A New Approach to Testing Children with Autism Spectrum Disorder using Affect

Veronica Rivera

University of California Santa Cruz, Santa Cruz CA 95060, USA
vearivер@ucsc.edu

Abstract. In order to qualify for special education services, elementary school children with Autism Spectrum Disorder (ASD) are given a myriad of standardized tests. However, even when they have high cognitive abilities they often have difficulty answering test questions due to the nature of their disability. This causes them to underperform and not qualify for the services that would best suit their skills. The present proposal details a research plan to create an intelligent testing system that attempts to motivate the student upon detecting boredom and low levels of engagement.

Keywords: Affective Computing, Intelligent Tutoring System, Autism Spectrum Disorder, learner motivation, engagement, standardized testing.

1 Introduction and Problem Description

School-age children diagnosed with Autism Spectrum Disorder (ASD) are given several standardized tests in preschool and elementary school such as the Test of Visual Perceptual Skills, to measure their abilities in areas such as visual discrimination and sequential memory. Test results are a crucial factor used by school psychologists to recommend appropriate special education services. However, children with ASD often have difficulties taking standardized tests not because they lack the appropriate skills, but because of the nature of their disability. They exhibit deficits in joint attention, lack of motivation in answering test questions, and difficulty interacting with the examiner. These difficulties negatively impact their future academic progress by causing them to underperform on assessments, resulting in inappropriate educational placement.

Many of these problems arise from the format in which the tests are administered. Current tests are often given orally with verbal instructions, which are more difficult for children with ASD to understand than visual instructions [7]. This may cause low motivation to complete tests. Additionally, these tests are not engaging, lowering motivation even further.

However, most children with ASD show an affinity towards content displayed on computers [6]. Because of their eagerness to utilize technology, children with ASD could greatly benefit from intelligent tutoring systems to enhance their education. Emotion and affect have been used to make intelligent tutoring systems more personal

and engaging [1]. Such research is backed by studies demonstrating that emotions profoundly affect students' academic performance and ability to problem solve [5]. Most existing systems have been designed for and tested on neurotypical students. Because children with ASD exhibit increased emotional responses, we hypothesize that their performance on standardized tests would be further affected by their emotional state.

Intelligent testing systems exist for neurotypical individuals, such as the one in [3]. However, the proposed intelligent testing system offers a new approach by using automatic emotion detection to engage students during the test and targeting a group of users that is not yet well represented by existing systems.

2 Proposed Solution

An interactive testing method that responds to decreases in levels of engagement would enable children with ASD to perform to the best of their abilities on standardized tests. Two research questions driving this project are: *1) What factors motivate a child with ASD to complete academic tasks? 2) How can boredom and changes in engagement level most accurately be detected?*

The test will be administered to students on a computer with a webcam, which will capture displayed emotions for the duration of a given test. It will use supervised learning methods such as those in [2] on the captured facial expressions to detect boredom and low levels of engagement. The goal of the proposed system is to be a tool for school psychologists and other educators to better serve children with ASD, not to replace the important role these professionals play. Therefore, the system will not make final placement decisions regarding appropriate educational services, but will provide test results and data about changes in a child's motivation.

Results from the emotion recognition software will be used to create an interactive testing system that responds to low levels of engagement and perceived boredom. It will attempt to motivate the child by adjusting the difficulty level of questions presented and using supportive comments and animations. A human cartoon animated with movement and sound effects will be present in a corner of the screen throughout the entire test, providing encouraging messages. It has been shown in past research that although children with ASD typically have poor face processing abilities, using animated cartoon figures in an intelligent tutoring system for learning vocabulary can provide benefits for many of them [4]. The authors of [4] hypothesized that these results can be extended to other educational settings. Additionally, instructions will be presented in a visual format.

The proposed system will be evaluated using a control group and an experimental group. The control group will be given a test such as the Test of Visual Perceptual Skills, and the experimental group will be given a test using the proposed intelligent testing system. The proposed system will be considered successful if students in the experimental group exhibit higher scores and generally enjoyed working with the system, as determined by a post-test survey. Confounding factors to

take into account include a student's base intelligence, ability to use technology, and level of ASD.

3 Concluding Remarks

Although the proposed system is in its early stages, it holds great potential to open up new perspectives not just for improving the educational opportunities of children with ASD, but also for promoting inclusivity of individuals with special needs in existing intelligent tutoring systems. In the near future we will collaborate with special education teachers and school psychologists to create test content and revise the design plan before implementation of the software. We will also experiment with adding EEG sensors in the form of a wearable device to more accurately detect boredom.

References

1. Bosch, N., Chen, Y., D'Mello, S.: It's Written on Your Face: Detecting Affective States from Facial Expressions while Learning Computer Programming. In: Trausan-Matu S., Boyer K.E., Crosby M., Panourgia K. (eds) International Conference on Intelligent Tutoring Systems 2014. Lecture Notes in Computer Science, vol. 8474, pp. 39-44. Springer, Switzerland (2014).
2. D'Mellow, S., Jackson, T., Craig, S., Morgan, B., Chip-Man, P., White, H., Person, N., Kort, B., El Kaliouby, R., Picard, R., Graesser, A: AutoTutor Detects and Responds to Learners Affective and Cognitive States. Workshop on Emotional and Cognitive Issues at the International Conference on Intelligent Tutoring Systems. Montreal, Canada (2008).
3. Kozierkiewicz-Hetmańska, A., Nguyen, N.T.: A Computer Adaptive Testing Method for Intelligent Tutoring Systems. In: Setchi R., Jordanov I., Howlett R.J., Jain L.C. (eds) Knowledge-Based and Intelligent Information and Engineering Systems 2010. Lecture Notes in Computer Science, vol. 6276, pp. 281-289. Springer, Heidelberg (2010).
4. Massaro, D.W., Bosseler, A.: Read my lips: The importance of the face in a computer-animated tutor for vocabulary learning by children with autism. Autism 10(5), 495-510 (2006), doi: 10.1177/1362361306066599.
5. Pekrun. R., Linnenbrink-Garcia, L.: Handbook of Research on Student Engagement. Springer, Boston, MA (2012), doi: 10.1007/978-1-4614-2018-7.
6. Ploog, B.O., Scharf, A., Nelson, D., Brooks, P.J.: Use of Computer-Assisted Technologies (CAT) to Enhance Social, Communicative, and Language Development in Children with Autism Spectrum Disorders. Journal of Autism and Developmental Disorders, 301-322 (2013), doi: 10.1007/s10803-012-1571-3..
7. Quill, K.A.: Instructional Considerations for Young Children with Autism: The Rationale for Visually Cued Instruction. Journal of Autism and Developmental Disorders 27(6), 697-714 (1997).