Geometric Reasoning in an Undergraduate on the Autism Spectrum: A Magic Carpet Case

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In this report, I examine the unusually precise geometric reasoning of a student in linear algebra given the beginning of the Magic Carpet sequence outside of their normal curriculum. Analysis of possible reasons for taking this approach and implications for teaching are presented.

My research attends to mathematical problem solving by adults on the autism spectrum (with a formal diagnosis), particularly those with a relatively strong background in mathematics. In this report, I focus particularly on the case of one student's work on one of the Magic Carpet problems of Wawro, Rasmussen, Zandieh, Sweeney, & Larson (2012).

Much of the research currently done on mathematics learning in people on the autism spectrum is focused on young children (e.g. Klin, Danovitch, Mers & Volkmar, 2010; Simpson, Gaus, Biggs & Williams, 2010; Iuculano et al., 2014) or looks at mostly arithmetic. There is also a notable strain of work done on the population of research mathematicians (e.g. James, 2003; Baron-Cohen, Wheelwright, Burtenshaw & Hobson, 2007), but very little attention is paid to groups in the middle (mainly high school and college students, or adults other than career mathematicians). This is a gap which I have sought to help fill with my own research, including the particular selection which I present here.

The theoretical framework that guides my research is rooted in the work of Vygotsky. I also start from a perspective of neurodiversity, generally referring to a positive and inclusive perspective on not only autism, but also other neurological differences (Silberman, 2015). More specifically, given my interest in focusing in-depth on interviews with a small number of people, I use case studies (Yin, 2009) from these perspectives. I also include Fischbein's notion of intuition (1979, 1982) and Grandin's work on geometric reasoning and autism (1995) to further my analysis.

The data for my study comes from a series of eleven clinical interviews with a university student on the autism spectrum that I conducted, each focusing on a different set of problems. In this report, I focus on the first of several Magic Carpet tasks, introduced by Wawro, Rasmussen, Zandieh, Sweeney, & Larson (2012).

In this specific portion of the data, I have found suggestions of a tendency toward higher precision than typically seen in geometric solutions and inclinations toward systematic rather than intuitive reasoning. The tendency toward geometric solutions generally is also a notable characteristic, but comparison to other participants suggests that this is only part of a tendency among people on the autism spectrum to gravitate toward favored types of solutions.

I also examine possible effects of the tendencies seen in the interview data for instruction, such as on the possibility to avoid intended approaches and topics (such as an algebraic view of vectors) as well as opportunities to take advantage of the unusual approaches of students on the autism spectrum to benefit instruction overall. This highlights the importance of being able to see validity in unusual student work and interacting with students without deficit-based preconceptions, something which holds particular importance across a variety of forms of disability-related education research.

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