# Mobilna aplikacija za podporo samostojnosti na področju vsakdanjih rutin mladostnikov z avtizmom in/ali ADHD

# Mobile Application to Support Independence in Daily Routines of Adolescents with Autism and/or ADHD

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## Abstract

To support increased independence among adolescents with impaired executive functions, especially those with autism and/or ADHD, we developed, tested, and evaluated a pilot mobile application. Based on theoretical foundations, our own research, and expert recommendations, the app offers visual and time-based structuring of routines, tracking progress through a *Pomodoro* [1] timer and a reward system. The application was tested over 14 days by 12 adolescents and 2 young adults (11 male, 3 female): 6 with autism only, 1 with ADHD only, and 7 with both, using their own smartphones or tablets. After the trial users rated its usability, benefits, and motivational impact very positively, with special praise for the innovative real-time visual timer (calendar) that improves time awareness. They also suggested additional features, such as audio alerts outside the app, integration with other digital tools, and various forms of rewards. This analysis of the pilot version calls for further research with more users facing executive function challenges, including those transitioning to independent living for the first time while studying or working, and longer-term monitoring of app usage to assess its effectiveness.

## Keywords

Adolescent independence, digital support, mobile application, executive functions, autism, ADHD

## 1 Introduction

Adolescents with autism and/or ADHD, despite average or high intellectual abilities, often struggle with daily tasks due to impairments in *executive functions* such as planning, organization, self-control, and self-regulation [3, 4, 5]. These difficulties include poor behavioral adaptation and issues with inhibiting behaviors [6], affecting organizational skills [7] and the performance of everyday tasks such as morning routines, hygiene maintenance, money management, and keeping things in order [8, 9]. As a result, these adolescents often rely heavily on parental support, which hinders their independence and creates family tensions [10]. To ease the transition to independent living, adolescents need tools that provide visual support and help with time management through reminders. Mobile apps, a readily accessible support form, can boost adolescent independence and reduce parental strain [11]. However, many existing solutions lack empirical evidence on their effectiveness [12]. Involving adolescents in developing these tools increases their motivation, trust, and engagement [13, 14].

*Autism*, with a prevalence of 3.8% in children in the USA in 2020 [15], is medically defined as a spectrum of disorders in social communication, interaction, and repetitive behaviors [5]. The social model and neurodiversity theories, however, view autism as a neurological difference, a natural variation in brain development, with both challenges and strengths, many of which are socially conditioned [16, 17]. With appropriate support, individuals with milder impairments can live independently, aided by technologies that enhance self-monitoring strategies, communication, and social interaction [18, 19].

*Attention Deficit Hyperactivity Disorder* (ADHD), a developmental neurological condition, involves difficulties with attention, hyperactivity, and impulsivity, impacting functioning in various environments [5]. Diagnosed in 5.6% of youth aged 12 to 18, ADHD often co-occurs with autism [15]. Digital support can help improve self-regulation, attention, and task optimization in individuals with ADHD as well [20].

The aim of this research was to develop, test, and evaluate a mobile application designed to support adolescents with autism and/or ADHD in independently carrying out everyday routines. We set three objectives: (1) to identify the challenges and needs of adolescents with autism and/or ADHD in becoming independent in daily routine tasks, (2) to develop and test a mobile app to support their independence in organizing and performing such routines, and (3) to assess the usability of the developed mobile application.

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[1] Pomodoro (Italian for "tomato") is a timer used in mobile apps, based on a time management technique with work intervals and short breaks, developed by Francesco Cirillo in the 1980s. The name comes from a tomato-shaped kitchen timer Cirillo used [2].

To achieve the first goal, we prepared two questionnaires (for parents and adolescents) and included 12 families with 11 adolescents aged 13 to 16 and one young adult (aged 19), diagnosed with autism and/or ADHD. We found that perceptions of challenges in completing tasks often differed between adolescents and parents. While adolescents believed they completed most tasks independently, parents emphasized the need for constant prompting and help in structuring activities. Both groups reported challenges in attention, forgetfulness, motivation, and time perception, especially during school learning. Adolescents often experience parental supervision as burdensome or unnecessary, which leads to conflicts. Personal responses revealed inner struggles such as anxiety, impulsivity, and, among girls, perfectionism, indicating a need for a more sensitive and individualized approach.

## 2 Development of the Mobile Application *Pica*

For the second objective, we aimed to develop a mobile application to support the independence of adolescents with autism and/or ADHD, based on both theoretical and empirically identified needs. During its design and development, we carefully considered expert guidelines for creating such applications and actively involved adolescents, who made significant contributions to the content and functionality.

### 2.1 Analysis of User Needs and Desires

Every development process starts with analyzing user needs [21]. We summarized these needs based on expert literature on organizational challenges for adolescents with autism and/or ADHD, and supplemented them with our own research from questionnaires for adolescents and parents (first objective). From the synthesis of both sources, we identified three key challenges: (1) difficulties with organizing and executing routines, (2) poor time awareness, and (3) dependence on parental reminders. These challenges guided the design of the application: (1) structuring daily activities, (2) visual time representation, and (3) reminders and motivation for less preferred tasks. Upon reviewing and testing a sample of existing applications for organizational and time orientation support, we found that while these applications offer similar features, they do not provide users with a clear sense of task duration and available time in a day. Therefore, we placed the development of time awareness at the core of our application.

Adolescents involved in the study played a key role in shaping the application. They were invited to give suggestions through semi-structured interviews during a focus group on the Zoom platform. Suggestions included gamification and rewards, direct voice interaction with the app, collaboration with parents on assigned tasks and work quality, visual customization based on individual needs, time adjustments, and reminders to improve focus. These suggestions were analyzed and meaningfully incorporated into the app's development within available resources.

### 2.2 Expert Recommendations

Boulton et al. [22] in the first systematic review of mobile applications and digital resources for children with developmental difficulties concluded that there is a lack of methodologically sound research on the effectiveness of digital interventions for adolescents with autism and ADHD, which complicates to provide the expert recommendations to families with respect to apps or digital resource. Powell et al. [23] evaluated ten popular applications for children with ADHD and found that they do not meet users' complex needs and are not methodologically well evaluated.

The development of quality digital interventions requires collaboration with experts and users, supported by health, academic, and governmental institutions [14, 22]. Despite limited evidence of effectiveness, research emphasizes the importance of appropriate content, user interface, reminders, and interactive conversational assistants [14], as well as co-creation with adolescents, which enhances their trust and motivation [13, 14].

Based on discussions with clinicians and adolescents, Powell et al. [23] outlined the following guidelines for designing apps for adolescents with ADHD: (1) Apps should have a simple interface for easy use. (2) They should be visually attractive and content-related to users' experiences and challenges. (3) They should address symptoms, such as managing inattention, hyperactivity, and impulsivity, while offering strategies to improve organizational skills. (4) Content and language should be age-appropriate. (5) A reward system should be included to encourage regular use. (6) Apps should promote users' social development rather than hinder it.

We followed these recommendations as closely as possible, considering research limitations and the project's goals. Some recommendations, such as the interactive conversational assistant, were not implemented due to technical and financial constraints. Additionally, we did not include features for promoting social relationships, as this goes beyond the scope of the research.

### 2.3 Application Development and Description

Based on the identified needs and expert recommendations, as well as adolescents' desires, we developed a pilot mobile application with the working title *Pica*, designed to support adolescents with autism and/or ADHD who struggle with executive function deficits, particularly in planning and executing daily routines and managing time orientation.

*2.3.1 Development Environment of the Pica App* We developed the *Pica* app using the Flutter framework and the Dart programming language, which allows for the development of applications for both Android and iPhone. The application can also be run on personal computers or as a web application. For Apple devices, Xcode must be installed, and for Android devices, Android Studio. The program code, consisting of approximately 8,300 lines, was designed, programmed, tested, and debugged in Microsoft Visual Studio Code from October 2024 to May 2025.

*2.3.2 Access to the Pica App.* For Android devices, the application is available as the installation file *pica<version_num>.apk*, accessible at the following link (which also includes a detailed description of the app in Slovene): https://drive.google.com/drive/folders/1j2hlxfSmtJzRlObZDOdpsX90jl3cIAaF.

For iPhone devices, the application is available on the App Store. Since the name *Pica* was already used, we symbolically named the app: *Pizza Pomodoro Time*, available at: https://apps.apple.com/si/app/pizza-pomodoro-time/id6745557246.

*2.3.3 Description of the Pica App.* The name has a double meaning: (1) It is an acronym in Slovene for "Support for the Execution of Target Activities" (in Slovene: *Podpora Izvedbi Ciljnih Aktivnosti*). (2) Visually, the app resembles a sliced pizza. As a symbolic motivational reward for successfully completed routines, we also included a pizza-building mechanism: each task within a routine represents one slice of pizza.

Due to atypical time perception in adolescents with autism and/or ADHD, especially in estimating time intervals [24, 25], we developed an innovative digital calendar (Figure 1, left). This calendar, in the form of time strips, enables real-time visual monitoring of time and supports event sequence understanding. It is color-coded, adjustable (stretchable/compressible), and allows customization of time units (year, month, day, hour, minute, second) (Figure 1, middle).

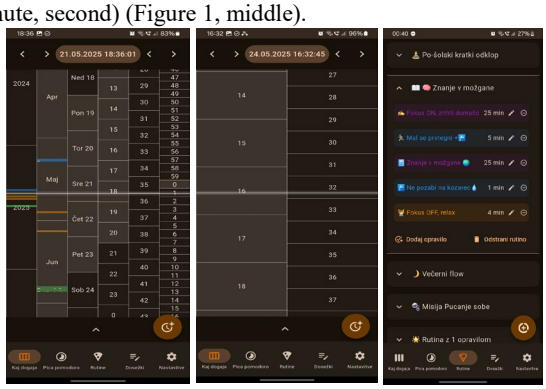

**Figure 1: Screenshots of: linear calendar with time tracks (left), adjustable time unit display (center), routine-creation page (right)**

For supporting weak organizational skills, the application includes routines made of consecutive tasks with defined durations but no fixed start or end times (Figure 1, right). When the first task begins, the *Pomodoro timer* starts (Figure 2, left). Visual cues, color coding (lighter shades for elapsed time), and sound alerts encourage timely completion. Each completed task is marked, and the user is rewarded with a slice of pizza (Figure 2, middle). Upon completing the entire routine, a visual-audio congratulations message is displayed (Figure 2, right), along with the full pizza as a reward. This system enhances focus, improves planning, and encourages consistent daily routine execution.

**Figure 2: Screenshots of: routine execution page (left), reward page (middle), visual-audio congratulation message upon completing a routine (right)**

## 2.4 Testing of the App and Usability Evaluation

The application was tested for two weeks. We invited participants from the first phase of the research, along with additional families, resulting in 14 participants: 12 adolescents (aged 13–16; 10 male, 2 female) and 2 young adults (male, 19; female, 28). During personal interviews, we introduced the app's functionalities to them, clarified testing expectations, and checked whether the application was successfully installed.

After the testing, two questionnaires (for adolescents and parents) were administered to assess the usability of the *Pica* app and to achieve the third research objective. All adolescents (n=14) rated the app positively based on their initial impressions. They described it as useful, modern, interesting and convenient, although a bit complex initially. They highlighted its assistance in organising daily tasks and recognized its potential.

More than half of the adolescents used the pre-set routines or modified them, which shows their supportive value. Those who created their own routines (almost half entered at least three) emphasized the need for even more customisation, for example enabling to copy tasks or entire routines. It emerged that we should more explicitly encourage parental involvement in planning rouitnes, as this was taken too much for granted. However, the high number of routines created indicated the potential of the app for structuring the day. It would be beneficial to allow more time for the roll-out and to provide additional user support.

Adolescents and parents rated the app's functionalities on a 5-point Likert scale. Most rated all features highly (4 or 5), with particular praise for the innovative calendar. Most also agreed that the rewards motivated them to use the routines daily. However, 13 out of 14 participants missed reminders when leaving the app. Parents positively evaluated key functionalities: 85% highlighted the importance of sound alerts and colours, and the same percentage said that the calendar in the form of moving timelines was visually more effective than a traditional one.

Adolescents and parents also assessed the app's usability for challenges such as planning, time orientation, independence, studying, tidying up, and evening routines. Most adolescents (9/14; 64%) and parents (12/13; 93%) believe the app improves planning and task execution. The majority also noted improved time awareness (adolescents 79%, parents 85%), greater independence (71% adolescents, 85% parents), and faster evening routines (71% adolescents, 92% parents).

For learning challenges, half of the adolescents reported better concentration, with 39% of parents felt the opposite. Opinions were divided on motivation to learn: 36% of adolescents felt the app could not help, while 61% of parents disagreed. When it comes to tidying up the room, 62% of parents and 43% of adolescents find the app useful.

Overall, the analysis shows that both adolescents and parents recognize the *Pica* application as a promising tool for supporting organization, daily tasks, and time orientation, which can foster greater independence and reduce reliance on parental support.

## 2.5 Suggestions for Future Development

We gathered opinions and suggestions for the future development of the *Pica* app at each developmental stage. Initially, we asked participants about their functional

expectations, which we incorporated into the app's development. During testing, they provided feedback and improvement suggestions. Afterward, we collected their opinions via questionnaires, including open-ended questions about perceived strengths and suggestions for further development.

The most frequent suggestions for improvement included the desire for sound alerts that would work outside the app, which was proposed by nearly all participants. This functionality would help to remind users to start a routine and to maintain their attention during the routine. Suggestions also included better integration with other tools, such as alarms and calendars, and synchronization with educational platforms (e.g., e-Assistant) and family apps for greater control over data input (e.g., FamilyLink and FamilyWall).

Additional suggestions include integrating calendar events with the pomodoro timer for better task planning, increasing the variety of rewards, enabling task copying, and changing the visual design of the app to keep it engaging for users.

For further development, it would be sensible to test the app with more users over a longer time period, to involve additional programmers in the development to manage the complexity of the code, and to look for funding opportunities through project calls in the field of digital support for mental health. With additional resources and development opportunities, the app could include additional functionalities such as gamification, integration with e-Assistant, diary notes, user choice rewards, and integration with other digital tools and applications to further improve user experience and support effectiveness.

## 3 Conclusion

Adolescents with autism and/or ADHD face numerous challenges due to weak executive functions, making it difficult for them to develop independence, follow routines, organize tasks, and manage time. To help overcome these challenges, we developed and tested the *Pica* mobile app, which supports the organization of daily life, and we analyzed its effectiveness.

In conclusion, the *Pica* app has already successfully fulfilled its primary purpose in the pilot version, as it has been evaluated as a valuable support for the participating adolescents with autism and/or ADHD in their daily routines. The development of the pilot application could be continued, upgraded, and eventually included as a assistive technology in the daily life of neurodiverse adolescents or individuals with executive function challenges. The app also has potential for a wider range of users who could benefit from such a tool to organize daily tasks and improve time awareness with an innovative real-time calendar.

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