College-educated adults on the autism spectrum and mathematical thinking

Jeffrey Truman

Simon Fraser University

This study examines the mathematical learning of adults on the autism spectrum, currently or formerly undergraduate students. I aim to expand on previous research, which often focuses on younger students in the K-12 school system. I have conducted various interviews with current and former students. The interviews involved a combination of asking for the interviewee's views on learning mathematics, self-reports of experiences (both directly related to courses and not), and some particular mathematical tasks. I present some preliminary findings from these interviews and ideas for further research.

BACKGROUND ON AUTISM-RELATED RESEARCH

The Autistic Self Advocacy Network (2014) states that autism is a neurological difference with certain characteristics (which are not necessarily present in any given individual on the autism spectrum), among them differences in sensory sensitivity and experience, different ways of learning, particular focused interests (often referred to as 'special interests'), atypical movement, a need for particular routines, and difficulties in typical language use and social interaction. Over the past few decades, there have been many research studies about learning in students on the autism spectrum, such as those reviewed by Chiang and Lin (2007). A large portion of these studies focus on K-12 students, and particularly elementary students, but some of the ideas and procedures in those studies lend themselves to use in a post-secondary context.

INTERVIEW PROCEDURES

After an initial period of background information and anything else in particular my interviewees wished to share about their perspectives on mathematics, I gave various mathematical tasks to elicit more specific responses. Some of these were directly related to specific courses, such as the example-generation tasks used by Bogomolny (2006) and the Magic Carpet Ride sequence used by Wawro et al. (2012). I have also given more general tasks, such as the paradoxes examined by Mamolo and Zazkis (2008); one reason for this was the interplay between visual and algebraic explanations seen in some student responses to these paradoxes.

THEORETICAL FRAMEWORK

There were several reported characteristics of people on the autism spectrum which I thought could be promising for mathematics education research. In particular, I was interested in details of prototype formation, special interests, and geometric approaches. I will detail each of these with a comparison to the particular findings relevant to them in Joshua's case.

PROTOTYPE FORMATION

I started looking into prototype formation after reading a study by Klinger and Dawson (2001). It suggested that people on the autism spectrum did not form prototypes of objects when given tasks asking about group membership, instead taking an approach based on lists of rules. Although this is presented as a problem, like many other autism-related studies, I suspected that this approach could be helpful for more abstract or proof-based mathematics. I have found many other students having trouble with mathematical questions that appear to result from a prototype-based approach, and this is particularly true when the course focuses on mathematical proof. In fact, I found a very similar division reported in mathematics education research by Edwards and Ward (2004), phrased as lexical or extracted definitions versus stipulative definitions. This did not appear to be the case for Joshua; he reported having this kind of thinking in the past, but was quite focused on "big picture" ideas today (this was, in fact, a recurring phrase in the interviews).

GEOMETRIC FOCUS AND VISUALIZATION

Particularly due to the work of Temple Grandin, one of the most famous people on the autism spectrum, there is often an association between the spectrum and visualization or spatial reasoning (Grandin, Peterson, and Shaw, 1998). While I would caution against being too broad with an association like that, I did find a strong preference for visual, spatial, or geometric reasoning in the interviews I conducted with at least one student. My suspicion is currently that there may be stronger variance or preference in types of reasoning, but that it is not all necessarily toward the geometric type.

PARADOXES

I have also presented several paradox tasks during my interviews. Like many of the students in previous studies, the people I interviewed found these to be strange and paradoxical. However, the response was notably more positive than those from most students. I also found it notable that I did not see any tendency toward rejecting the mathematical facts after they had been presented, unlike in many of the students in the prior studies.

References

Autistic Self Advocacy Network (2014). *About autism.* Retrieved from http://autisticadvocacy.org/about-autism/

Bogomolny, M. (2006). *The role of example-generation tasks in students' understanding of linear algebra* (Doctoral dissertation, Faculty of Education-Simon Fraser University).

Edwards, B. S., & Ward, M. B. (2004). Surprises from mathematics education research: Student (mis) use of mathematical definitions. *American Mathematical Monthly*, 411-424.

Grandin, T., Peterson, M., & Shaw, G. L. (1998). Spatial-temporal versus language-analytic reasoning: the role of music training. *Arts Education Policy Review*, *99*(6), 11-14.

Klinger, L. G., & Dawson, G. (2001). Prototype formation in autism. *Development and Psychopathology*, *13*(01), 111-124.

Mamolo, A., & Zazkis, R. (2008). Paradoxes as a window to infinity. *Research in Mathematics Education*, *10*(2), 167-182.

Wawro, M., Rasmussen, C., Zandieh, M., Sweeney, G. F., & Larson, C. (2012). An inquiry-oriented approach to span and linear independence: The case of the magic carpet ride sequence. *PRIMUS*, *22*(8), 577-599.