

# Development of a prototype module for social skills tutoring of children with autistic spectrum disorders

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## Aims

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The goal of this project is to evaluate the potential of autonomous virtual agents as social tutors for children with autism spectrum disorder. Virtual agents can be broadly defined as either autonomous, being self-contained and behaving independently, or authorable, being controlled by an outside influence such as a researcher interacting with a control panel. There is evidence from existing studies that, in terms of interventions for autism, autonomous virtual agents can be of use in language learning (Bosseler & Massaro 2003) and authorable virtual agents can be used to teach social skills (Tartaro & Cassell 2006). This project draws inspiration from these existing studies and aims to investigate whether autonomous virtual agents can also be used to successfully teach social skills. It seems that virtual agents have vast potential for use with this learner group, as they can be customised to meet individuals' needs and are predictable, consistent and patient.

The primary goals of this project are to develop a self-contained software prototype based on virtual agent technology and perform an evaluation on it involving children with autism. From this, test scores and participant feedback will be used to indicate whether this approach appears promising and further work into the use of autonomous virtual tutors for teaching social skills is justified.

## Method

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Fourteen participants were involved in the study, three with high functioning autism, ten with Asperger Syndrome and one with classical autism. Six participants were involved in the evaluation of both tutors; four participated in the conversation skills tutor only and four in the dealing with bullying skills tutor only. This resulted in ten children participating in the evaluation of each tutor (conversation tutor, mean age: 10.5, range 6 to 15; dealing with bullying tutor, mean age: 9.9, range 6 to 15).

The evaluation process was constructed so that an individual could complete the process in roughly an hour, including breaks and the built-in testing. The evaluation process for both the conversation tutor and dealing with bullying skills tutor was identical, each consisting of three rounds of interaction with the virtual tutor. Each round was designed to take approximately fifteen minutes, with a five minute break occurring between each.

In the conversation tutor there were three types of questions. In 'face test' questions, the virtual tutor modelled a facial expression, possibly with a verbal cue, and participants were required to name the expression. In 'action test' questions, the virtual tutor asked a question such as, If the person you are talking to is bored, which of these is the best thing to do?, and participants chose the appropriate action from the given options. In 'combined test' questions, participants were presented with an expression and asked to choose the action to take from the listed options. In the dealing with bullying skills tutor there were four types of questions. In 'strategy steps' questions, participants were asked to identify what they would do first, next and last if confronted with a bullying situation by clicking on options presented on the screen. In 'is friendly test' and 'is bullying test' questions, participants were required to determine whether a presented scenario was a friendly or bullying situation. In 'laughing test' questions, participants asked to identify whether a presented scenario constituted laughing with or laughing at someone.

All sets of questions were presented in random order to reduce the effect that any particular ordering may have had on the outcome. Throughout the testing phases no feedback was given and a new question was provided as soon as a response was made to the previous question. All lesson content was spoken aloud by the Head X virtual person and all icons, text and interactive content utilized throughout the lesson was presented on the Java interface.

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## Results

Through comparison of the pre-test and post-test data, it became apparent that most participants achieved at least a small improvement in their test scores. For the conversation skills tutor a 32% improvement on average was found. Using a Wilcoxon Signed Rank test, this overall improvement was found to be statistically significant ( $p < 0.05$ ) supporting the notion that it was the use of the tutoring software that led to this outcome. A visual representation of participants' pre-test to post-test scores can be seen in Figure 1. While each test was short, having only nine questions total, it contained three sections as previously discussed. On further analysis of the data, significance was reached for the 'face test' section ( $p < 0.05$ , Wilcoxon Signed Rank test) but was not the other sections, with many participants answering correctly in the pre-test and thus having no room for improvement in the post-test.

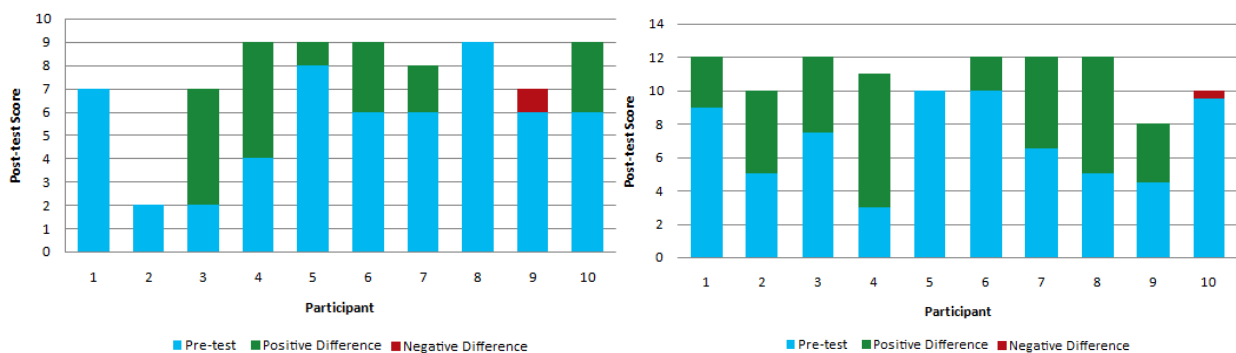


Figure 1: Comparison of pre- and post-test scores for conversation tutor (left) and dealing with bullying tutor (right).

For the dealing with bullying skills, a 54% improvement on average was obtained. This result was found to be significant through a Wilcoxon Signed Rank test ( $p < 0.01$ ), supporting the notion that the improvement here is the result of participants' interaction with the social tutor and not chance. Again an analysis was done for each of the components of the test. In this case, the test results were broken down into a 'strategy steps' component and 'situational reasoning' component. Statistical significance was reached for the 'strategy steps' ( $p < 0.01$ , Wilcoxon Signed Rank test), but not 'situational reasoning' section. Again, a high number of participants answered the 'situational reasoning' questions correctly in the pre-testing stage, leaving no scope for increased scores.

From observation of the survey results in Figure 2 it becomes clear that most responses were at the agreement end of the scale, suggesting that overall the participants' experiences with the conversation tutor were positive. Most notable is that all participants agreed quite strongly with the statement 'the tutors were friendly'

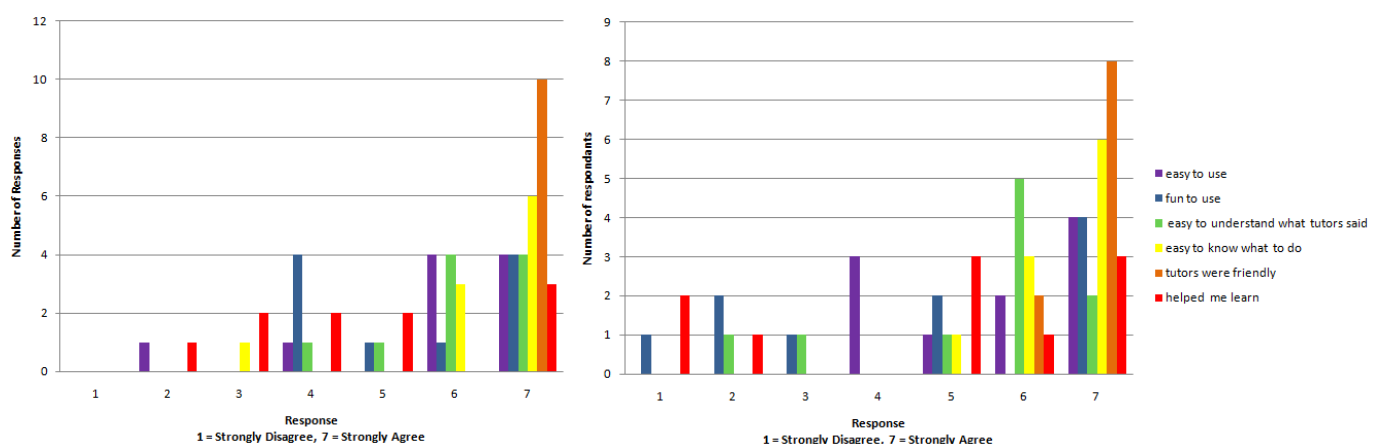


Figure 2: Survey results for conversation tutor (left) and dealing with bullying tutor (right).

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## Discussion

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On a very positive note, the overall improvements in participants' test results reached significance for both tutors, strongly suggesting that the gains made were due to the use of the tutoring software and not simply due to chance or other external factors. On breaking the pre- and post-tests down into their constituents, it was found that only the 'face test' component in the conversation tutor and the 'strategy steps' component in the dealing with bullying tutor reached significance, however other sections were nearing significance also. In some sections many participants answered a high number of questions correctly in the pre-test, leaving little scope for improvement. This suggests that for some participants the lesson content and difficulty level of the given questions was not sufficiently challenging, and as such a mechanism to monitor learners' progress and adapt to their needs would be ideal.

Anecdotally, there were several participants whose caregivers expressed surprise at their incorrect post-test choices and stated that this must have been because they were experiencing fatigue. In an ideal situation the evaluation of each fifteen minute block would be spread out more than was done here but given the time limitations of the study this was not viable. Along with the length of the evaluation, the repetitiveness of the modules was cited as a negative. However, repetitiveness was also mentioned as a positive by a number of participants. For those needing lesson content repeated for practice, it was a positive, and it should be noted that this was the aim of structuring the modules in this way. However, for some participants it was unnecessary and led to disengagement. Again, a mechanism that continually assesses the learner's level of proficiency and repeats only where necessary would help ensure that lesson content was appropriately challenging and engaging. Additionally, while the repetitiveness of lessons was an issue for some, the content of the lessons was cited as a positive aspect by several participants, confirming that the choice of lesson topics was appropriate and worthwhile for this learner group as was hoped.

A common issue with the software was the voice of the tutors, in particular the male voice. Participants and caregivers noted that this was because they did not always sound natural or exhibit correct intonation, causing some confusion, as the intonation of a verbal utterance such as 'oh' could indicate a variety of things including interest, disappointment or confusion, depending on the tone and context. While the best voices available were used, this is still noteworthy and it is expected that in future as the technology develops, more realistic voices will be available.

Overall, the survey results for both tutors were very positive with all participants strongly agreeing with the statement about the tutors being friendly. As one of the aim of this project was to provide a non-judgemental learning opportunity, this is a very positive result and suggests that this goal was achieved, and further supporting the notion that overall the participants' experiences with the tutoring software were positive. Additionally, 75% of participants said they found the tutoring program very easy to use and from observation all participants appeared to interact with the software very competently. Overall participants responded very positively to the notion of the virtual tutor for social skills teaching. While these early test and survey results provide tentative support, feedback from participants and their parents has been very positive and enthusiastic, which is very encouraging.

## References

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Bosseler, A. & Massaro, D. (2003), 'Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism', *Journal of Autism and Developmental Disorders* 33(6).

Tartaro, A. & Cassell, J. (2006), Authorable virtual peers for autism spectrum disorders, in 'Proceedings of the Workshop on Language-Enabled Educational Technology at the 17th European Conference on Artificial Intelligence (ECAI06)', Riva del Garda, Italy.