A classification model for psychological apps: a first categorization of apps for children with Autism Spectrum Disorder

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Abstract. Technology is increasingly used in the context of existing rehabilitation therapies for neurodevelopmental disorders as Autism Spectrum Disorder (ASD). The use of mobile devices appears extremely functional for people with autism spectrum disorder (ASD) primarily due to how easy it is to use mobile phones, now within everyone's reach. Technology can be transported, used, and also for the possibility that these devices offer to overcome problems in the management of face-to-face interactions or problems associated with treatment outside the therapy room. The recurrent use of technologies in rehabilitation has generated, in recent years, a proliferation of software for autism in different areas and categories and, in addition, confusion and disorientation due to the absence of a guideline that helps parents, teachers, and therapists in selecting the application closest to the individuals with ASD critical issues. Thus, our work aims to propose a categorization model of existing applications for children with ASD starting from a functional diagnosis approach. Applications are described and categorized according to the areas on which training and rehabilitation are focused. Our intent is to create a guide for caregivers, with the hope that it could become a really effective tool to deal with the difficulties that ASD disorder involves.

Keywords: autism, app, technology.

1 Introduction

1.1 Autism Spectrum Disorders: an overview

Autism Spectrum Disorder is a particular condition of neurological development [1] that leads to atypical cognitive development and behavior. Despite the fact that individuals with ASD all belong to the same diagnostic label, the term 'spectrum', express the variability of cases. The disorder's manifestations vary in relation to the severity level of ASD condition [2] and it is also related to the chronological age and the level of development of the individual.

However, some common behavioral aspects of the autism condition have been identified. Diagnostic classification systems [3] have defined the ASD as a condition characterized by communicative and social difficulties and a restricted repertoire of interests and activities. There is an ASD prevalence in male children rather than females with a 4:1 ratio. DSM-5 outlines the different diagnostic criteria of the Autism Spectrum including atypical behaviors in socio-emotional reciprocity, in orientation and attention towards social stimuli, difficulty to adapt behavior to different social situations, and lacking integration of verbal and non-verbal communication. Movements and speech are often stereotyped, behavior rituals and everyday routine are rigid.

Moreover, impairment of the function of people with ASD compromises and has consequences in various contexts such as school [3]. A good evaluation of the child with ASD should be global, therefore including every aspect of its functioning, and performed by a professional team in collaboration with caregivers in order to implement personalized interventions aimed at improving both children and caregivers quality of life.

1.2   ASD and mobile technology

Interventions for people with ASD are different and programmed according to the specific characteristics of the individual. Some intervention programs include the use of mobile technology, like tablets. Mobile technology generally stimulates motivation and the interest of children with ASD is more easily captured with the use of tablets: the child with ASD, therefore, appears more inclined to focus on the task. Another advantage is represented by the fact that the use of a tool like a tablet, could reduce the anxiety of some children with ASD and could be perceived as safer: the anxiety derives from the discomfort of relating to other people and from weak communication skills.

Technology can also enhance the work of those who evaluate and diagnose, as a real-time data acquisition combined with rapid information processing can guide in the choice of tests for an in-depth evaluation, useful to provide a picture as complete and detailed as possible of the difficulties experienced by the person.

Mobile technology is easy to transport, is supplied by flexible multimedia content and big storage capacity, provides accuracy of data recording and collection[4]. These advantages make mobile technology so useful and concretely profitable [5].

In recent years there has been an increase in the production of application for the treatment of Autism Spectrum Disorder. The market contains a high number of applications but the iOS and Android platforms do not check whether the apps in their stores have been scientifically validated; they simply perform a standard check of the program allowing any developer, even with a non-clinical background, to publish applications in the mental health category and present them to the market as delegated to the treatment of behavioral and psychological problems, psychoeducation, health care [6].

Despite the massive growth in the number of 'clinical' applications, the scientific studies aimed at explaining their use methods and at demonstrating their effectiveness failed to keep up with their development. Therefore, there is a high risk that these applications, from the clinical point of view, are used without any scientific reference. The lack of a guideline has generated confusion about the choice of these applications.

Parents, rehabilitators and educators have opted for self-organization in app selection as an expedient. An association of mothers, for example, has begun to review and categorize the educational applications [7] of the market by creating their own web page "Mamamo" [8]. Educators also worked on developing websites that had the same purpose: to create real communities of users willing to provide reviews of the applications used. Autism Speaks, which is the world's largest association for autism, has recognized the need to create a filter, still very generic, of existing applications related to this area. On the website of "Autism Speaks" [9], a section has been dedicated to a database that generates a list of applications related to inserted criteria, as the use purpose of applications, the device used, and the age of the child. However, this is still a generic selection. In Spain, they have created a similar site also available in English "Appyautism" [10].

The need to categorize existing applications has led to the creation of e-books that have unfortunately assumed the clear appearance of product catalogs. The assistive technologies world is divided into categories (category of learning, communication, everyday life, and so on). However, the model used for the division of technologies does not conform with a classification of technologies for autism based on needs and learning domains. Considering this large number of existing applications, it is our intention to present a model for classifying existing apps based on a functional diagnosis of the child with ASD.

2   Categorization model of applications for children with ASD

The growth of in demand for mobile applications for people with ASD and the proportional increase of them requires more structured guidelines. We propose a categorization model of apps that consists of four macro-categories, each of which is related to a different and specific treatment area of the child. The applications are described and categorized with reference to the main functional areas for enabling/rehabilitating the child. The categorization model that we propose in this paper wants to be as much as possible related and understandable to psychologists, teachers and parents, for this reason we have chosen to propose a categorization of educational applications for mobile devices that is as close as possible to the functional diagnosis of the child. The functional diagnosis is the analytical description of the psychological and physical functions of a child who is experiencing difficulties.

The functional diagnosis (F.D.) , in fact, is an articulated document that outlines the functioning modalities of the child's abilities and is drawn up after an accurate clinical examination; the F.D. summarizes all the information within a psychological and functional "framework" that will allow teachers, educators and caregivers to understand all the problems that the child has shown during a complete psychological assessment.

The functional diagnosis, in fact, often becomes a tool that helps to know the child, in fact the document of the functional diagnosis describes: the set of the difficulties, the residual capacities and those that can be compensated, and the development potential of the child.

A complete functional diagnosis describes the cognitive aspects, the child's interpersonal skills, linguistic development, motor development, memory, attention and spatial and temporal organization, as well as autonomy.

We believe that a good model for the categorization of educational applications can and should be as close as possible to the model of functional diagnosis, since it would be easily consulted and useful to all the experts.

Currently, there is no such categorization, operators rely on reviews in order to choose the most congenial application to their needs, we decided to start from this scenario and make an analysis of the applications present on these databases and then categorize them in the "App autism" website [11].

At the preliminary stage of our work, we carefully examined existing applications for children with ASD. First, we underlined some aspects that can contribute to making the classification even more articulated. In fact, we pointed out that each application can be closed, leaving the user the opportunity to make changes by inserting, for example, additional content, or opened, offering the opportunity to modify certain aspects such as game items. Another significant distinction is the one relating to the hardware or software nature of the application. Indeed, it is possible that the same application, conceived as a software, can subsequently be realized also in the hardware version [12] and can use tangible interfaces [13]. We also identified applications based on the context of use, since there are apps designed for use at school or at home. The last categorization has been made between applications exclusively dedicated to the processing or designed to be simply a technological exercise. This information is a label that should simplify the identification of the most suitable application. It must be considered that many mobile applications on the market cannot be classified as totally educational or rehabilitative applications, many of them, in fact, have only entertainment purposes. The first parameter to take into consideration to check if a mobile application is professional and suitable for use in schools or during a rehabilitation session, is to check whether it contains learning assessment tests, if there are any clear references to learning areas and if it integrates a reporting system of the learning that the child acquires during the game sessions.

After a preliminary investigation and classification phase, we implemented the classification model of applications for children with ASD. Our model consists of four macro-areas: 'routine and behavior tracking', 'social-emotional training', 'functional communication' and 'data recording and ABA practices' (Fig.1).
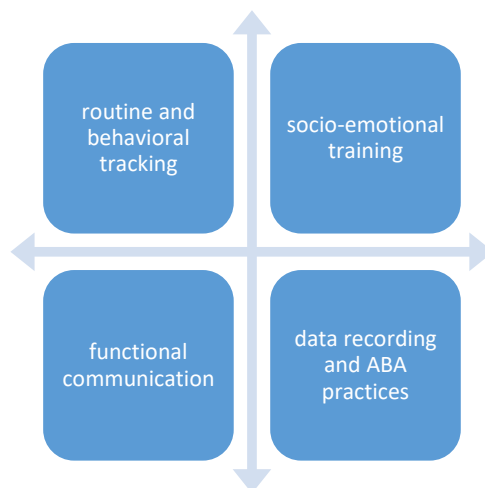
Fig. 1. Categorization areas

Macro-areas:	
1. Behavior tracking	Applications that simplify the acquisition and processing of data on behavior and produce graphs that allow to check the behavior's trend.
2. Socio-emotional training	Applications designed to work on communication and social interaction deficits manifested by the subject in contexts in which he lives and aimed to improving the capacity for self-regulation.
3. Functional communication	Applications created to progressively eliminate the problem behavior deriving from a communication deficit.
4. Data recording and aba practices	Applications that the behavior analyst uses to facilitate and integrate his own work.

Table 1. Categorization macro-areas

For each of them, there is a description of how the application must be characterized to be part of it. The app related to 'behavior and tracking behavior' area facilitate and speed up the processes of acquisition and development of data on behavior and generate automatic graphs that allow to visualize and therefore monitor the trend[14]. An app

placed in this area must then satisfy some requirements such as: taking note of the individual behavior in a predetermined time interval, collecting the data and inserting it in a graph to allow observing the trend, processing the data so that it is possible to document the progress of the intervention.

Within the 'training socio-emotional training' area we find all those applications that stimulate self-regulation and empower communication [15, 16] and social interaction in different contexts. Children with ASD often don't develop a theory of mind and are not able to attribute mental states to others, communication exchanges are compromised and there's a lack of interest for social contexts to which they belong. The applications related to this category are aimed at reducing the difficulties in conversation, moderating non-verbal communication, improving the ability to maintain relationships, stimulating motivation to interact, making the child able to adapt his behavior to the different contexts.

Cognitive, emotional and social self-regulation concerns the control and modulation of thoughts and emotions but also behavior monitoring. When an individual develops good self-regulation he is able to respond adequately to the environment's demands. In children with ASD self-regulation is compromised. Applications that support the child during the creation of social stories are particularly suited to meeting the criteria of the applications placed within this category.

The macro area of 'functional communication' encompasses all those applications that aim at the progressive extinction of problem behaviors deriving from a communication deficit. It frequently happens that children with ASD have significant difficulties in communicating their needs and thus implement problem behaviors. The applications related to this macro area have been designed to contribute to the reduction of these communication problems.

'Data recording and ABA practices' is the last macro area we have identified. Within this area are placed all those applications that constitute an integration of the behavioral analyst's work. It has been discovered that the ABA method is considered as an effective intervention strategy for people with ASD, the applications of this category collect and analyze the treatment data, guaranteeing greater efficiency and quality to the intervention and offer the possibility of integrating and consolidate the work done by the therapists thanks to the chance to use the app at home, therefore outside the therapy room.

3   Conclusions

Recognizing then the potential of applications in the contexts of diagnosis, rehabilitation and treatment of people with ASD, the objective is to encourage integration, learning, socialization, cognitive improvement, personal skills through the development and the use of software and mobile devices. Therefore, mobile technology and, specifically, all those applications designed and created exclusively for subjects with ASD, can respond concretely to the needs of the caregivers and therapist community [17]. In order to disseminate this categorization model for mobile applications that support the reha-

bilitation of children with ASD, we have also created a website (http://appautismo.al-tervista.org/) that collects the applications that have been categorized during our study. Within the website, every application that was found was tested by a team of expert psychologists who also produced videos to show how it works. Subsequently, for each application, the team of psychologists identified the most suitable age group to be used by a child and, finally, proceeded to describe the possible psychology methodology that could have inspired the exercises and games proposed.

The choice of the best application is still based on intuition. A model of categorization of existing applications is therefore necessary. Inserting in the description a link that refers to a specific model of categorization of applications for the ASD, like the one we developed, could help to make a more informed choice of the application. Our intent was to create a guide, a real useful tool for children caregivers, with the hope that it could become a real effective tool to deal with the difficulties that ASD disorder involves.

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