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Additional key factors mediating the use of a mobile technology tool designed to develop social and life skills in children with Autism Spectrum Disorders: Evaluation of the 2nd HANDS prototype

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ABSTRACT

Of late there has been growing interest in the potential of technology to support children with Autism Spectrum Disorders (ASD) with social and life skills. There has also been a burgeoning interest in the potential use of mobile technology in the classroom and in the use of such technology to support children with ASD. Building on these developments, the HANDS project has developed a mobile cognitive support application for smartphones, based on the principles of persuasive technology design, which supports children with ASD with social and life skills functioning – areas of ability which tend to be impaired in this population. Based on the evaluation of the implementation of an initial prototype, a second prototype was developed in the summer of 2010 and implemented in the 2010/11 academic year in four special schools for children with ASD. This paper reports on a qualitative interpretivist evaluation of the second prototype, identifying which factors mediate the level of engagement with the technology by both teachers and children. Fifteen teachers and twenty six children used the second prototype.

Data was gathered using from teachers ($n = 15$) using direct classroom observation, individual semi-structured interviews, and questionnaires. Semi-structured interviews were also used to collect data from some parents ($n = 6$) and children ($n = 10$). A number of factors identified in the first prototype are also found to be present in the second prototype. However new factors are also identified, including student awareness of difficulties and associated motivation to change, and the preference of some children with ASD to receive persuasive messages from mobile devices. Particular issues related to the cognitive structure of children with ASD are considered. Further design guidelines are proposed for future implementations of similarly purposed technology tools.

1. Introduction

Recent developments in mobile applications for children with ASDs have shown mobile ICT's potential to enhance participation in educational settings and wider social contexts, for young people with the social, emotional and cognitive impairments typically associated with this condition. Some of this work has been done as part of the HANDS Project (HANDS Project, 2011).

ASDs are developmental disorders, whose aetiology has a significant genetic component, arising in early childhood, and result in a lifelong condition (Volkmar, Lord, Bailey, Schultz & Klin, 2004). Wing and Gould (1979) classify the main behavioural expressions associated with ASD as the "autism triad". These are mild to severe impairments in (1) reciprocal social engagement, (2) reciprocal communication, and (3) flexible regulation of self, behaviour and interest.

Impairments in social and communicative reciprocity and in adaptive, flexible regulation of self and behaviours in individuals with ASD lead to significant difficulties in both social and life skills (Howlin, 2004). Having ASD, consequentially, leads to a very high risk of marginalization and social exclusion, with adolescence and early adulthood being especially critical periods for individuals with ASD. They

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have a highly decreased chance of finding adequate jobs (and jobs at all), of managing an independent life, and of establishing long-term interpersonal relationships (Haskins & Silva, 2006; Shea & Mesibov, 2005).

Given the high risk of marginalization and social exclusion associated with ASD, it is not surprising that there has been some hope invested in the potential of assistive technology to support individuals with ASD in overcoming such barriers to adaptive functioning and social interaction.

Bernard-Opitz, Sriram, and Nakhoda-Sapuan (2001) used a multimedia computer program to teach young children with ASD how to think through social situations and conflicts whilst Parsons, Mitchell, and Leonard (2004) and Mitchell, Parsons, and Leonard (2007) evaluated the potential of virtual environments to teach both social awareness and social behaviours to individuals with ASD. Wallace et al. (2010) demonstrated that young people with ASD find modern virtual reality settings authentic enough to allow for realistic simulation of social situations with associated potential for development in social skills. The Aurora project (Aurora, 2000) and studies by Dautenhahan and Werry (2004) explored the use of robotic technology in developing social interactions. In related work, Farr, Yuill & Raffle (2010) reported on an exploratory demonstration of the successful use of technology embedded in graspable toys to promote play and increased social interaction.

In a recent review, Wainer and Ingersoll (2010) examined fourteen studies going back to 1995, which used innovative multimedia programs to teach language, emotion recognition or social skills to individuals with ASD. Their review indicated that some studies indicate a likely potential for the use of technology to deliver positive interventions in social and emotional development (see Moore & Taylor, 2000; Rayner, Denholm, & Sigafoos, 2009).

There has also been growing interest in the last five to seven years in the use of mobile technology with children with ASD. Mechling, Gast, and Seid (2009), in an exploratory study, evaluated the use of a Personal Digital Assistant (PDA) with multiple prompt levels, reporting on its potential to increase efficacy in completion of novel tasks and transitioning within and between tasks. Gentry, Wallace, Kvarfordt, and Lynch (2010) used standardized measurement tools to measure the efficacy of PDAs as cognitive aids in a sample of high school students with ASD, indicating positive initial outcomes. Reports are also being published on the use of mobile technology specifically to support social skills development. Tentori and Hayes (2010) report on the initial implementation of a smartphone application designed to give children social cues in specific social situations.

This paper reports on the implementation of the second prototype of a smartphone application developed in the HANDS project, which allows teachers to flexibly develop individually tailored interventions to develop social and life skills. The key objective of the paper is to report on an interpretivist evaluation of the implementation and use of the second prototype, identifying key factors mediating the level of engagement with the technology by both children and teachers, taking such engagement to be at least indicative of the likely effectiveness of the technology in bringing about positive behaviour change in the domains and social and life skills. Particular emphasis is paid to novel mediating factors identified in the evaluation of the second prototype which were either absent or only weakly detected in the evaluation of the first prototype (Mintz, Branch, March, & Lerman, 2012).

1.1. Mobile systems for people with cognitive disabilities

There has been a parallel interest in the use of mobile technology to support people with cognitive disabilities due to traumatic brain injury, stroke or Alzheimer's disease, particularly in respect of providing support for travelling. The MAPS-Lifeline prototype (Carmien, 2004; Carmien et al., 2005) created a GPS-based mobile device system, which included dynamic monitoring by caregivers. Lindström (2007) reports on Swedish trials of navigation assistance systems based on mobile technology and GPS for people with cognitive disabilities. User reports indicated that reliability and ease of use were design priorities. The Opportunity Knocks project (Patterson et al., 2004) created a mobile GPS-based application to provide cognitive assistance to users with cognitive impairments using public transport. The system automatically detected the user's current mode of transportation, and using a heuristic learning algorithm, detected when the user does something unexpected such as missing their usual train station. Brown et al. (2011) report on their development and evaluation of an initial prototype of a GPS-based Android application to support route navigation based on serious gaming. Users with intellectual disabilities and sensory impairments rehearsed potential routes using the application games, potentially reducing reliance on the need for guidance and support during travel.

1.2. The HANDS project

The HANDS software consists of a web based flexible toolkit that teachers use to develop specific support and intervention sequences specific to the need of each child. These sequences consist of a series of linked screens, each of which can include customizable text, images, video and sound. These customized "Personal Trainer" sequences can be linked to the associated comprehensive diary function also included in the software. Personal Trainer sequences can be stored as templates, and a sharing function allows teachers to adapt existing sequences for other children.

Intervention sequences developed using the flexible toolkit (see Fig. 1) are then loaded via a synchronization function on to the client application on the child's smartphone (see Fig. 2). On a regular basis the teachers then encouraged children to complete both the life skill and social skill task using the support of the intervention on the HANDS application.

The system also includes an electronic footprint feature that creates a log file record for every use of the mobile application by the child. The application was developed using Windows Dynamic Mobile and smartphones used included the HTC Diamond and HTC Touch HD. A pilot implementation in Android 2.2 was also undertaken.

HANDS was developed using the principles of Persuasive Technology Design (Fogg, 2003), a sub-discipline within the broader field of human–computer interaction. A growing number of researchers and systems designers in the last five years (see Ploug, Hasle, & Oinas-Kukkonen, 2010), responding to developments in this sub-discipline, have shown an increasing interest in how computers can be consciously designed to persuade users towards a particular course of action. The majority of applications to date have been developed for commercial contexts. For example, aspects of persuasive technology design are incorporated in to many website applications. The well known Ebay site uses a rating system to indicate buyer and seller feedback – a coloured star and a number is placed next to the users' names to indicate different levels of feedback. The intent of the designers in implementing this is to persuade users to be fair and honest in their transactions on the site. HANDS was one of the first projects to apply Persuasive Technology Design for use in educational settings.