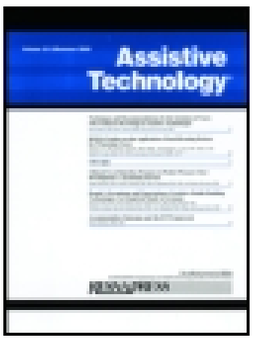

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Parents act as intermediary users for their children when using assistive technology for cognition in everyday planning: Results from a parental survey

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ABSTRACT

Assistive Technology for Cognition (ATC) is employed by children with and without disabilities. However, how the ATC is used in everyday life has not been studied. The current study investigated ATC-usage in everyday planning in three groups: 1) children qualifying for Swedish habilitation centers (ID/ASD), 2) children with disability not qualifying for habilitation service (ADHD), and 3) children with typical development (TD). A parental survey was conducted (n = 192) and answers were analyzed with statistical tests and inductive thematic text analysis. Results showed that all groups used ATC, most in the Habilitation group and least in the TD group. According to parents, ATC supported cognitive functions in all groups, but it became evident that the parents were responsible for planning by setting up the ATC, whilst the children merely executed the plans. This was linked to several limitations, for example the design was not appropriately adapted for these groups. The implications for the practitioners are 1) evaluate the users' cognitive abilities and choose an ATC suitable for that individual rather focusing on the diagnosis, and 2) follow up usage to see if it is the parent or the child that are using the ATC.

ARTICLE HISTORY
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KEYWORDS
Activities of daily living; assessment; cognitive impairment; developmental disability; electronic aids to daily living; usability

Introduction

There are a variety of assistive technologies for cognition (ATCs) available for families with children regardless of disability. The introduction of small and affordable technologies has enabled readily accessible devices. ATC is used to support or substitute cognitive functions, with the purpose of enabling activities and societal participation (International Organisation for Standardization, 2016), and includes for example calendars (both digital and paper), step-by-step schemas, and different types of aids to conceptualize time (Gillespie, Best, & O'Neill, 2012). However, research on how common ATCs are and how they are used in families in their everyday life is limited. In Sweden, some diagnoses (ID and ASD) grant access to ATCs via habitational centers, but ATCs are readily available commercially. Swedish habilitation centers are publicly funded centers providing support and services for children and families with disabilities. The aim of the present study was to, by means of a parental survey, investigate ATC-usage in an everyday planning situation in three groups that differed with regard to whether they qualified for habilitation service and disability status: 1. Habilitation group (children with ID and/or ASD), 2. Disability group (children with attention deficit hyperactivity disorder, ADHD, a diagnosis that does not qualify for habilitation service), or 3. children with TD.

ATCs can be classified into different domains. To increase knowledge about the ATCs, it is important to use classifications of ATCs rather than to evaluate specific devices. One classification framework for ATC-evaluation by Gillespie et al. (2012) is based on the type of cognitive function that is supported according to the International Classification of Functioning, Disability and Health (ICF, WHO, 2001). Their classification domains include: *alerting* (drawing the user's attention to e.g. a task at hand or a personal goal), *reminding* (reminding the user about tasks), *micro-prompting* (guiding users through step-by-step prompts), *storing and displaying* (storing and presenting episodic events), and *distracting* (distracting users from anxious events or other provoking stimuli). This classification framework considers the functionality of the ATC in general and is not restricted to how it is used in one specific activity by one user. To this end, the present study applies Gillespie et al.'s (2012) system for classification on assistive technologies designed to aid planning abilities in three different groups of users.

Planning ATCs can be used in a variety of different activities in an individual's life, for example, planning activities, personal goals, daily routines etc. (Janeslätt, Lindstedt, & Adolfsson, 2014). Studies investigating assistive technologies specifically for planning abilities have shown promising results in everyday life, participation at work and prospective memory amongst adults with different cognitive disabilities, including ADHD, ASD, and ID (de Joode, van Heugten, Verhey, & van Boxtel, 2010; Lindstedt & Umb-Carlsson, 2013; O'Neill & Gillespie, 2015a; Wennberg & Kjellberg, 2010). Accordingly, Gillespie et al.'s (2012) classification framework recognizes that assistive planning technologies should in particular, provide support within micro-prompting and reminding domains. In a literature review from 2004, Lopresti, Mihailidis, and Kirsch, stated that adequate ATC interventions have the potential to enhance traditional rehabilitation practices.

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Supplemental data for this article can be accessed here.

Research focusing on children's use of ATCs is underrepresented, and to the best of our knowledge, comparisons of different groups are lacking. For instance, in a comprehensive review performed by de Joode and et al., (2010), the majority of included studies involved only adult participants (+ 18 years of age). Earlier literature has raised methodological issues concerning self-reporting data for individuals with ID (Emerson, Felce, & Stancliffe, 2013; Finlay & Lyons, 2001). Thus, parents, rather than the children, were addressed to answer the research questions in this study.

Technology to support cognition is regularly utilized regardless of the user having a disability or not (Norman, 1993). ATCs are commonly used, they support cognitive functions, and have positive effects on a range of areas for different groups. In Sweden, ATCs can be prescribed by habitational services to individuals who need cognitive support. The law of Support and Service for Persons with Certain Functional Impairments (LSS), primarily includes people with the diagnoses ASD or ID (SFS, 1993, p. 387). The specifications of the law reflect that the need for support is larger in ASD and ID compared to other groups for example ADHD. The diagnoses ADHD, ASD, and ID have different cognitive profiles. Low intellectual ability is part of the definition for ID, and is common amongst people with ASD, whereas it is not associated with ADHD (American Psychiatric Association., 2013). There are areas where all three groups have difficulties with, such as executive functions (Barkley, 1997; Danielsson, Henry, Messer, & Rönnberg, 2012; Pennington & Ozonoff, 1996) and adaptive function (e.g. Carter et al., 1998; Lindblad et al., 2013; Roizen, Blondis, Irwin, & Stein, 1994; Stein, Szumowski, Blondis, & Roizen, 1995). However, unlike ID, poor adaptive function is not specifically addressed in the ADHD diagnostic criteria (American Psychiatric Association, 2013). An individual's need for ATCs is dichotomized in Swedish law where an ID or ASD diagnosis grants access to habilitation services, but a more nuanced picture emerges when considering the overlap in cognitive difficulties among different diagnoses. Thus, there is a discrepancy between societies view of need for support and the areas of difficulties that research states the groups have. Based on that notion, we wanted to see how that reflects in the use of ATCs in everyday life.

Research investigating the adaptive abilities in people with ADHD compared to ID/ASD concluded an even higher impairment for people with ADHD compare to ID/ASD, suggesting a greater need of social support (Lindblad et al., 2013). The comparison of the two disability groups (the one accessing habilitation support and the one who doesn't), as well as the comparison to people with TD in an everyday planning situation has not yet been done. Thus, this study sought to compare the three groups to answer whether the usage of ATC in the three groups differ in terms of amount of ATCs being used, how much supervision is needed, how the ATCs are used, and how the parents report the ATC support cognitive function.

Actual ATC-usage might differ when ATCs are studied outside of the lab. A literature review on ATC-usage in clinical settings found a need for thorough instruction and close monitoring (Scherer, Hart, Kirsch, & Schulthesis, 2005). It was also found that studies were often limited to the clinical or experimental setting, and possibly lacked ecological validity. This is in line with O'Neill and Gillespie (2015b) who recommended studying ATCs in their typical context. A study of technology-usage in people without disabilities in developing countries is an example from another area of research (Sambasivan, Cutrell, Toyama, & Nardi, 2010). It was found that multi-user interactions in day-to-day technology was common among users with limited literacy or poor technological skills. In sum, research investigating how ATCs are used in different disability groups is often limited to controlled clinical settings and studies of usage in everyday life situations from a family perspective are rare.

The present study

Parents' experience with ATCs in an everyday planning situation was investigated. In order to distinguish what is disability-related and what is typical use of technology, the study included a group consisting of families with children with a TD, one group of individuals with ID and one with ID/ASD. Accordingly, the participating parents belonged to three groups: parents of children who received habilitation services (Habilitation group), parents of children who did not receive habilitation services but had a child with an ADHD diagnosis (Disability group), and parents of children with TD. As individuals with intellectual disability and children with TD with an age around six cannot be expected to be able to read and answer surveys, this study targeted parents as respondents.

We predicted that due to the lower intellectual ability and access to habitational services the Habilitation group will report the highest number of ATCs. We expected the Disability group to report a need for ATCs due to executive and adaptive functional difficulties. However, because this group does not qualify for habitational services, reported number of devices used should be lower than the Habilitation group. Lastly, we considered children with TD will rely far less upon ATCs than the other groups. On the whole, we predicted that parents from all groups will report that ATCs successfully support cognitive functions. With regard to group differences in the amount of parental supervision needed, or the manner in which ATCs are employed (questions 2 & 3 below), the published literature is too sparse to warrant predictions.

In the context of the above, the research questions were:

(1) Does the number of ATCs a family has differ between the three groups?
(2) Is there a group difference in adult supervision during planning?
(3) How are ATCs used when families plan their daily activities?
(4) According to parents' reports, how well do ATCs support cognition?

Methods

Inclusion criteria

An online survey was administered to parents with at least one child between 6 and 19 years of age. The rationale for not including children below the age of six was as the compulsory school attendance in Sweden starts at that age. Children below the age of six was not expected to plan to a great extent. Participating parents in the Habilitation group were required to have a child with mild ID and/or ASD. Parents included in the Disability group had children diagnosed with ADHD but were not eligible for habilitation services. The TD group comprised of parents with typically developed children (i.e. no cognitive disability).

Participants Characteristics

Participants from all groups were recruited via private online interest groups on Facebook and familjeliv.se (a Swedish online platform for families). All groups had separate forums for their respective situation (ADHD, ASD, ID or for parents in general, TD). The survey included a question on if their child had a diagnosis or not to check group belonging. Social media was used to reach parents regardless of contact with the habitational service centers. In Sweden, 93% of the population has internet access, 70% of them are Facebook users and almost half of them use the internet daily (Findahl & Davidsson, 2015), which made this recruitment method suitable to reach families all over Sweden.

Of the 217 respondents, 192 were included in the study. 25 were excluded because they failed to answer all open-ended questions (11 respondents), did not have a child in the required age range (11 respondents), or did not meet group requirements of disability (3 respondents). The mean age of the included children was 10.4 (SD = 3.3) of which 36% (n = 70) were girls. A total of 46 of the responders were parents to children with TD (Mean age = 7.9, SD = 2.0 years), 74 parents to children with ADHD (M = 10.2, SD = 2.6 years), and 72 to children with ID and/or ASD (M = 12.2, SD = 3.4 years).

Survey

The survey was developed by the authors and based on the literature on ATC and cognitive functions in the targeted groups. The survey was tested in a pilot study on parents to children with ID to verify that the questions were interpreted as intended. The survey was not changed after the pilot study as the questions were judged to have been answered in a desirable manner. The data from the pilot were however not included in the current analysis as that pilot survey was answered by pen and paper rather than online. Data were collected via an online survey (see Appendix for survey in Swedish) to the three parent-groups separately. The survey included both closed- and open-ended questions and was administered via Google Forms. The closed-ended questions included age, diagnosis, gender of their child, the need for another person to be present or not, and what kinds of ATCs they utilize to support everyday planning. The closed-ended questions were analyzed using statistical analyses. The open-ended questions included how the parents experience the ATC in everyday life and were analyzed using a thematic text analysis. The same survey was used for all three groups. The data were collected during 2014.

Ethics

The study was reviewed and approved by the Regional Ethical Review Board in Linköping, Sweden (ST 2014–016). Respondents were encouraged to email the test leader to receive a cinema ticket as a token of appreciation, which approximately 50% of them did.

Statistical analysis

The Kruskal-Wallis H test was used to compare the total number of reported ATCs used between groups and a χ^2 goodness-of-fit test was used to compare the groups on frequency of the need of another person being present in the planning situation. The statistical tests were reanalyzed including the 11 excluded participants with missing data on the open-ended questions but responses on the quantitative questions. The same pattern of results was found and therefore these results were not reported in the results section. The α-level was set to 5% (two-tailed) for all statistical analyses.

Inductive thematic text analysis

The remaining research questions were answered through analysis of the open-ended questions. The analysis was performed through the process described in Braun and Clarke (2006) and trustworthiness and credibility was assessed as described in (Nowell, Norris, White, & Moules, 2017).

First, the first author (LP) read and re-read the data to get familiarized with the data. As the answers were in a written form no transcription was needed. After reading through the data, LP started generating initial codes and categorizations of the different answers. The majority of the answers consisted of less than three sentences, thus most of the answers were coded with one code only (as opposed to dividing the answers from one parent into several different codes). In this phase, all data were included, regardless of relevance for the research questions. Secondly, LP generated initial codes in the data. In this phase, the data that added meaningful parts to the research questions were coded into different codes. This phase was performed several times to refine codes by combining and splitting potential codes. The initial codes went from more detailed to less detailed to capture many themes as possible. In the last coding scheme, the data were reduced and compiled into categories to identify segments of the data that share a common or similar code. In the third phase, LP searched for themes that captured what the data behind the codes meant among the codes. The themes were based on codes that were repeating ideas, terms that were often used, or distinct differences and similarities in the participants' tone in the answers. The themes that emerged were then reviewed in a forth phase. In order to validate the themes, LP re-read the data and the themes were refined to fit the data. The codes

were mapped so that the themes were cohesive, mutually exclusive themes. In this phase, the second author (HD) reviewed the codes and themes. The themes were then discussed, and a consensus was made by both authors and then synthesized into the themes presented in the paper. Lastly, in the themes were named and clear definitions were generated. Quotes from the respondents were then added to represent the content of each theme. Then the themes that did not make a meaningful contribution for the scope of this article were excluded from the results.

The reported devices were classified according to the classification system developed by Gillespie et al. (2012). Second, latent themes were captured in the answers with an inductive thematic text-analysis performed in line with Braun and Clarke (2006). The answers were assigned to different themes that emerged from the data. The themes were then either included in the results or excluded due to scope limitations in this article. Excluded themes included answers about properties of ATCs that were not associated with cognitive functions, or external factors such as not knowing what was available on the market and lack of professional support from the habilitation services.

Results

This section starts with the statistical results from the closed-ended questions, by 1. comparing the total number of reported ATC between groups and 2. the group comparisons of frequency of the need of another person being present in the planning situation. These two results are analyzed with statistical analyses. Then follows the results from the inductive thematic text-analysis of the open-ended questions. This analysis answers the research questions on how the ATCs are used, the classification of the reported ATCs according to Gillespie and et al., (2012) classification system, and how the different ATCs supported cognitive function.

Group differences in number of ATCs

A Kruskal-Wallis H test found statistically significant difference of reported number of ATCs used, $H(2) = 64.51$, $p < .001$, $\eta^2 = 0.34$. Pairwise comparisons with Bonferroni adjusted p-values, revealed significant effects between all three groups. The Habilitation group ($Mdn = 5$) reported more ATCs than both the Disability group ($Mdn = 3$), ($p < .001$; $r = 0.31$) and the TD group ($Mdn = 1$), ($p < .001$; $r = 0.58$), and the Disability group reported more ATCs than the TD group ($p < .001$; $r = 0.30$). The group differences are presented in Figure 1.

The reported devices were classified according to the system proposed by Gillespie et al. (2012). All, but the classification category: *distracting*, were represented in the reported ATCs. Parents reported that they used commercially available devices (e.g. egg timers and calendars in smartphones), as well as devices provided by habitational services. Different types of *reminding* devices were most frequently utilized across all groups. These included calendars (both paper and digital) and weekly schedulers. This was followed by *altering* ATCs such as different types of timers, which were used to indicate task duration and to facilitate task switching. Third came, *micro-prompting* devices used for higher level cognitive functions and abstractions, such as sequence schemas. ATCs for *storing and displaying* consisted mostly of different types of cameras. Frequency (mean and SD) of how many ATCs used in each classification and group is presented in Table 1.

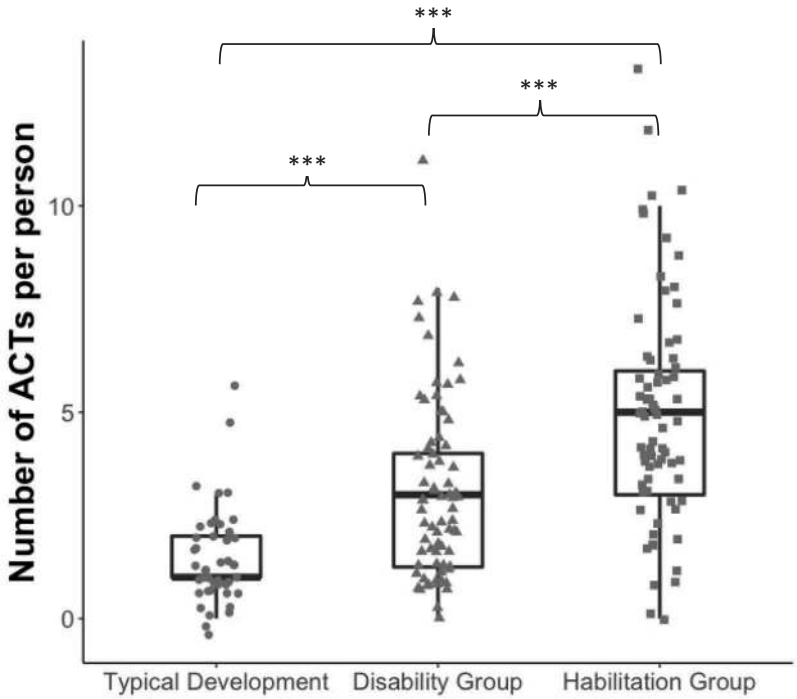

Figure 1. *The reported number of ATCs in the three groups: Typical development, Disability group, and Habilitation group. *** = p < .001.*

Group differences in adult supervision during planning

A χ^2-test found significant difference between the three groups regarding the need of another person to be present when making plans, $\chi^2(2) = 11.28$, $p = .004$, $\varphi = 0.24$. The habilitation group needed the most adult supervision (86 %), followed by the Disability group (74 %) and TD group (59%).

Results from the thematic analysis

The description together with a quote to capture the theme is presented in Table 2. The themes were placed under the two remaining research questions: *1. How are ATCs used when families plan their daily activities?* and *2. According to parents' reports, how well do ATCs support cognition?*.

How are ATCs used when families plan their daily activities?

How the ATCs were used in an everyday planning situation was investigated by analyzing the open-ended answers. The emerged themes are presented in *italic* bellow. The theme regarding how the ATCs were used, was *parents being there* and the theme as to whether parents reported making plans for the child, was *time- and energy consuming*. Interestingly, analysis revealed that it was not the children who made plans by operating ATCs, instead, it was the parents who set up the ATCs for the child to later execute the pre-defined plan. For instance, parents would make the schedule or set the timer, and then the child followed the instructions. *"Requires me to as a parent to prepare and take care of them (e.g. setting the alarm)"*. The most reported feature the ATCs lacked was off-loading for parents. *"We as parents sometimes forget that we have to work in a certain way, and we do always have to be active in all instructions and routines, every day. Something that gets very tiresome of course*. Further, the parents asked for an ATC that would encourage children to make their own plans to become more independent. *"It does not make my child to become more independent"*. To reduce their parental workload, parents asked for more advanced ATCs and extra resources, such as help from other people.

According to parents' reports, how well do atcs support cognition?

The results from the inductive thematic analysis revealed that parents reported that ATCs successfully in supported cognitive functions. *"The timer works fairly well. Gives a clear sense of time and a reminder of when to finish a task"*. There were four themes that emerged: 1) *supports memory*, 2) *facilitates time management and cognitive flexibility*, 3) *facilitates higher-level cognitive functions and abstractions* and, 4) *supports long-term memory*. These themes were then matched with the classification framework below.

Reminding

Parents reported that the ATCs were regularly used to *support memory*. In particular, the use of schemas off-loaded the child's memory and graphically displayed different activities and made them easier to remember. *"Calendar to remember events that are not part of the weekly routine"*. Parents also reported, especially the Disability group, that weekly schedules enabled children to check for themselves what was going to happen that week or day. *"Calendar with pictures helps her understand that she can see for herself what's going to happen"*

Altering

Facilitated time management and cognitive flexibility. Parents from all groups reported that ATCs helped their child's cognitive flexibility and supported shifting from one activity to another. "My daughter needs clear ending between activities and preparation for the next moment, timer and verbal instructions are important Timers are used as a cue for the finish of one task and beginning of the next. They also help children represent the timing of events, for example, understanding the concept that something is going to happen within the next hour. *"Timer helps when shifting activity"*. However, parents reported they were missing ATC that helped their child to understand how long they should take on one activity and still have time for the next activity.

Micro-prompting

Facilitated higher-level cognitive functions and abstractions. Parents to children with disability reported that they used pictures and other graphics to make events visual and supported the child's difficulty in managing sequential tasks. *"Pictures in what order tasks should be performed in the shower, toilet, etc., works really well and give a concrete support"*. Pictures provided visual support and made the tasks more comprehensible for children in all groups with diagnoses.

Storing and displaying

Some parents mentioned using diaries or cameras to store information to support the child's *long-term memory*. *"Important in order to tell what have happened"*. However, ATC for storing and displaying was not commonly used in the planning situation (see Table 1).

Table 1. Mean and SD reported ATC per respondent divided on each group.

		ID/ASD			ADHD			TD			All Groups together		
ATC classification	Example of ATC	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD
Altering	Timer	1	0.57	0.50	0	0.49	0.50	0	0.24	0.43	0	0.46	0.50
Micro-prompting	Sequence schema	0	0.42	0.62	0	0.20	0.50	0	0.02	0.15	0	0.24	0.52
Reminding	Daily or weekly schedule	2	1.82	1.42	1	1.35	1.12	1	0.87	0.88	1	1.41	1.24
Storing and displaying	Camera or diary	0.5	0.76	0.85	0	0.20	0.44	0	0.15	0.42	0	0.40	0.68
Others/Mixed	Mobile phone	1	1.04	0.88	0	0.54	0.80	0	0.15	0.42	0	0.64	0.83
Sum of ACT		4	4.61	2.71	2	2.78	2.31	1	1.43	1.15	3	3.15	2.58

Table 2. The definition of the themes from the thematic analysis.

Theme	Quote	Description
Parents being there	*"I as a parent keep track of everything and enter the events into the calendar. Reminds and supports when needed"*	A recurrent theme was that a parent (or another adult) was often around in the planning situation. The parent was reminding, setting up the plan, and making the schedules. Thus, the analysis revealed that it was not the children who made plans by operating ATCs, instead, it was the parents who set up the ATCs for the child to later execute the pre-defined plan. For instance, parents would make the schedule or set the timer, and then the child followed the instructions.
Time- and energy consuming	*"It requires a lot of energy, time and presence from me"*	It was very common for the parents to report that the planning took a lot of their time and energy. The most reported feature the ATCs were lacking was off-loading for parents. Further, the parents asked for an ATC that would encourage children to make their own plans to become more independent. To reduce their parental workload, parents asked for more advanced ATCs and extra resources, such as help from other people.
Supports memory.	*"S/he can check the schedule as many times as s/he wishes in order to finish what s/he's supposed to do."*	The parents reported that the ATCs were regularly used to *support memory*. The ATC supported working memory, long term memory, and prospective memory. The use of schemas off-loaded the child's working memory and graphically displayed different activities and made it easier to remember what steps to perform while doing an activity. The ATCs were also used to help the child remember activities events that had happen yesterday and to help the child remember what will happen tomorrow. Parents also reported, especially the Disability group, that weekly schedules enabled children to check for themselves what was going to happen that week or day.
Facilitated time management and cognitive flexibility.	*"By using a timer, it facilitates to finish a task on a given time, I feel that it makes it easier when the time becomes visual and not abstract"*	Parents from all groups reported that ATCs helped their child's cognitive flexibility and supported shifting from one activity to another. Timers are used as a cue for the finish of one task and beginning of the next. They also help children represent the timing of events, for example, understanding the concept that something is going to happen within the next hour. However, parents reported they were missing ATC that helped their child to understand how long they should take on one activity and still have time for the next activity.
Facilitated higher-level cognitive functions and abstractions.	*"With a schedule of images, the son's uncertainty concerning what will happen reduces, making him feel more confident in what will happen during the day."*	Parents to children with disability reported they used pictures and other graphics to make events visual and supported the child's difficulty in managing sequential tasks. The parents had made sequence schemas for supporting the division of larger goals into sub-goals such as what steps are included in having a shower and thus supporting higher-level cognitive functions of planning and ordering and thus creating an overview of the situation. Additionally, ATC was commonly used to make abstract information visual. Pictures provided both visual support and made the tasks more comprehensible for children in all groups with diagnoses.

Discussion

This section begins by briefly reviewing results that are in accordance with the literature, before discussing the main finding that children use the ATC with their parents as an intermediary user.

The thematic analyses revealed that, according to parents, ATCs successfully support cognitive functions in terms of memory, time management and higher-level cognitive functions. This study adds to the literature claiming ATC support cognitive function (de Joode et al., 2010; Lindstedt & Umb-Carlsson, 2013; Lopresti, Mihailidis, & Kirsch, 2004; Wennberg & Kjellberg, 2010).

There were group differences in the amount of ATCs used. All groups, even the TD group, reported that they used ATCs to some extent, a result that to the best of our knowledge has not been reported before in the literature. The Habilitation group reported the highest number of ATC used. The Habilitation group, followed by the Disability group, reported significantly more ATC usage than the TD group, suggesting that children with disability have more need of support than children without a diagnosis. ID and ASD, are traditionally associated with poor adaptive functioning, whereas ADHD is not. However, as Lindblad and et al., (2013) concluded, both children with ADHD and children with ID have lower adaptive functioning. A speculation is that the low adaptive functioning in the disability and habilitation groups could be the reason for why they are using more ATCs compared to the typical developing group. The ADHD group used more ATCs and had an even greater need of another person to be present than the TD group. Thus, our results indicate that regardless of disability and or habilitation care entitlement, families seek and use ATCs. This is in line with earlier research stating difficulties (for example adaptive functioning) in both disability groups (e.g. Lindblad et al., 2013). However, the legislation provided easier access to ATCs for the ID and ASD group and might be reflected in the difference of number of reported ATCs.

There was a need of another person to be present in the planning situation. The main result from our study indicated that parents play a crucial role in their children's everyday planning, which places high demands on parents. Furthermore, our results suggest that the child was not the operator of the technology, rather the children used the ATCs via their parents. Thus, the interaction between the child and the ATC was not direct, but instead intermediated by an adult. Sambasivan and et al.,(2010) defines intermediated usage as when another person is the operator of the technology when the primary user is not capable of operating the device entirely on their own. In summary, the need of another person to be present and intermediated usage forms a need of constant adult support and hinders independence in the child.

Perhaps the children are capable of planning by themselves but are not inclined to as a part of their developmental behavior. One argument as to why parents acted as an intermediary user in planning situations might be that children and adolescents in general, are not prone to plan. One study investigating planning ability in adolescents without disabilities demonstrated that when directly requested, adolescents performed on par with adults in planning tasks (Chalmers & Lawrence, 1993). The authors concluded that research suggesting adolescents have poor planning abilities, have not considered that adolescents tend not to plan on their own initiative, but nevertheless possess good planning capabilities. Maybe, the same argument could be used for the population studied here. The children might start to plan and utilize their devices directly, without an intermediary, as they mature, irrespective of disability.

On the other hand, ATC might not be customized to the children's' strengths and weaknesses. A possible reason for the involvement of an intermediary user might also be explained by poor mapping between an ATC's design and the child's need of support. Several studies have emphasized the importance of considering individual differences both when prescribing and developing ATCs (e.g. Lopresti et al., 2004; Sayko & Tremoulet, 2015; Scherer & Federici, 2015; Scherer et al., 2005; Wessels, Dijcks, Soede, Gelderblom, & De Witte, 2003). Practitioners are encouraged to prescribe ATCs that closely match the need of the user, elaborate how the family should administer the ATCs, educate the user in the usefulness of ATCs, and design ATCs to fit the users' physical and cognitive abilities (Leopold, Lourie, Petras, & Elias, 2015). In summary, if the ATC calls for an intermediary user it might not fit the main users' need, practitioners should therefore consider supplying more comprehensive instructions when prescribing ATCs.

In 2005, Scherer and colleagues argued that with disabilities are being less exposed to technology in general. This issue seem to have been resolved with the introduction of relatively cheap and assessible technologies such as tablets, smartphones and laptops (Fletcher-Watson & Durkin, 2015). Fletcher–Watson and Durkin argues that this advancement in technology has enabled individuals with neurodevelopmental disabilities to gain the same access to technology as individuals with a TD. The authors also argue that the technology could even be very well suitable for individuals with cognitive difficulties as it seems to engage people with ADHD in activities that enquire sustained attention or individuals with ASD in activities that require social skills in online games. That is, the individuals engage in activities that traditionally are a core deficit in their symptomology. Nevertheless, the results from this study seem to indicate that the ATCs are still not supporting the individual in the situation and requires the involvement of another person. Scherer and et al.,(2005) argued that ATCs of today might demand the very same cognitive ability of the user as they are supposed to support. Fletcher-Watson (2014) highlighted in her review the need for including the literature on cognitive skills of people with disabilities when designing computer assisted learning tools.

Perhaps, training the user's cognitive capacities could constitute a complement to the ATC (Danielsson, Zottarel, Palmqvist, & Lanfranchi, 2015; Kirk, Gray, Riby, & Cornish, 2015). However, the effects of cognitive training have been debated, and future interventions carefully has to consider what to train and how to achieve transfer effects into everyday settings (Kirk et al., 2015; Melby-Lervåg & Hulme, 2013). The implications if not dealt with, are that the child gets less proficient and is unable to independently participate in society without reliance upon other people

Technological developments promise more advanced and user friendly ATCs. Advances in computer science with speech recognition, and object recognition brings powerful and innovative new technologies that can provide support for individuals with cognitive disabilities (Erlandson & Sant, 2010; Ficocelli & Nejat, 2012; Lussier-Desrochers, Bouchard, Bouchard, Roux, & Henry, 2013; O'Neill & Gillespie, 2015b; Roux, Lussier-Desrochers, Lachapelle, Bouchard, & Bouchard, 2016). Incorporating basic design principles (to be universally usable, to have intuitive design, to be error tolerant, to require low physical effort, and to be flexible) is still in its infancy when designing user friendly ATCs (Norman, 2013; Steel & Janeslätt, 2017). Meanwhile, Dawe (2006) states that a device should be easy to use, otherwise it will not be used at all. The challenge for manufacturers of ATCs is to keep ATCs easy to use, yet at the same time, complex enough to successfully support the users' cognitive capabilities. Future ATCs may minimize the need of intermediaries, by developing smart technology and incorporate basic design principles in the design, thereby enabling the child to use the ATC by themselves.

Limitations

This study has some limitations. The respond rate in the current study was difficult to assess as the recruitment was done on social media. There might be members in the groups that were not active and thus have not seen the post. Some people might also members of several of the groups targeted in this study, giving a biased response rate. Additionally, the members can have shared the survey with their friends outside the group. This might have a biased effect on our result. It could be that only the parents who were most accustomed with technology (and in turn more active on social media) that answered the survey. Future research should ask families not active on line to see if their answers might differ from the ones given in this report.

As this study asked parents rather than the users themselves, it is possible that the answers are biased by the parent's experiences and does not reflect the children's experience of ATC. Thus, future studies should target the children themselves to further validate our results. Further, we did not include any demographical data on the parents to increase response rate and avoid biased responds (e.g. unwillingness to report if high or low social status). Additional information on the parent's economic status or education level might influence the usage of ATC and future studies should investigate this further.

Conclusions

ATC usage was reported in all groups, with most devices used in the Habilitation group followed by the Disability group and the TD group. The Habilitation group reported the highest need for another person to be present, followed by the Disability group and the TD group. We found that the parents were acting as an intermediary user between the child and the ATC, but results also showed that the parents report that the ATCs successfully supported several cognitive functions. As one parent said: *"The timer gives him a sense of time, each thing has its own place which helps with the everyday routine, we think and he ACTs to so speak"*. There can be several reasons for the intermediated interaction in the results: the children not being prone to plan or not being exposed to technology, or the ATCs not being carefully mapped to the child's need. We suggest, future research should aim to reduce the need of an intermediary and carefully consider the user's cognitive capabilities, develop more advanced ATCs and to consult the design principles. Implications for practitioners from this study is to 1) choose an ATC that matches the user's cognitive abilities, 2) follow up usage and make sure the ATCs are used as planned, and 3) provide the appropriate training for the user to enable direct use of ATC instead of intermediated use.

The implications for the practitioners are 1) evaluate the users' cognitive abilities and choose an ATC suitable for that individual rather than focusing on the diagnosis, and 2) follow up usage to see if it is the parent or the child that are using the ATC.

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