Irwin <i>et al.</i> , 2021], and making healthy food choices [Irwin <i>et al.</i> , 2021] can become challenging.
Household Routine	They don't take their glasses and plates to the sink, leaving them where they eat; They forget to take care of their pets, take out the trash, make their beds, and the place where they keep their toys.	Difficulty following family/daily routines [Coghill <i>et al.</i> , 2008; Weisberg <i>et al.</i> , 2014] and sitting down for meals [Benczik and Casella, 2015]. Forgetfulness of daily activities [Association, 2013; Weisberg <i>et al.</i> , 2014], such as performing tasks and obligations [Association, 2013].
Organization and Autonomy	They have little autonomy and, therefore, do not go out alone or do their schoolwork alone; They leave books and notebooks lying around; They forget where they put their school materials and do not organize them; They lose objects inside the house and leave them out of place; They forget books, pencils, and pencil cases at school; They always leave their clothes untidy and their room disorganized.	Losing things [Coghill <i>et al.</i> , 2008; Association, 2013; Mitranont <i>et al.</i> , 2018]. High disorganization [Coghill <i>et al.</i> , 2008; Shuai <i>et al.</i> , 2017; Rapport <i>et al.</i> , 2020]. More excessively demanding and attention-seeking behavior [Coghill <i>et al.</i> , 2008]. Difficulty keeping materials and personal effects in order [Association, 2013]. Lack of motivation/withdrawal [Coghill <i>et al.</i> , 2008].
Time Management	They have difficulty keeping to study, school, lunch, bath, and bedtime schedules; They end up staying past the set playtime; They forget school dates; They leave homework until the last minute.	Poor time management [Association, 2013; Rapport <i>et al.</i> , 2020]. Poor planning skills [Rapport <i>et al.</i> , 2020]. Difficulty in perceiving time [Sonne <i>et al.</i> , 2016b] and in meeting deadlines [Association, 2013].

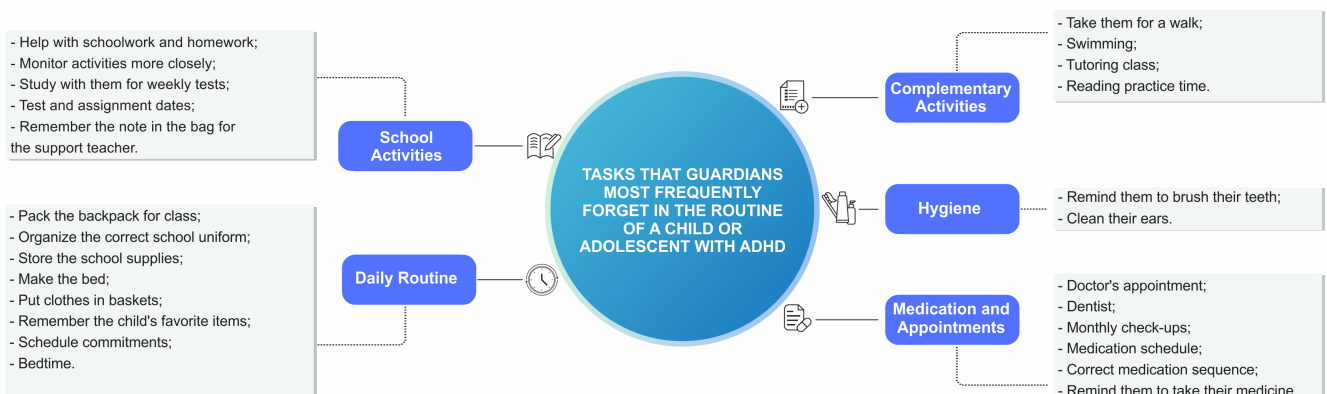


Figure 4. Activities that caregivers most often forget in the routine of a child or adolescent with ADHD.

adolescents consider boring, difficult, or often forget to do, five main themes were identified: *Class*, *Leisure*, *Self-care*, *House*, and *Autonomy*. Similarly, the rewards mentioned by the participants were grouped into five main themes: *Autonomy*, *Technology*, *Recreation*, *Material benefits*, and *Social*

recognition. Figure 6 summarizes the thematic classifications, with subfigure 6(a) highlighting the themes and codes related to activities, and subfigure 6(b) those related to rewards.

Within the *Class* theme, participants reported difficulties both with school materials, such as packing the backpack,



Figure 5. Dynamics with children and adolescents with ADHD. Source: research data.

forgetting to include a necessary notebook, or bringing the wrong materials to class, and with academic responsibilities, such as doing homework, with mathematics frequently cited as a challenging subject. In *Leisure*, the activity coded as “Book” was the most frequently mentioned, indicating difficulty in maintaining interest in reading. The *Self-care* theme, which encompasses hygiene and well-being related activities, included reports of trouble sleeping due to restlessness or sensitivity to light, forgetting to take medication, and challenges with fine motor tasks such as trimming nails. In *House*, participants reported forgetting where pet food was stored, having difficulty cleaning cages due to animal behavior, and struggling to put toys away on high shelves. Finally, in *Autonomy*, participants described difficulties saving money they had received, finding it tiring to wear multiple layers of clothing, and feeling indecisive when choosing what to wear.

The rewards, in turn, revealed motivations related both to immediate pleasure and social recognition. Within the *Autonomy* theme, rewards were associated with the desire for free time to choose activities and moments of silence to escape the daily bustle. These rewards fit the concept of autonomy, as they reflect the pursuit of greater control over one’s own time and space. In the *Technology* theme, rewards involved the use of digital devices, such as watching television (anime, cartoons, action, and animated movies) and using smartphones, mainly for TikTok and YouTube. Some participants reported organizing their daily tasks to secure more phone time, usually limited to one hour per day. In *Recreation*, favorite outing places included shopping malls, parks, and clubs, while frequently mentioned games included tag, hide-and-seek, cycling, playing ball, and board games like Monopoly. They also mentioned an interest in reading, highlighting manga and action, horror, and mystery books. The *Material benefits* theme included gifts such as toys, cars, balls, bicycles, shoes, slippers, clothes, and video games, as well as snacks like apples, mangoes, and hamburgers. Regarding money, some participants mentioned using it to buy sweets or clothes. Finally, in *Social recognition*, praises such as “congratulations” and encouraging expressions including “you did well,” “you are very good,” “I’m impressed,” “you managed it,” and “I’m glad you did that” were highlighted, evidencing the value placed on positive reinforcement.

Among the activities mentioned, the one coded as *Back-pack* was the most frequently cited, appearing in 85% of the

responses. This was followed by activities related to *Bed and Homework* (65% each), *Toys and Room* (60% each), *Brushing* (55%), and finally *Shower* and *Materials* (50% each). Among the rewards, the least mentioned were *Treat* and those created by children/adolescents themselves, while all others were mentioned by more than 50% of participants. Figure 7 presents the distribution of the selected codes, with Figure 7(a) referring to activities and Figure 7(b) showing the distribution of the chosen rewards.

Finally, Figure 8 presents the participants’ choices by age. Regarding activities (Figure 8(a)), children aged 10 and 11 reported difficulties with 21 of the 23 listed activities, with a higher concentration in the themes of *Self-care*, *House*, and *Class*. Participants aged 8 highlighted additional challenges related to *Autonomy* and *Leisure*. Concerning rewards (Figure 8(b)), *Praise*, *Phone*, and *Game* were mentioned by at least one participant from each age group, and together with *Television*, these were the most recurring preferences.

Children and adolescents also expressed their expectations for an application to assist with daily tasks, with the desired features organized into four main themes: *Educational and Motivational Content*, *Appearance and Personalization*, *Entertainment and Connectivity*, and *Task Support*, as presented in Figure 9 alongside their respective codes.

The *Educational and Motivational Content* theme gathered children’s and adolescents’ desire for the application to provide a space to record goals and difficulties, as well as practical suggestions to face daily challenges. It was also suggested that the application link school subjects to careers of interest, include tips about common ADHD symptoms, and offer guidance to help restless classmates in the classroom. Another point mentioned was the importance of enabling integration with school information, such as exam content and class schedules, to support study organization. In the *Appearance and Personalization* theme, suggestions included creating and customizing an interactive character to explain tasks, adjusting or disabling sounds (notifications and interactions), searching content by topic, and watching videos within the application itself. The desired visual style included a colorful, animated, and engaging interface, with blue as the favorite color and the cat as the most cited mascot. The *Entertainment and Connectivity* theme brought suggestions such as rewards for daily use, linking tasks to games, interaction with virtual assistants (such as Alexa), and the possibility to exchange experiences with caregivers directly through the platform. Finally, the *Task Support* theme encompasses tools for routine organization, such as creating schedules and activity reminders.

5.3 Description of the functional prototype and persuasive foundations

Based on the data collected, a functional prototype for Android was developed that integrates the main demands identified by parents and caregivers along with persuasive strategies consolidated in the literature. Table 5 presents these strategies as applied in the development, while Figure 10 illustrates the main screens of the application, including Home, Calendar, and Routines, as well as specific pages for detailing individual tasks and a predefined list of daily activities.

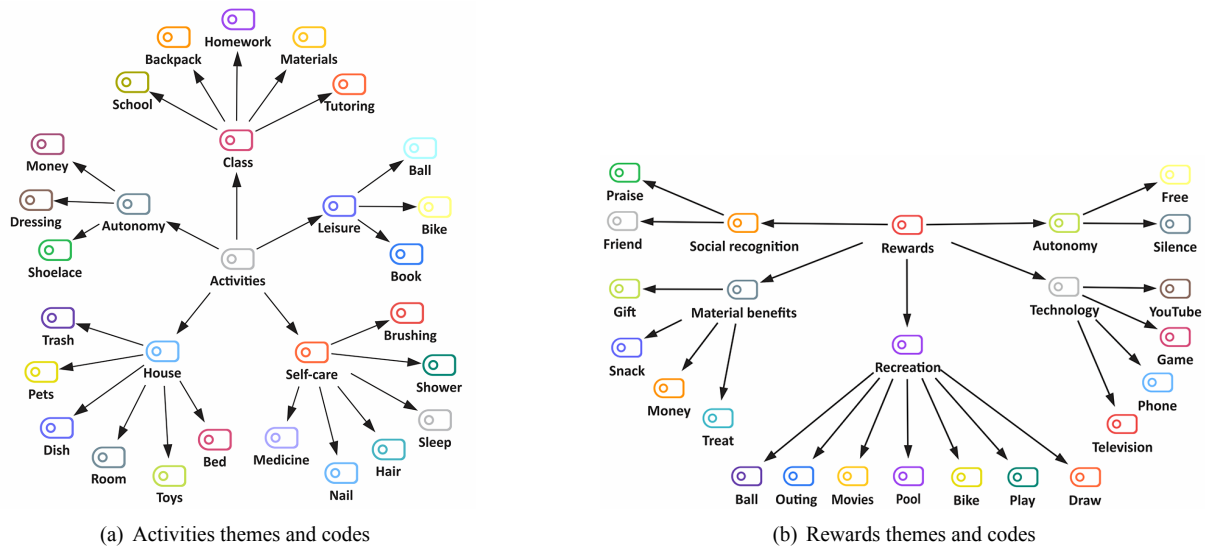


Figure 6. Classification of themes and their respective codes related to activities and rewards. Source: the authors used MAXQDA software.

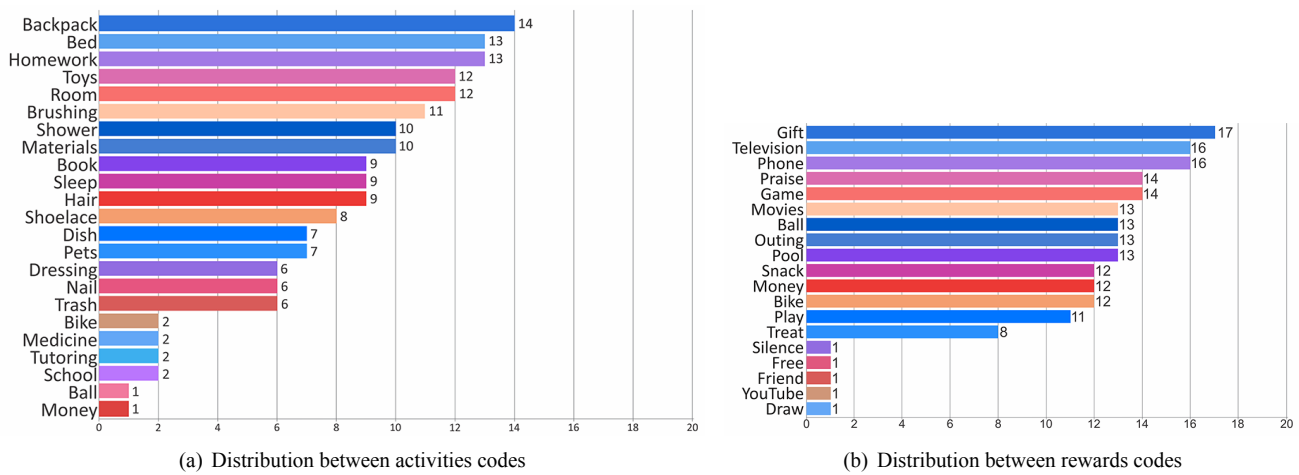


Figure 7. Distribution of respondents' choices among codes related to activities and reward. Source: the authors used MAXQDA software.

Table 5. Set of persuasive strategies used in creating the prototype.

N	Persuasive strategy	Authors
01	Task support	Oinas-Kukkonen and Harjumaa [2009]
02	Dialogue	
03	Triggers	Fogg [2009]
04	Ability	
05	Feedback and Monitoring	Michie et al. [2013]
06	Goals and Planning	
07	Commitment and Consistency	Cialdini [2001]

The Home screen was divided into two versions: one focused on the caregiver's routine, shown in Figure 10(a) with a bluish color scheme, and another dedicated to the child or adolescent's tasks, shown in Figure 10(b) with an orange hue. This color differentiation facilitates the identification of the active profile. It aligns with the task support and dialogue principles of Oinas-Kukkonen and Harjumaa [2009], the triggers described by Fogg [2009], and the commitment and consistency principle of Cialdini [2001], potentially aiding routine organization and user engagement. A button in the upper right corner, symbolized by two arrows and present on all main screens, allows switching between profiles, im-

mediately adapting the layout and displayed functionalities. At the center of the screen, a widget highlights the next calendar event, followed by a list of the day's tasks with an option to filter by period. This direct presentation facilitates task execution and acts as a visual reminder and stimulus for self-regulation, according to the concepts of 1) feedback and monitoring, and 2) goals and planning from Michie et al. [2013]. It also aligns with the ability principle from Fogg [2009] and task support from Oinas-Kukkonen and Harjumaa [2009], by simplifying access to the most relevant actions for the user.

By clicking on a task, the user accesses the Task Status screen, shown in Figure 10(c), where details of the selected activity are displayed. On this screen, it is also possible to edit the task via a pencil icon button located in the lower right corner. Clicking on the event widget directs the user to the Calendar screen, shown in Figure 10(d), designed for recording sporadic appointments such as medical consultations, school meetings, or other activities that are not part of the daily routine. This functionality addresses caregivers' demand for a practical way to view and receive reminders about these events.

The Calendar screen, shown in Figure 10(d), features a

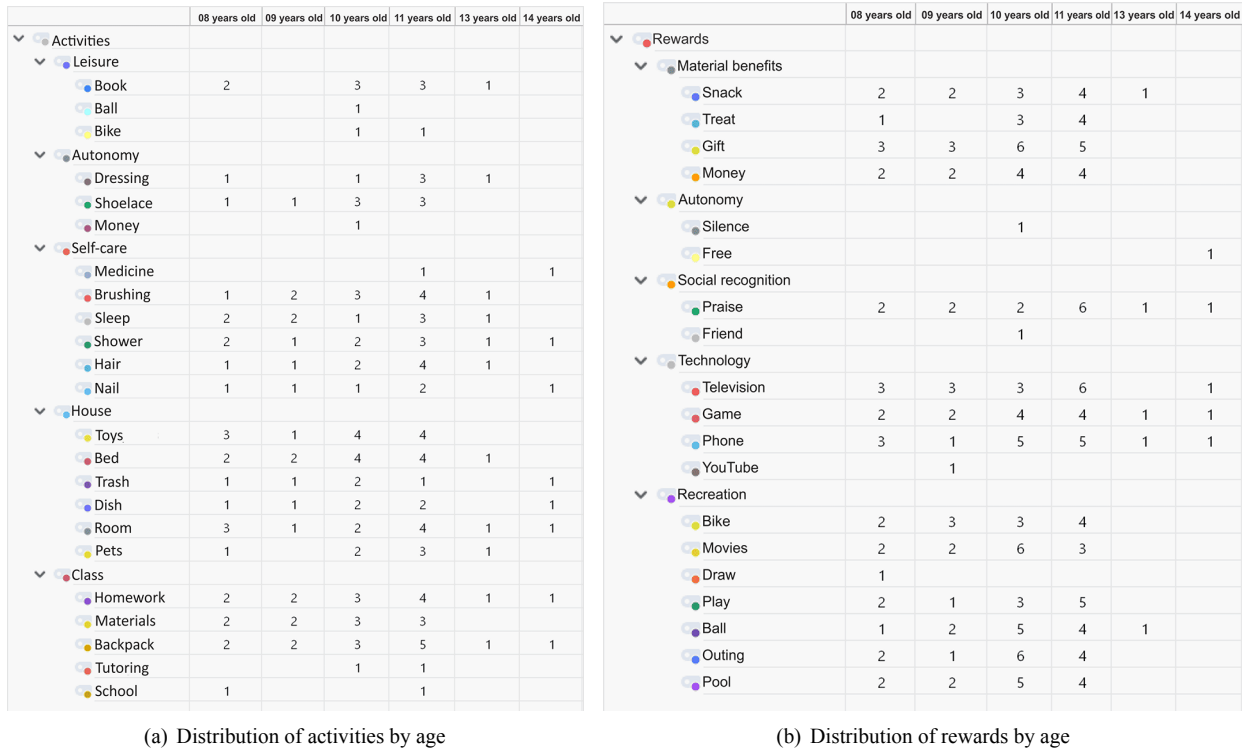


Figure 8. Distribution of codes by age in relation to activities and rewards. Source: the authors used MAXQDA software.

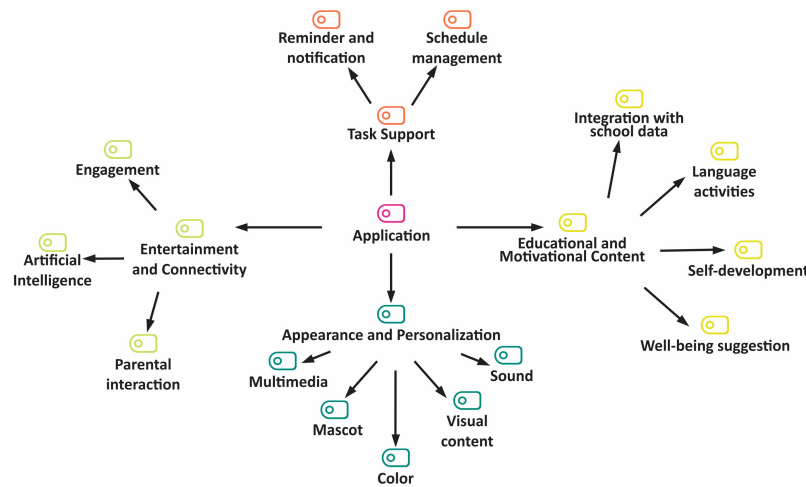


Figure 9. Themes and codes for the features desired by children and adolescents. Source: the authors through MAXQDA software.

monthly view with navigation between months, where days with registered appointments are highlighted in blue. Selecting one of these days displays a widget similar to that on the Home screen, showing event details including date and time. The interface follows the trigger principles proposed by Fogg [2009] by presenting the desired event centrally along with essential event information in a simplified manner, promoting a user-friendly interface aligned with the task support principle of Oinas-Kukkonen and Harjumaa [2009] and the ability principle of Fogg [2009]. This contributes to a smooth experience, consistent with Fogg [2009]’s concept of ability for creating effective systems. Furthermore, the reminder follows the recommendation of Oinas-Kukkonen and Harjumaa [2009]’s dialog category and the triggers of Fogg [2009]. Additionally, the floating button in the lower right corner allows users to add new events, directing them to the form shown

in Figure 10(e). Registered events are indicated by red dots below the corresponding day number in the calendar.

The Routines screen, shown in Figure 10(f), organizes recurring daily activities into three periods of the day: Morning (6 a.m. to 12 p.m.), Afternoon (12 p.m. to 6 p.m.), and Evening (6 p.m. to 12 a.m.). This subdivision follows the recommendation that reminders should be temporally contextualized, which can enhance engagement with tasks [Lentferink et al., 2017]. Additionally, providing filters to segment activities by time of day offers a detailed view of scheduled tasks, simplifying visualization and incorporating the ability and trigger principles of Fogg [2009], as well as the task support principle of Oinas-Kukkonen and Harjumaa [2009]. By selecting a day, the caregiver views pending tasks. For example, in Figure 10(f), Saturday is selected, and the child still needs to tidy their bedroom. In the lower right corner,

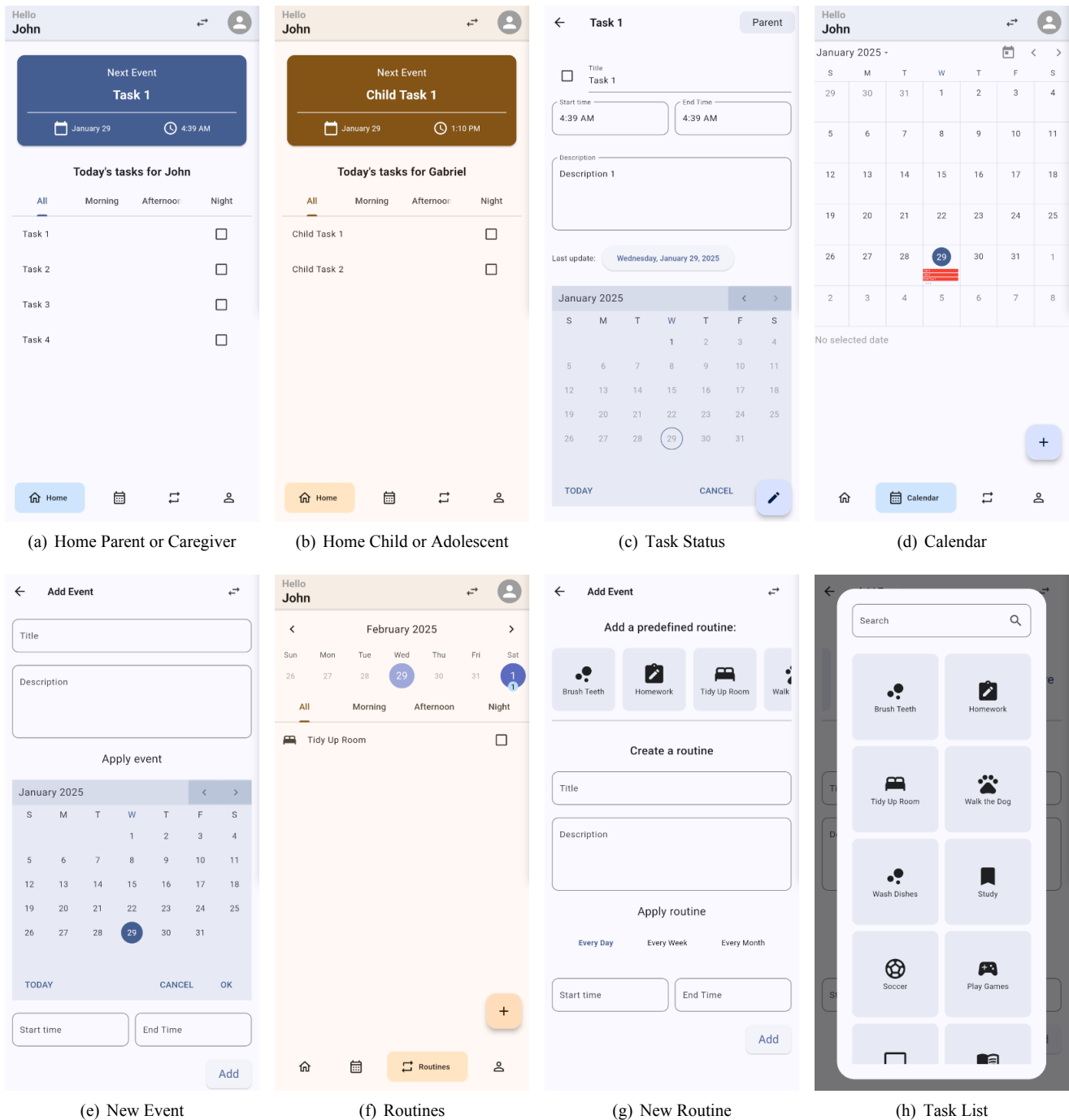


Figure 10. Prototype screens.

a floating button directs the user to the screen for creating a New Routine, shown in Figure 10(g). When adding an activity, it is possible to set the task title and description, as well as choose to repeat it daily, weekly, or monthly, simplifying routine creation within the tool. At the top of the screen, there is a list of predefined activities, shown in Figure 10(h), based on the tasks most frequently mentioned by parents and caregivers during data collection. This feature, combined with the presence of icons and a search box, aims to facilitate routine assembly, aiming to reduce cognitive load and speeding up navigation. The visual elements function as triggers [Fogg, 2009], while the overall interface structure reinforces task support [Oinas-Kukkonen and Harjumaa, 2009] and aligns

with the ability strategy of Fogg [2009].

5.4 Evaluation of the prototype with parents and caregivers

Nineteen parents and caregivers participated in the prototype evaluation, with the vast majority being female (18 women and 1 man). Ages ranged from 25 to 51 years, with an average age of 37. Of these participants, 9 had also contributed during the initial data collection phase. Figure 11 illustrates some moments captured during the prototype evaluation.

Overall, participants reported a positive reception to the application. Three of the nineteen caregivers experienced



(a) Presentation of the prototype (b) Interaction with the prototype

Figure 11. caregivers interacting with the prototype during the evaluation. Source: research data.

initial difficulties with the interface, particularly regarding understanding the routines screen and creating events. The others found the interface intuitive, highlighting its similarity to features in other familiar applications. The simplicity of navigation was noted as a positive aspect, and one participant emphasized that the tool would be useful for monitoring the child's task completion.

During interaction with the prototype, spontaneous suggestions regarding desired functionalities emerged. These contributions were organized into three main themes: *Routine Management*, *Parental Control*, and *Interactivity and Integration*, as illustrated in Figure 12, along with their respective analysis codes.

The *Routine Management* theme includes parents' and caregivers' suggestions regarding the importance of persistent reminders to support task completion, the ability to send photos as proof of activity completion, expanding the list of predefined tasks in the application, and creating a specific space for managing medication use. The *Parental Control* theme gathered suggestions focused on device usage monitoring, including tools to manage screen time, block applications during activities, and a location system to track the child or adolescent in real time. Finally, the *Interactivity and Integration* theme proposed the implementation of gamification elements and a more playful interface to increase engagement among children and adolescents with ADHD. Suggestions also included integration with school data, allowing the sharing of grades and assignments with the tutoring teacher; connection with virtual assistants such as Alexa; and the possibility of exchanging experiences among users on the platform, expanding this space to include not only children and adolescents but also other parents and caregivers.

6 Discussion

6.1 Profile of parents and caregivers

The sociodemographic profile of the caregivers participating in this study reveals aspects that directly influence the design of technologies aimed at supporting families with children and adolescents with ADHD. The majority of caregivers were women, a pattern widely documented in research on parenting in the context of the disorder. Studies indicate that mothers and female caregivers often take the lead in family care and in

seeking treatment and interventions [Craig, 2006; Corcoran and Dattalo, 2006; Gerdes et al., 2021].

The predominance of female participants not only reflects a demographic pattern but may also influence the type of contributions brought to the design process. Research indicates that mothers are usually more involved in the daily care of their children, performing tasks that require planning and continuous monitoring, such as feeding, hygiene, and organizing the school routine [Craig, 2006]. This involvement enables them to describe daily routines and challenges with greater detail. On the other hand, the low participation of male caregivers limits the diversity of perspectives on family routines. Exploring how different types of caregivers interact with supportive technologies, including their motivations, resistances, and usage patterns, remains a promising direction for future studies aiming to broaden the reach and equity of proposed solutions.

In addition to gender, the age distribution of caregivers also proves relevant. Ages ranged from 25 to 80 years, and although adults within an age group more familiar with technology prevailed, the presence of older caregivers demands attention to interface design. Studies indicate that older adults tend to adopt digital technologies more cautiously, valuing simplified interfaces, practical examples of everyday use, and often structured support such as tutorials or in-person assistance [Kebede et al., 2022].

Another important aspect concerns family structure. A significant proportion of caregivers were observed to live outside stable unions, with at least 43.3% of children and adolescents being cared for by a single adult or within alternative family arrangements. These configurations impact routine management and time availability, requiring more flexible solutions that do not assume the joint support of two caregivers. Studies indicate that single-parent families face additional challenges in balancing domestic, professional, and caregiving responsibilities, which affect their ability to maintain stable and sustainable routines [Yorks, 2022].

Finally, nearly half of the caregivers reported having participated in Parental Training, which may indicate a positive predisposition toward adopting new approaches, especially when these are supportive, adaptable, and aligned with the family's reality. Studies suggest that caregivers involved in parenting interventions tend to engage more readily with new strategies, facilitating the acceptance of tools when they are consistent with the lived context [Corcoran and Dattalo, 2006; Gerdes et al., 2021].

6.2 Profile of children and adolescents

Regarding children and adolescents, the predominance of male participants reflects trends in the literature, which indicate a higher prevalence of ADHD diagnosis among boys, especially in clinical contexts [Babinski, 2024]. However, recent studies warn of difficulties in recognizing ADHD in girls, particularly when symptoms manifest in less obvious or disruptive ways [Martin, 2024; Babinski, 2024]. This finding underscores the importance of developing technological solutions sensitive to gender differences, addressing diverse profiles even within contexts of unequal sampling.

The age range between 8 and 14 years considered in this

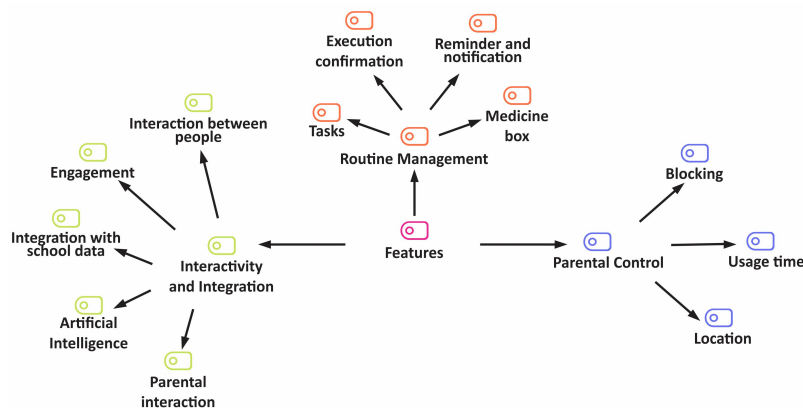


Figure 12. Themes and codes for features suggested by parents and caregivers. Source: the authors through MAXQDA software.

study was appropriate for the proposed objectives. Age-based analyses highlighted relevant nuances, such as children aged 10 and 11 reporting difficulties in a greater number of activities, possibly due to the social, cognitive, and typical changes of this period, as discussed by Vijayakumar *et al.* [2018]. The additional challenges reported by 8-year-old children align with evidence on cognitive and socioemotional development in this age group, which indicates barriers to independent management of commitments [Anderson *et al.*, 2001]. However, consistent patterns were observed in the responses. Activities such as bathing, tidying the bedroom, doing homework, and organizing the backpack were mentioned by at least one participant across all age groups (except for age 12, for which there were no participants), highlighting recurring challenges in daily life. Similarly, rewards such as praise, more screen time, and digital games were valued by children and adolescents of different ages, indicating that both affective and digital stimuli evoke shared interests. Thus, although there are age-specific particularities, there are also common elements that validate the adopted age range. A design that acknowledges this diversity can combine general features with customization options, allowing the solution to address both broad demands and developmental particularities of children and adolescents.

Finally, over 70% of the children and adolescents in the study, according to their caregivers, owned their cell phones, reflecting the increasing familiarity of this age group with smartphones [Cetic.br, 2021; Martín-Cárdaba *et al.*, 2024; Gerosa *et al.*, 2024]. This trend aligns with research highlighting mobile devices as a strategic opportunity for developing self-manageable technologies, especially when combined with parental monitoring and personalization features [Berloffia *et al.*, 2022; Güzel and Öztürk, 2025], reinforcing the importance of mobile solutions that establish a direct connection with children/adolescents.

6.3 Behavioral and functional challenges

The daily challenges reported by the caregivers participating in this study reflect difficulties widely described in the literature on ADHD. Several studies indicate that the main symptoms of the disorder involve difficulties in organization and concentration, often associated with distractibility, directly affecting task planning and deadline management [Bunford *et al.*, 2015; Santos, 2017; Groves *et al.*, 2022;

French *et al.*, 2024; Stefanidi *et al.*, 2024]. These authors also emphasize the role of deficits in executive functions and emotional regulation in these processes, which compromise not only academic performance but also the completion of daily tasks.

Emotionally, children and adolescents with ADHD face significant challenges in dealing with frustrations, criticism, or rejection, situations that can trigger explosive reactions [Ferreira, 2011; Groves *et al.*, 2022]. In addition, they frequently exhibit impulsive behaviors and difficulty following instructions as expected, highlighting the need for additional supervision in various activities [Santos and Vasconcelos, 2010; Santos, 2017; French *et al.*, 2024].

The results of this study confirm many of these findings, revealing significant convergences regarding the challenges experienced by children and adolescents with ADHD. Participants' responses indicate that tasks such as brushing teeth and doing homework are among the most frequently forgotten activities, corroborating the literature [Benczik and Casella, 2015; Irwin *et al.*, 2021; Stefanidi *et al.*, 2025]. The areas of most significant concern among caregivers include School Tasks, Organization and Autonomy, and Personal Care and Hygiene, which together account for more than 80% of the tasks considered most critical, highlighting the main points of attention in the family routine.

Furthermore, the children and adolescents themselves reported difficulties that complement those indicated by the caregivers, such as forgetting to take prescribed medication, trouble sleeping, and challenges in tidying up toys, as well as forgetting school materials and disorganization of personal belongings, aspects supported by the literature [Santos and Vasconcelos, 2010; Ferreira, 2011; Yoon *et al.*, 2012; Cortese *et al.*, 2013; Bunford *et al.*, 2015; Santos, 2017; Groves *et al.*, 2022; French *et al.*, 2024]. Other details mentioned include difficulties caring for pets and indecision about what to wear, aspects not found in the literature that broaden the understanding of the daily challenges they experience.

This compilation of information contributes to a deeper understanding of the needs and challenges experienced by children and adolescents with ADHD, potentially supporting the development of more effective solutions tailored to the realities of these families, such as applications or support strategies that facilitate the completion of daily tasks, promoting greater engagement and autonomy [Stefanidi *et al.*, 2024,

2025; Nieterau et al., 2025].

6.4 Shared forgetfulness and hereditary aspects of ADHD

A relevant finding of this study concerns the recurrence of forgetfulness and organizational difficulties among both parents/caregivers and children and adolescents with ADHD. When asked about which family routine tasks they tend to forget, adults most frequently mentioned school activities and daily routine aspects. Similarly, when reporting tasks that require more effort or are often overlooked by children and adolescents, caregivers themselves highlighted categories such as schoolwork, organization, autonomy, and personal care.

This overlap of difficulties may be related to the high heritability of ADHD, reflecting traits of the disorder also present in caregivers, even at subclinical levels. Beyond genetic predisposition, the family environment and parenting styles directly influence how symptoms manifest and are managed.

Such evidence reinforces the importance of recognizing caregivers not only as mediators of child behavior but also as individuals who face challenges related to attention, memory, and organization. In this regard, digital solutions aimed at ADHD should consider this expanded family dynamic, addressing both support for the child and the facilitation of adults' daily lives, as proposed by Thennakoon et al. [2020].

6.5 Rewards, motivation and engagement

The responses of children and adolescents with ADHD, as well as those of their parents and caregivers, reveal a strong preference for immediate and visual rewards, such as extra screen time and games. From a neuropsychological perspective, studies show that children with ADHD frequently demonstrate aversion to delay and preference for immediate rewards, even if of lesser value [Mokobane et al., 2020; Mphahlele et al., 2021].

Positive reinforcement supports the development of planning, organization, and information retention, aspects commonly impaired in the ADHD [Musullulu, 2025]. However, the effectiveness of these strategies depends on the relevance of the reward to the child. Rewards that are insignificant or disconnected from their interests can hinder persistence when facing challenging or frustrating tasks. Studies on frustration tolerance suggest that children with ADHD are less likely to persist in the face of obstacles and exhibit greater emotional reactivity when they do not perceive clear returns for their effort [Seymour et al., 2019].

In addition to technological rewards, both groups mentioned incentives such as outings, toys, snacks, and treats. The preference for concrete and immediate gratification rewards is consistent with the delay aversion profile widely documented in the literature on children with ADHD [Mokobane et al., 2020; Mphahlele et al., 2021].

Another point of emphasis concerns the role of verbal praise, which was cited by children and adolescents as a motivating reward, highlighting the importance of affective recognition. Parents, in turn, also reported frequent use of praise as an incentive strategy. This finding reinforces evidence that

social and emotional reinforcement, mainly when supported by consistent affective bonds, promotes self-regulation, self-esteem, and the emotional and behavioral development of children with ADHD [Claussen et al., 2024; Nieterau et al., 2025].

These findings support that design strategies based on personalized rewards, whether material, digital, or social, can be effective in promoting engagement and adherence to routines. However, the children/adolescents themselves must participate in the process of defining the rewards, ensuring that they are perceived as meaningful and motivating. Active participation in this process contributes not only to engagement but also to the development of autonomy and a sense of control, which are fundamental aspects in the daily management of ADHD [Groves et al., 2022; Musullulu, 2025].

6.6 Participants' expectations and interaction with the prototype

The responses of children and adolescents regarding what they would like the prototype to include revealed a set of expectations characterized by autonomy, playful experience, and personalization. The codes that emerged from their statements indicate a desire for an application that fosters creative exploration and personalized learning tailored to their individual preferences. Elements such as vibrant colors, interactive mascots, and adjustable sounds reinforce the pursuit of a visually engaging and sensory environment. Additionally, functionalities aimed at self-development and daily school life were suggested, signaling a forward-looking perspective and attention to the educational context. The presence of videos and content organized by theme points to a preference for interactive audiovisual strategies. Finally, entertainment and connectivity were also valued, with suggestions encompassing aspects such as rewards, virtual assistants, and interaction with caregivers within the platform. These proposals reveal an interest in a more interactive and connected experience that promotes both engagement and dialogue with the family environment.

During the initial data collection, parents and caregivers, who still didn't have access to the prototype, emphasized the need for effective alarms and reminders, both audible and visual, to support the management of their children's daily routines. They also mentioned a desire for playful engagement mechanisms, such as rewards and games with level progression. The organization of the routine was extensively detailed, including domestic chores, school activities, and leisure time. Finally, they emphasized the importance of family interaction, mentioning functionalities that promote communication between caregivers and children.

The expectations of children/adolescents and their caregivers highlight the importance of a design that balances autonomy and support. While young users prioritize personalization, playfulness, and connectivity, showing interest in rewards, mascots, virtual assistants, and interactive videos, adults emphasize routine organization and the use of reminders. These demands align with the literature, as personalized stimuli and gamification enhance engagement and motivation [Matthews et al., 2016; Alhasani et al., 2022; Adaji and Adisa, 2022; Silva et al., 2023], while alarms, vi-

sual schedules, and positive reinforcement effectively support routine management and strengthen executive functions [Kyrakaki and Driga, 2023; Wong *et al.*, 2023]. Furthermore, the emphasis on a visually attractive and intuitive design reinforces the importance of aesthetic aspects for usability and continued use [Matthews *et al.*, 2016]. Thus, the design challenge lies in integrating these expectations into a flexible, functional, and contextually sensitive solution tailored to the familial and educational setting of ADHD.

After interacting with the prototype, caregivers presented new perspectives. Their suggestions increasingly emphasized aspects related to supervision, safety, and parental control, such as a medication box, task completion confirmation, app blocking, real-time location tracking, and usage time control. Additionally, a proposal emerged for a network of interaction among parents and caregivers, indicating that the application could serve not only as a support tool for children but also as a space for exchange and support among adults. These functionalities align with persuasive strategies such as Triggers [Fogg, 2009], Commitment and Consistency [Cialdini, 2001], Feedback and Monitoring [Michie *et al.*, 2013], and Social Support [Oinas-Kukkonen and Harjumaa, 2009], as they encourage repeated actions, foster a sense of responsibility, provide visibility over the child's progress, and expand the role of the application by transforming it into a collaborative space that strengthens engagement and the sharing of effective educational practices.

Regarding routine management, previously mentioned topics such as reminders and task organization remain prominent, but with more functional suggestions, including the creation of persistent alarms and the expansion of task lists. Furthermore, the continued emphasis on the use of rewards and games as motivational strategies demonstrates ongoing appreciation for gamification and positive reinforcement.

During the prototype evaluation, although caregivers generally demonstrated positive receptivity and found the interface intuitive, some users experienced difficulties navigating specific screens. This situation highlights the need to include clear and accessible tutorials or instructions, which can be especially helpful for older users who tend to value this type of support [Kebede *et al.*, 2022].

Finally, the comparison between the initial expectations and the post-interaction suggestions reveals both consistency and evolution in the caregivers' demands. This analysis highlights the app's potential to evolve from merely a functional tool into an integrated platform that supports daily organization, learning, and the strengthening of family bonds. Although the prototype includes various desired features, there remain opportunities to enhance its personalization, integration, and parental support capabilities.

6.7 Ethical implications and risks in the use of digital technologies

The widespread presence of mobile devices among the children and adolescents in this study underscores the potential of digital technologies as support tools for the daily lives of families with ADHD. However, frequent and prolonged use of these technologies also raises significant concerns that must be taken into account in the development of responsible

digital solutions for this population.

Recent studies indicate an association between ADHD symptoms and problematic use of digital media, suggesting a bidirectional relationship in which excessive consumption tends to exacerbate symptoms over time, while higher symptom levels also increase the likelihood of excessive use [Wallace *et al.*, 2023]. Meta-analyses reveal moderate correlations between impulsivity, inattention, and excessive internet use, with a greater impact on impulsivity and hyperactivity [Augner *et al.*, 2023], as well as a higher propensity for internet gaming disorder among children with ADHD [Berloffia *et al.*, 2022], especially in contexts of low parental supervision [Güzel and Öztürk, 2025]. Digital games, with their rapid stimuli and frequent rewards, amplify such impacts, creating a multiple-risk scenario for this population, including compulsive patterns mediated by dopaminergic reward mechanisms [Weinstein and Lejoyeux, 2020]. Furthermore, intensive use of social networks has also been associated with worsening ADHD symptoms [Wallace *et al.*, 2023].

In this context, it becomes essential to adopt a balanced and ethical approach when designing digital solutions aimed at children/adolescents with ADHD. Although features such as digital rewards, reminders, and visual reinforcements can enhance engagement and promote adherence, their indiscriminate use may trigger compulsive behaviors and dependence. Meta-analyses indicate positive effects of digital interventions, including moderate improvements in ADHD symptoms [He *et al.*, 2023]. However, for these benefits to be realized safely, technologies must adhere to strict criteria of transparency, security, and the promotion of child autonomy.

Furthermore, the use of persuasive technologies with vulnerable populations, such as children with ADHD, requires careful attention to relevant ethical dilemmas. Researchers argue that computational persuasion strategies must consider the principle of non-maleficence and the risks of manipulation, especially when targeting users with lower self-regulation capacity [Berdichevsky and Neuenschwander, 1999; Jacobs, 2020; Calvaresi *et al.*, 2025]. It is necessary to ensure explainability and clear limits for persuasive interventions to avoid violations of autonomy and adverse effects on socio-emotional development.

In this regard, although the prototype developed in this study currently focuses on the interface for parents and caregivers, its evolution towards a version intended directly for children and adolescents should include self-regulation features, establish limits for persuasive stimuli, promote balanced personalization combined with parental supervision, and encourage awareness of technology use [Jacobs, 2020; Weinstein and Lejoyeux, 2020; Calvaresi *et al.*, 2025]. Thus, the application can maximize its functional and therapeutic benefits while minimizing ethical risks and negative impacts associated with compulsive use of digital technologies.

7 Final considerations

This study investigated the challenges faced by families of children and adolescents with ADHD in managing daily routines, exploring the potential of persuasive technologies as allies in this process. Based on a user-centered approach

guided by the extended UCD model, it was possible to identify distinct and complementary needs among different user profiles, reinforcing the importance of flexible solutions that balance child autonomy with parental support.

Although some findings resonate with results already described in the literature, this study offers an original contribution by addressing the topic within the Brazilian sociocultural context, which remains underrepresented in HCI research focused on ADHD. This contextualization lends relevance and timeliness to the investigation, broadening the scope of the field by highlighting specific practices, values, and challenges that influence families' experiences with (or without) technologies supporting routine management. Thus, the research not only validates previous findings but also reinterprets them through a diverse and underexplored reality, underscoring the importance of context-sensitive approaches.

By integrating concepts of persuasive design and mediated interaction, this work advances the development of technologies that are more attentive to neurodiversity and the multiple cognitive, emotional, and relational dimensions involved in daily care. Unlike most initiatives in the field, this study includes a critical and grounded reflection on the role of persuasion in the context of ADHD. This discussion, often absent from related research, is essential to guide more conscious design choices aligned with ethical principles, particularly when working with vulnerable populations, where risks of manipulation and dependency must be prevented. In this sense, the theoretical contribution of this study is expressed in the articulation of the foundations of HCI, persuasion, and ethics, connecting them to the real challenges faced by families with children and adolescents with the disorder.

In contrast, the practical contribution lies in the prototyping of a solution targeted at caregivers. Taken together, the features of the functional prototype reflect an effort to balance usability, practical relevance, and theoretical foundation. The goal is to provide an accessible and intuitive solution that can promote parental engagement in planning and monitoring the family routine. The design elements, screen organization, and customization features were designed to reduce cognitive load, facilitate navigation, and encourage daily activities, helping to form habits and develop a more structured routine. This prototype, therefore, represents an initial step toward creating a tool that combines technology and scientific knowledge with the real-life context of families of children and adolescents with ADHD.

7.1 Limitations and future work

Among the limitations, the concentration of the sample in a single location stands out, restricting comparisons across different regional contexts. An imbalance was also observed in the participants' profiles, with a predominance of mothers with medium/high educational levels, a small number of fathers, only one girl diagnosed with ADHD, and uneven representation across age groups, with no children aged 12. These characteristics limit the breadth of perspectives captured, underscoring the need for future studies with more diverse and representative samples.

Additionally, it was not identified whether all caregivers were biological parents, an important aspect given the hered-

ity of the disorder, highlighting a gap to be explored in subsequent studies. The ADHD presentations (predominantly inattentive, hyperactive-impulsive, or combined) were also not considered, which could have contributed to a more personalized design aligned with variations in the profile.

Another relevant point is that only some of the participants involved in the prototype evaluation had participated in the initial data collection, which may have limited the continuity and depth of collaboration. Moreover, although the study followed the principles of extended UCD, it was not a complete co-design process, as users were not directly involved in conceiving the prototype. Incorporating co-creative stages in the future could enhance engagement, especially in developing the interface for children and adolescents, leading to solutions better tailored to their needs and preferences.

Regarding technology use, although children's access to smartphones was identified, the study did not delve into their actual usage patterns or the participants' level of familiarity with digital technologies, issues that could be further explored in future research.

Given the limitations identified, the following stages of the project aim to deepen and refine the findings of this study by broadening the diversity and representativeness of participants, with particular attention to variables such as gender and parental role, and by incorporating co-creation practices into subsequent phases. The overarching goal is to foster more active user engagement in the design process, thereby supporting the development of solutions that are more closely aligned with their realities and specific needs.

In this sense, the following guidelines are proposed for the continuation of the project: (1) investigate functionalities that foster positive parental interaction; (2) enhance the interface designed for parents and caregivers, based on feedback collected during the validation phase; (3) develop and validate a specific interface for children and adolescents with ADHD, taking into account their cognitive and emotional needs as well as the persuasive aspects of the interaction, to encourage engagement and adherence without inducing harmful behaviors or overload; (4) implement and evaluate the complete application in real-world usage contexts, integrating the interfaces designed for both target groups; and (5) make the solution publicly available to broaden its reach and social impact, to promote the well-being of families living with the disorder.

Declarations

Authors' Contributions

Caroline R. S. Jandre: Methodology; Development of research instruments; Data collection and analysis; Prototype design; Writing, review and editing of the text. Fernando C. S. Dal' Maria: Data collection and review; Prototype design and development; Writing, review and editing of the text. Débora M. de Miranda: Supervision of data collection; Review and editing of the text. Cristiane N. Nobre: Supervision of the research; Review of the research instruments and collected data; Review and editing of the text.

Competing interests

The authors declare that they have no competing interests.

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Availability of data and materials

The datasets and the prototype software generated and analyzed in this study will be available upon request.

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