Cognitive Science and Technology

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Teaching Skills with Virtual Humans

Lessons from the Development of the Thinking Head Whiteboard

Springer

Cognitive Science and Technology

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About This Book

The face of education is rapidly changing in response to a demand for more flexibility in learning and a plethora of new technologies becoming available. Embodied Conversational Agents (ECAs) are one such technology changing the way we teach and learn. Often referred to as pedagogical agents or virtual tutors when used in an educational setting, ECAs are used to increase both engagement and understanding in educational software settings. Here we explore the range of educational areas ECAs are currently used in, how we can create appealing and effective agents and learning systems, and what the future holds for teaching and learning with ECAs. To assist in this discussion the development and evaluation of the Thinking Head Whiteboard, an ECA-based system used for teaching social skills to children with autism, is presented as a case study.

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Chapter 1
Introduction

In the context of education ECAs can take on multiple roles. It is common for the ECA to take on the role of the teacher, facilitating learning through a combination of explicit instruction, feedback and questioning, much like a classroom teacher would (Bosseler and Massaro 2003; McNamara et al. 2004). Another approach entails having the ECA take on the role of peer or collaborator, modelling positive behaviours and skills while interacting with the learner in order to guide the learner towards developing desired knowledge and behaviours in a more natural way (Milne et al. 2013; Tartaro and Cassell 2008). ECAs may also take on the role of another learner, requiring that the human learner teach them about a subject of interest, and in doing so expand and consolidate their own knowledge of that subject (Blair et al. 2007).

We are all individuals, and as such have different learning preferences, backgrounds, and areas of need. Considering this, it makes sense to implement ECAs in educational software in the role most suited to the target audience and topic content being addressed. When teaching fact and procedure driven areas, such as mathematics or physics, a teacher ECA may be the most appropriate choice, whereas in socially driven areas, such as learning conversation skills, a collaborative peer may prove more beneficial. Of course, we are not limited to a single ECA in any given scenario, and as such a combination of teacher and peer ECAs may be the optimal solution for engaging and effective learning. While we can hypothesise which approach is most appropriate for a given context based on what works with human teachers, tutors and peers, ultimately it is through evaluation of educational outcomes that we will discover the most suitable option for any given combination of learner and content.

A key consideration when developing ECA-based educational software is the ECA itself—its appearance, voice, facial and body gestures, and other mannerisms all combine to create a persona. Existing research shows that for an ECA to be engaging and well accepted, these need to mesh in a culturally realistic manner and come across as natural rather than robotic or contrived (Iacobelli and Cassell 2007). Further, the persona must be appropriate to the role the ECA is playing and be in line with existing human–human social conventions. It is not appropriate to have a

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young child-like ECA teaching tertiary level physics, nor an adult ECA play the role of a peer for a school age learner.

In this book we provide a variety of examples of ECA-based educational software, spanning both age group and application area, a discussion of issues relating to the design and implementation of both the ECA itself and the system it is embedded in, and a discussion of underlying educational principles. As a case study we also present the Thinking Head Whiteboard, a flexible and customisable ECA-based learning system, and discuss the outcomes of an initial evaluation using this system as a social skills tutor for children with autism. Finally, we look at future directions for ECA-based educational software.

1.1 Recommended Reading

This book is designed to be useful for a wide audience, and as such some sections will be more relevant for each individual reader than others. An overview and reading recommendations are provided here to assist you to get the most out of this text.

1.2 For Families and Educators

This Chapter and Chapters 2, 3, 4 and 9 are likely to be most relevant, depending on your interests and goals. This Chapter and Chapters 2 and 3 cover the reasons why virtual tutors are useful learning aides, what makes an effective teacher and an effective educational environment, and which elements from these learnings can be used in a virtual setting. Chapter 4 provides an overview of existing virtual tutors, not only for children with autism, but across multiple applications, subjects, and stages of life. Chapter 9 summarises and speculates about what the future may hold for virtual teachers.

1.3 For Developers and Researchers

For colleagues who are currently developing virtual tutors or embodied conversational agents for other purposes, Chapters 2 and 3 provide useful insight into what practices effective human teachers use to support their learners, and how we can adapt that into a software context. Chapter 5 addresses specific recommendations about designing Embodied Conversational Agents that are engaging, trustworthy, and appropriate for their intended purpose. Chapters 6 and 7 are specifically aimed at developers who are creating educational software for individuals with autism, and

these lead into Chapter 8 where we share the details of the evaluation of our own Social Tutor for children with autism, including technical challenges faced, lessons learned, and recommendations for future developers.