What's next? Development of a smartphone visual planner designed for ease of use by adults with intellectual disabilities and autism

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Introduction

Visual planners or schedules can be used with people who have difficulties in understanding associated with conditions such as autism spectrum condition (ASC) or intellectual disability (ID). They prompt users about the activities or tasks they will be undertaking in order to help reduce anxiety and confusion and assist users to participate in the activities they are offered. Planners can be realised in physical form for a user to engage with; they can also be realised in computer-based or mobile applications. Symbols, images and text can be used in the user interface, which should be designed for simplicity and clarity in order to make it accessible and comprehensible. Visual information about activities should be uncomplicated and language used should be clear. The development of a prototype mobile visual planner application for people with ASC and ID is described here.

Visual planners

Some visual planners can be too complex for people with ASC and ID. They can have 'busy' interfaces with many items displayed, e.g., a full day's schedule of activities on one detailed page. Previous activities might remain on display, marked as 'completed', while multiple upcoming activities are listed to show everything that remains to be done. Symbols and icons might be present, with strong colours and contrasts used. The overall effect of such a display can be confusing and over-stimulating for people with ASC and ID.

A project was therefore devised to develop a mobile visual planner application (app) which could show its user what was currently happening and what task or activity should happen next, while minimising visual distraction and over-stimulation caused by excessive information and display content. This paper hence discusses:

- the development of a prototype smartphone app designed to help people with Autism Spectrum Condition (ASC) and Intellectual Disabilities (ID) to follow the schedule of their day;

- trial of the developed technology with people with ASC and ID and their carers.

Background

Visual supports and scene-based systems offer a variety of ways for assisting people with disabilities and communication difficulties (Alm *et al*., 1998). Visual supports and planners have been shown to be beneficial in helping to reduce anxiety and confusion among users with ASC and ID, for example, while enhancing their independence (Dettmer et al., 2000; Radi, 2017). Visual activity schedules have been shown to be effective with people with ID (van Dijk & Gage, 2019). They can be seen as examples of augmentative and alternative communication (AAC) used to support understanding (Beukelman & Light, 2020). Recommendations have been developed on the design of user interfaces for people with ASC (Pavlov, 2014), including developments for text simplification and enhanced reading comprehension (Pavlov *et al.*, 2016). An interactive scheduling system was designed to support classroom activities for children with autism in elementary school classrooms (Hirano *et al.*, 2010) and user interface design for children with autism has been investigated in the context of touchscreen assistive technology for the teaching of numeracy and calculation (Kamaruzaman *et al*., 2016). A tablet-based application for activity schedules was designed for children with autism spectrum disorders; children exhibited increased socio-adaptive behaviours in classroom, with more classroom and communication routines performed correctly (Fage *et al.*, 2014). From such previous work, and exploration of other planner and scheduler applications for people with ASC and ID, plans were assembled for the current project.

Aim of Development

The developed planner would enable a carer to create a day schedule with multiple activities for the app user to perform. The user would then see and follow the schedule. The app would avoid overloading the user with too much information and there would be options available to limit the amount of information on display at one time. The user interface needed to be simple and clear so that the current activity would be evident, followed by the

subsequent activity, while information about completed activities would be removed from display and information about upcoming activities would not be shown until needed.

Intended user population

The user participants taking part in these investigations were people who used communication supports and had associated conditions such as: cognitive impairment associated with ASC and difficulties in processing information; intellectual disabilities with difficulties in expressing themselves or understanding others; developmental disabilities and difficulties with communication. They were typically spending time in daycentres, supported by carers, while using paper-based visual schedules. They were known to have difficulty with aspects of touchscreen access such as swiping and scrolling.

Key design requirements

Key design requirements for this visual planner application were:

- Ability to show the current scheduled activity
- Ability to show the next scheduled activity
- Ability to remove from display the previous activity when completed
- Facility for adding new activities, including by carers
- Facility for adjusting how many activities can be shown at once
- Facility for accessing the app without swiping or scrolling
- Emphasis on ease of use for both service user and carer
- Emphasis on portable (mobile) operation

Design and development process

Low-fidelity prototypes for the visual planner were derived from design requirements. Discussion with clinicians around these low-fidelity prototypes led to high-fidelity prototypes being established for the user interfaces for users and carers, each requiring individual features and facilities.

Given the emphasis on portable (mobile) operation, smartphone technology offered advantages as a platform for this type of application (Jackson *et al.*, 2021) and was therefore adopted. The Android® environment was chosen on grounds of functionality, familiarity, cost, and acceptance. An agile development process was used for the application, with iterations of development and testing being conducted during the implementation in a succession of development 'sprints'.

Functionality

The developed prototype planner app enables a carer to create a day schedule (Figure 1) for a user, specifying a time, date and name for each activity (Figure 2) and selecting a symbol for it from an image or symbol library (Figure 3).
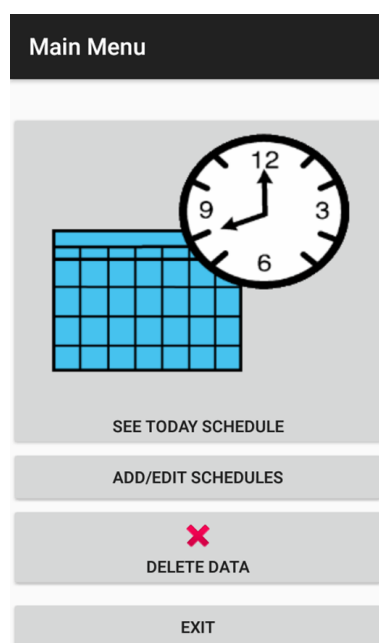

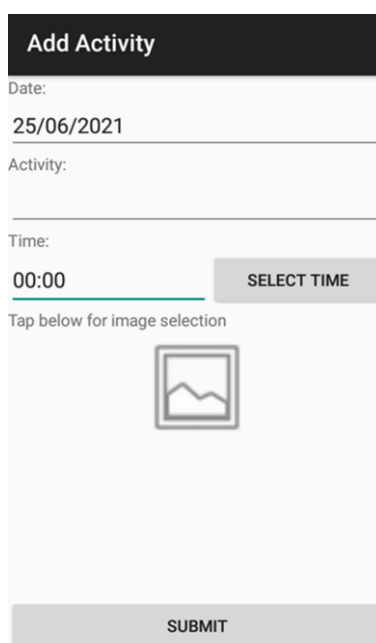*Figure 1: The carer begins laying out a day schedule for the user.*

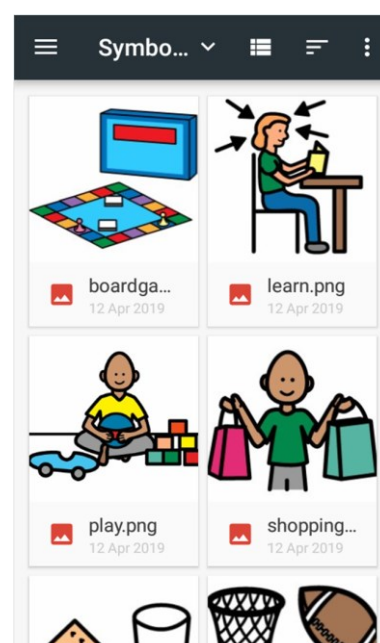*Figure 2: The carer enters date, name and time for each activity.*

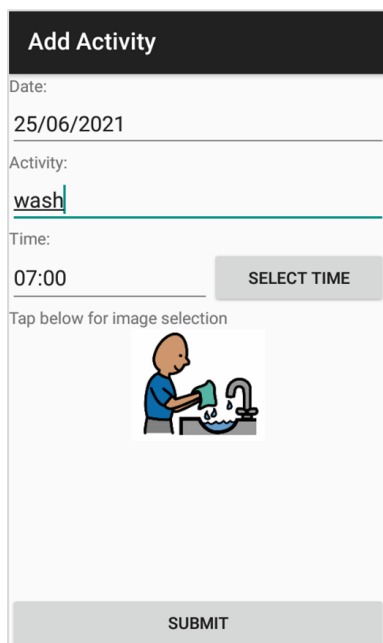*Figure 3: The carer selects a symbol for an activity from library.*

Figure 4: The activity page for the carer to review and submit into the day schedule for the user.
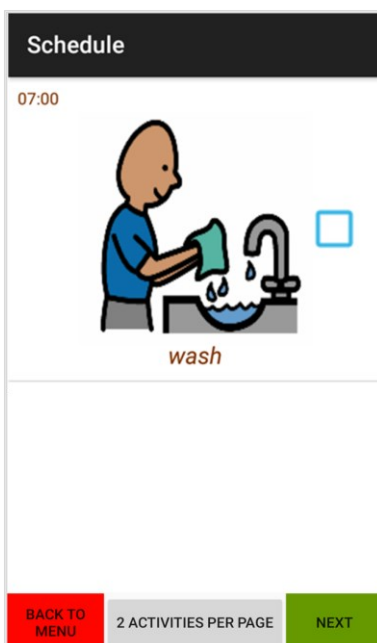

Figure 5: Activity page as the user sees it, prompting washing activity. Blue square is 'completion' button.
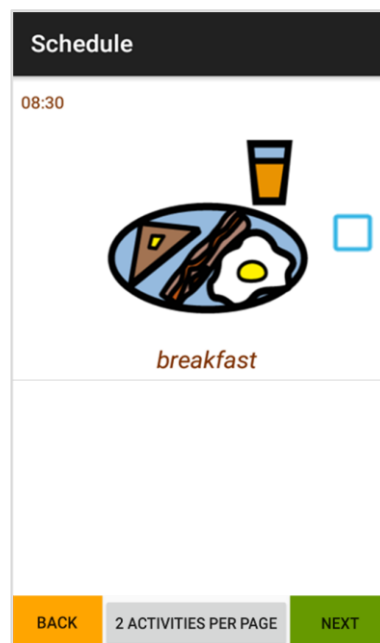

Figure 6: Another page for the user, prompting breakfast activity. (Grey button brings up 2 activities/page.)

The carer completes the activity item (Figure 4) ready for addition to the schedule. Figure 5 shows the activity item as the user will see it, prompting them to do the washing activity. Figure 6 shows the prompt for a subsequent activity (breakfast). The central (grey) button at the foot of Figures 5 and 6 enables the user or carer to change the number of activity items on simultaneous display, in this case to two (maximum). The square blue button beside the activity symbol can be pressed by the user to indicate completion of the activity, whereupon the app will remove the activity from view.

Evaluation

The researcher received specialist training and support in order to familiarise with the needs of people with ASD and ID and interaction with them, including strategies to manage any difficulties which might arise. Inclusive Communication training was also provided. A demonstration of the Talking Mat® method (Murphy & Cameron, 2008) was given with practice and guidance on how to carry out an evaluation with it.

A trial was conducted with four adult users with ASC and ID from three local daycentres. Symbol-augmented forms with simplified language were used with these participants to enhance comprehensibility (Arnott *et al.*, 2020). One carer from each daycentre also contributed to the trial, using unsymbolised forms. The trial activity was conducted within the daycentres. A carer would create a day schedule on the app for a user participant. The user would be given the app and asked to check this day schedule with the carer. The user then proceeded to use the schedule, working through the scheduled activities, with additional guidance from the carer if needed. After completion of the schedules, the users and carers were asked to provide feedback about the app and its operation.

User Feedback: All four user participants affirmed via questionnaire that they did not feel tired, rushed, or upset through use of the app. One user was positive and the other three neutral about being able to understand what was happening on the app, and one felt they had to think very hard when using it while the other three were neutral about that aspect. Thus, *user understanding of what was happening on the app* and *the mental effort required to use the app* are two areas to merit further investigation and possible further development. Three of the four user participants indicated when asked that they would like to use the app often.

Talking Mat®: Two of the user participants completed a Talking Mat® (Murphy & Cameron, 2008). One user was happy about seven (out of eleven) aspects of using the app and neutral about the other four, a relatively positive outcome. The other participant was happy about three aspects but neutral about four of them and unhappy about the rest, a less positive outcome. Both participants liked the screen size and its pictures, finding them easy to see; *knowing what to do* and some aspects of *app appearance* were less favoured by both participants, however.

Carer Feedback: Two of the three carers approved all aspects of the app on a workload questionnaire. The third carer reported some time and work pressure in using the app and some doubt over their own level of performance with it, but good outcomes otherwise. These were considered positive outcomes. There was mainly positive carer reaction on usability aspects of the app.

Discussion and Conclusion

The user participants showed a good response to the app; their outcomes were mostly positive and encouraging. Further development to reduce perceived effort and improve user understanding could be explored, as well as more practice and training time for the users to enhance familiarisation. Extended familiarisation and training might improve user understanding, which in turn might lessen the mental effort perceived by user participants. On the Talking Mat® session, one user was positive about most aspects of using the app and negative about none, while the other user gave a more mixed response, indicating an opening for further investigation and development. The carer workload feedback showed a positive outcome with only one of the three carers expressing any concern; further work on creating and managing schedules might address this.

A prototype smartphone app has been developed as an accessible and easy-to-use visual planner for use by persons with Autism Spectrum Condition (ASC) and Intellectual Disabilities (ID), and by their carers. It was designed to show its user what activity was currently happening and what activity should happen next, while minimising visual distraction and over-stimulation caused by extra display content.

In trial, users and carers were able to use the planner, the carers to create day schedules and the users to carry them out. Feedback indicated broad approval and some potential for further improvement, following which a fuller trial with a larger group of participants, both users and carers, could be planned. The investigation was viewed as successful and instructive with indications for further enhancement and development of the visual planner application.

Acknowledgements

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