

Building Autonomous Social Partners for Autistic Children

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Abstract. We present the design and implementation of an autonomous virtual agent that acts as a credible social partner for children with Autism Spectrum Conditions and supports them in acquiring social communication skills. The agent’s design is based on principles of best autism practice and input from users. Initial experimental results on the efficacy of the agent show encouraging tendencies for a number of children.

Keywords: Virtual Social Partners, Pedagogical Agents, Autonomy.

1 Introduction

This paper presents an autism practice-based approach to designing and implementing an autonomous virtual agent that can act credibly both as a peer and as a tutor to support young children with Autism Spectrum Conditions (ASCs) in developing social communication skills. The design of the agent is based on participatory design workshops with practitioners and children as well as the SCERTS framework [7] - an established educational intervention approach aimed to support social communication (SC) and emotional regulation (ER) of children with ASCs through appropriately designed transactional support (TS). Our pedagogical agent is implemented in a virtual environment called ECHOES intended for real-world use in schools as part of their everyday activities.

Autism is a spectrum of neuro-developmental conditions that affects three main areas (“triad of impairments” [1]): (i) *communication*: problems with verbal and non-verbal language; (ii) *social interaction*: problems with recognising and understanding other people’s emotions and with expressing their own emotions; and (iii) *patterns of restricted or repetitive behaviours*: problems with adapting to novel environments. We focus on enhancing the *social communication* competence of children with ASCs because this is the domain with which they typically have the most difficulty [6] and because recent studies indicate that individuals with ASCs and their caregivers consider support for social communication as the most desirable feature of technology-enhanced intervention [8].

The paper is organised as follows: Section 2 discusses why children with ASCs may benefit from virtual agents; Section 3 presents the SCERTS model, which provides the theoretical foundation of our agent’s design; Section 4 describes the design and the implementation of the ECHOES agent. Sections 5 and 6, respectively, report the evaluation of the agent and offer our conclusions.

2 Agent Technology for Autism

Children with ASCs have an affinity with technology and are motivated by computer-based training [8]. Software programs are predictable and structured environments that can accommodate the children’s need for organisational support and their preference for routine behaviours. The anxiety linked with social interaction can be mitigated by the use of artificial peers which are tireless, consistent and positive towards the child regardless of the child’s behaviours. An appropriately designed artificial peer can meet individual children’s needs and allow them to exercise the same skill in different scenarios, from structured situations to gradually more unpredictable contexts, thereby increasing the chances of transferring the learned skills from the virtual to the real world [11,2].

Despite a recent growing interest in the potential of artificial agents, both virtual and physically embodied, for human-computer interaction the efforts have focused primarily on agents with little or no *autonomy*, with the exception of the Thinking Head project [4], which focuses on developing a talking head that teaches social skills through its ability of realistically portraying facial expressions, and the virtual peers, Baldi and Timo [2], which are 3-D computer-animated talking heads for language and speech training. Autonomous agents carry a significant potential for autism intervention for children, because they can compliment the intensive one-on-one support that the children need, by allowing human practitioners to focus on the most complex aspects of face-to-face interventions, while managing any repetitive tasks and on-demand access.

The approach presented in this paper focuses on the development of a *fully autonomous* agent, i.e. an agent that is able to decide independently how to act best in order to achieve a set of high-level goals that have been delegated to it. In keeping with the classic agent theory of Wooldridge and Jennings [13], in addition to autonomy, the ECHOES agent is equipped with: (i) *pro-activeness*; (ii) *reactivity*; and (iii) *social ability*. The agent’s pro-activeness is important to maintaining the child’s attentional focus and to foster motivation. Reactivity is fundamental to adapting the support to the children’s changing needs as well as cognitive and affective states, while social ability – to maximising the chances of the child to experience a sense of self-efficacy in communicating with the agent.

3 Pedagogical Underpinnings for the ECHOES Agent

In order to identify the social communication skills that a virtual agent needs to possess to act as a credible social partner to children with ASCs and to support