Chapter 2
Designing and Evaluating Interactive Agents as Social Skills Tutors for Children with Autism Spectrum Disorder

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**ABSTRACT**

Autism spectrum disorder (ASD) makes communication and social interaction very difficult for those affected. Existing studies have reported positive results for teaching social skills to children with ASD using human-controlled virtual agents and language skills using autonomous agents. Here we combine these approaches and investigate the potential of autonomous agents as social skills tutors. A system for audio-visually synthesising an agent is developed towards this purpose and utilised together with two tutoring modules that we specifically designed for teaching conversation skills and how to deal with bullying. Following evaluation, children’s thoughts about their experience with the virtual tutor were investigated through use of a survey. The positive feedback and the modest but significant improvements in test scores for both modules suggest that this strategy for teaching social skills has much potential and that further research and development in this area would be eminently worthwhile.

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1. INTRODUCTION

Inter-human communication is not just about explicitly conveying facts and plans, but also about building friendship, authority, and other aspects of social relationships. Non-verbal signals play as important a role as verbal ones in this context, and learning how to correctly decipher and respond to them is essential to success in life.

People with autism spectrum disorder (ASD) find this more challenging than others, and therefore often struggle to participate successfully in society. Recent trends are pointing to a future in which we will be expected to also interact with computers in a more social way. Embodied conversational agents (ECAs) represent the ultimate form of this. ECAs are virtual anthropomorphic interface agents that emulate human face-to-face dialogue across all the natural modalities, including speech, intonation, gesture, gaze, and other verbal and non-verbal signals. Such virtual humans offer a new yet at the same time very familiar means of interacting with computers, and in attempting to create them we invariably also gain practical insights into human-to-human interaction.

ECAs constitute the ideal medium not just to explore but to convey knowledge in this domain; indeed, to act as tutors in social interaction. A computer cannot replace a human expert at this task, but any basic skills that can be taught in this way will allow the expert to spend more time on the difficult cases. Children with ASD are a promising target for this computer-aided approach, as they have the most to benefit from basic tutoring and also the greatest potential for improvement. This chapter shall hence be concerned with the creation and evaluation of an ECA that can assist such children in acquiring essential social skills.

We begin with an overview of ASD and consider the potential benefits and drawbacks of autonomous virtual agents as social skills tutors for children with ASD. Earlier software-based interventions are discussed and several ideas brought together to establish a new ECA-based approach towards bridging the gap between the theory and the practice of assisting these children. We establish an ECA synthesis framework that is customisable for this purpose and offer details on its implementation. Two lesson modules are then developed for the benefit of children with ASD; one focusing on conversation skills and the other on dealing with bullying. These lessons were chosen as they reflect common difficulties that children with autism face every day due to their communication difficulties and difficulties with reading body language. After testing the effectiveness of the lessons, children’s thoughts about their experience with the virtual tutor are investigated through use of a survey. We finish with a view towards the future, examining the further prospects of effective intervention with ECAs and the technologies that will contribute to it.

2 BACKGROUND

2.1 The Nature of Autism

Autism is a pervasive developmental disorder characterised by the ‘triad’ of impairments, encompassing impairments of communication and social skills as well as a tendency towards repeated patterns of interest and behaviour (American Psychiatric Association [DSM-IV-TR], 2000). Affected individuals may interpret language very literally, causing misunderstanding when sarcasm and metaphors are involved (Rapin and Tuchman, 2008).

Children with Autism Syndrome Disorder (ASD) frequently have difficulties in using and understanding non-verbal cues such as body language, gaze and facial expression, which reduces their ability to develop friendships and other relationships. Individuals with ASD can also find changes to their routines and environment quite confronting and stressful, as they struggle to generalise their skills to new situations. New