



# ICT to Aid Dental Care of Children with Autism

Mariasole Bondioli

Susanna Pelagatti

University of Pisa

Lungarno Pacinotti 43, 56124 Pisa

{mariasole.bondioli,  
susanna.pelagatti}@di.unipi.it

Maria Claudia Buzzi

Marina Buzzi

IIT-CNR

via Moruzzi 1, 56124 Pisa

{claudia.buzzi, marina.buzzi}@iit.cnr.it

Caterina Senette

IIT-CNR

via Moruzzi 1, 56124 Pisa

caterina.senette@iit.cnr.it

## ABSTRACT

Dental health in children with autism presents many challenges, due to their different perception of sensory experience and difficulty accepting unknown social contexts. The dental care setting presents strong sound-visual stimulations that can upset a patient with autism, often forcing dentists to administer chemical sedation in order to deliver dental care. In recent years, several technology-enhanced systems and apps have been proposed to help people with autism adapt to new contexts and cope with distressing social situations. Our study explores the potential of personalized digital tools for familiarizing these children with dental procedures and environments, and teaching them how to perform proper oral hygiene at home. A 3-month study to test ICT tools created to control children's anxiety and avoid sedation was carried out involving researchers, developers, dentists, psychologists, parents and ten children with autism observed under natural conditions during their first dental care cycle. The results appear to confirm the potential of personalized technology to reduce anxiety in professional settings, increasing children's wellbeing and safety and encouraging oral hygiene as part of their daily routine.

## CCS Concepts

• **Human-centered computing~Participatory design** • *Human-centered computing~Accessibility systems and tools* • *Applied computing~Healthcare information systems*

## Keywords

Autism; Dental health; Web application; Cognitive games

## 1. INTRODUCTION

The behavior of patients with autism spectrum disorder (ASD) makes the delivery of oral hygiene and dental treatment a big problem due to their different sensory perceptions. Recent studies acknowledge ASD children's difficulty approaching dental visits and performing daily oral care as the most significant factors in their poor oral health. Their higher rate of pathologies in fact can be related to a lack of prevention in oral care, which usually is not appropriately delivered to meet their special needs [5]. Children with autism need to be supported during dental visits by an interdisciplinary plan of action that takes into account the individual's specific needs and implements strategies to promote better dental health [5]. To increase the probability of successful dental treatment of ASD patients, the dentist should have an in-depth interdisciplinary understanding of the autism syndrome as well as of behavioral principles for therapeutic intervention. Barry [4] examined the problems encountered by children with autism

when accessing dental care, using a questionnaire completed by 112 subjects (parents), suggesting some intervention guidelines involving photos and social stories (which are a subset of the ICT activities attempted in our study).

The effectiveness of ICT in teaching various skills has been confirmed by several studies. Video modeling [10] and visual programs for the development of social skills [3] are increasingly used. The literature reports the use of video materials to obtain the cooperation of ASD children during a dental visit, for instance to visually teach the children how to brush their teeth [9]. Visual scheduling has also been very useful for helping the child understand and accept sequences of activities [6]. Isong et al. [5] tested two types of electronic screen media – a Google glass (sunglass-style video eyewear) and a DVD reader – showing that their use was beneficial in reducing fear and uncooperative behaviors in ASD children undergoing dental visits. However, they used the child's favorite digital movies or videos performed by a normal-typical child in a general dental setting. Personalization may increase the intervention's usability and efficacy, so we use videos and pictures made during the child's own dental sessions, making the child an active participant in content creation. This exploratory study investigates the use of ICT to engage and simplify dental care for children with autism by actively involving the subject; the aim is to define a general methodology to enhance current practice.

## 2. THE STUDY

Ten children 6-12 years old (age range covering the permanent dentition process) were recruited from among young patients with autism seeking access to dental care at a public hospital in Pisa. The group, identified with the help of the no-profit association Autismo Pisa Onlus, included nine low-functioning children (three non-receptive and non-verbal, three receptive non-verbal, and three receptive verbal) and one high-functioning. Two different multidisciplinary teams were enrolled: clinical professionals (dentists and neuropsychiatrist) and ICT researchers. Two dental professionals and one neuro-psychiatric expert defined the clinical protocol. Parents had a crucial role, especially by assisting and supervising recommended activities at home. One dentist supervised the overall procedures and interacted with parents; the other delivered oral care to children, assisted by the hygienist when necessary. An ICT researcher, present at all children's visits, recorded observational data of children's behavior. The protocol includes: (i) identification of figures and roles to involve; (ii) the number and frequency of visits to plan with the children; (iii) the amount, type, and collection of data needed to characterize the children; (iv) activities to perform during visits; (v) definition of the materials to be used. The first meeting helped the dentist get to know each child (and his/her parents) and test the child's reactions to simple requests such as to sit in the dental chair or open their mouth. A questionnaire was administered to the caregivers to collect data related to the child's oral condition, dental hygiene habits, sensory disturbances, the

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child's autism condition, and the use of technological devices such as tablets and smartphones.

## 2.1 Activities

The children's training was structured to include three different types of activities: medical procedures, educational activities (during the visits) and homework using a kit of personalized digital resources (video and games) that the dentist provided to each child's family. Visits were scheduled as weekly appointments (45 min) for each child over a 3-month period. The venue was always the same clinical room, to avoid confusion and ease familiarization. The dentist (helped by the ICT researcher) collected resources (part of the kit) gradually, visit by visit, personalizing them in all the intervention phases. The kit was given to the child to be used at home in order to prepare the child for the next appointment. Children were actively involved in resource collection using a tablet (especially as a camera) in order to create a constantly updated personal multimedia archive. Moreover, the dentist provided each child with typical dental objects such as mirror, probe, toothbrush, gloves and protective glasses, inviting the child to simulate their use at home, assisted by caregivers.

## 2.2 Materials

Examples of materials used in this study to support the familiarization process are: 1) **Cognitive learning games**, to familiarize the patient with dental procedures in an amusing way. In ASD children, games are used to stimulate learning through imitation [1], [2], [10] and to capture user attention and collaboration in performing specific tasks. Four kinds of customizable digital games: memories, puzzles, sequences and matching exercises. Sequences proved to be particularly helpful in teaching "how things happen" and how to communicate with clinical staff. As Menzies et Al. [7] highlighted in their study "the most important aspects of communication from the patient were identified as being *yes*, *no* and *stop*". 2) **Audio, video and photos** indexed by visit date, to keep track of the important phases of the visit. The child can navigate his/her resources and show them to parents, relatives or friends. 3) **Interactive PDF files** equipped with sound effects: particularly useful for narrating stories that introduce the dental environment, procedures and/or objects. This allows associating positive elements with a stressful event and can help reduce resistance to change. 4) **Videos** reproducing all actions from the arrival at the clinic to the child sitting in the dentist's chair. The videos are essential for activating the imitation. Seeing familiar people performing target actions can help the child's imitation process [8]. Crucial attention is devoted to technical details such as freeze frame, zoom, audio-visual aids and graphics that transform the footage into a powerful educational tool.

## 3. RESULTS AND CONCLUSION

This study investigated whether technology can make dental care more efficient, effective and pleasant for ASD children. Starting from previous research, we investigated how to take advantage of every child's interest in gaming and multimedia content, to facilitate ASD children's dental care. Results of this study appear to confirm the feasibility of the proposed approach and the positive role of technology support: (i) Eight out of ten children responded to this approach positively, modeling their behavior and becoming increasingly collaborative, visit by visit; (ii) Nearly

all caregivers manifested satisfaction with the approach due to their active involvement. (iii) Caregivers strongly committed to the protocol, who respected the weekly schedule, felt that the child-parent relationship was reinforced, and the corresponding five children successfully completed the dental protocol in the scheduled time. In contrast, three children who missed half or more of the scheduled sessions due to caregiver issues were also unable to complete the familiarization protocol and then their dental procedures in the time scheduled. Flexible and dynamically customizable technology could adapt to the specific needs and preferences of each child, aiding the familiarization process and reducing anxiety in professional settings, increasing children's wellbeing and safety.

Starting from these results, we extracted the requirements of a Web environment for easy creation, management and fruition of digital resources for ASD children and dentists, in an accessible structured framework. As future work, we will apply participative design and early prototyping to create the MyDentist platform.

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