

Autism in Mathematicians

The cause of autism is mysterious, but genetic factors are important. It takes a variety of forms; the expression autism spectrum, which is often used, gives a false impression that it is just the severity of the disorder that varies. Different people are affected in different ways, but the core problems are impairments of communication, social

interaction, and imagination. Mild autistic traits can provide the single-mindedness and determination which enable people to excel, especially when combined with a high level of intelligence. This is particularly true of those with the autistic personality disorder known as the Asperger syndrome.

The Asperger syndrome is recognisable from the second year, although not obvious until later, and endures throughout life. About half of those who have it succeed in making a success of their lives; the others find it too much of a handicap. Very briefly, the criteria for Asperger's include severe impairment in reciprocal social interaction; all-absorbing narrow interests; imposition of routines and interests on self and others; problems of speech, language, and nonverbal communication; and sometimes motor clumsiness. The casual observer may notice an aversion to direct eye-contact, peculiarities of expression, difficulty in coping in social situations, and an obsession with a particular subject, such as computer science. The syndrome is not uncommon: more than one person in a thousand may have it. The recent guide [10] by the psychiatrist Christopher Gillberg is a good introduction to the subject.

Hans Asperger was a Viennese paediatrician who, in his doctoral thesis [2] of 1944 (see [8] for a translation), described how among the people he had examined there were a large proportion whom he regarded as mildly autistic but who were otherwise remarkably able. He was struck by the fact that they usually had some mathematical ability and

tended to be successful in scientific and other professions where this was relevant:

To our own amazement, we have seen that autistic individuals, as long as they are intellectually intact, can almost always achieve professional success, usually in highly specialized academic professions, often in very high positions, with a preference for abstract content. We found a large number of people whose mathematical ability determines their professions; mathematicians, technologists, industrial chemists and high-ranking civil servants.

Asperger went on to write:

A good professional attitude involves single-mindedness as well as a decision to give up a large number of other interests. Many people find this a very unpleasant decision. Quite a number of young people choose the wrong job because, being equally talented in different areas, they cannot muster the dedication to focus on a single career. With the autistic individual the matter is entirely different. With collected energy and obvious confidence and, yes, with a blinkered attitude towards life's rich rewards, they go their own way, the way in which their talents have directed them since childhood.

Only a few years ago it emerged that essentially the same phenomenon had previously been described by the Rus-

sian neurologist G. E. Saucharewa under the name *schizoid personality disorder*. It was a considerable time before Asperger's research attracted much attention, but when it did the term *Asperger syndrome* was introduced to describe the kind of people he was referring to. Although there have been changes in the definition, the description is still used for a high-functioning variant of autism with predominantly good language and intelligence and better social insight than other forms of autism. A recent survey [4] of Cambridge University undergraduates confirmed the impression that a much higher proportion of Asperger people is to be found among the students of mathematics, physics, and engineering than students of the humanities. It seems likely that whereas in the past many people with Asperger syndrome were particularly attracted to professions where mathematical ability was an advantage, nowadays ability in computer science has become equally important if not more so.

Possible cases of the syndrome can be found throughout the arts and sciences. For instance, the painters Kandinski, Turner, and Utrillo, the composers Bartok and Bruckner, the philosopher Wittgenstein, the chemist Marie Curie and her elder daughter the atomic physicist Irène Joliot-Curie have all been suggested. In fact Asperger himself went so far as to conjecture: "It seems that for success in science or art a dash of autism is essential. For success the necessary ingredient may be an ability to turn away from the everyday world, from the simple practical, an ability to rethink a subject with originality so as to create in new untrodden ways, with all abilities canalised into the one speciality."

Retrospective attempts at diagnosis are inevitably somewhat speculative; the information on record does not answer all the questions that would be asked in a clinical investigation today. Bearing this in mind, there does not seem much doubt (see [14], [16]) that among physicists Newton, Cavendish, Einstein, and Dirac had the Asperger syndrome; in fact Newton appears to be the earliest known example of a person with any form of autism (a convenient outline of Newton's life has been given by Milo Keynes in [17], but the articles of Michael Fitzgerald [6] and Anthony Storr [23] are most relevant). It seems to be widely accepted that Einstein had Asperger syndrome, although none of the many detailed biographies mentions this. Since autism became generally recognised by psychiatrists only within the last sixty years, there must be numerous past cases which have gone unrecognised, although it may seem surprising that even recent biographers should pass over what must be one of the main features of the life-stories of their subjects.

Newton and Dirac can reasonably be counted as mathematicians, although they are generally classed as physicists; Cavendish and Einstein also made extensive use of mathematics. What other well-known mathematicians are likely

to have had Asperger syndrome? Michael Fitzgerald [6] has argued the case of Ramanujan, and, with M. Arshad [1], that of the Nobel Laureate John Nash. Banach and Riemann might also be considered. Among mathematicians with the syndrome alive today, one (see [3]) has been awarded the prestigious Fields medal. It seems easier to find manic-depressive mathematicians [12]—for example, Abel, Sylvester, and Cantor—although these are more common in the arts than the sciences. However, it is the association of the syndrome with mathematical ability, observed by Asperger himself, which makes it of special interest.

There is some doubt as to whether there is a sex difference. Women appear to be less seriously affected by the syndrome than men, and perhaps are less likely to present themselves for assessment. Simon Baron-Cohen, the psychiatrist who heads the autism research centre at Cambridge University, believes that autistic adults show an unusually strong drive to "systematise" the world around them. Even in normal populations, men are more prone to systematise than women; conversely, women are more able

to empathise than men. Social interaction usually depends on empathy, although the autistic often learn to compensate for the lack of it and succeed in presenting the appearance of normal interaction.

It is probably impossible for the non-autistic to understand what it must be like to be autistic, but the personal studies of college students with autism collected by the anthropologist Dawn Prince-Hughes [20] give some idea. Asperger people who write about their experience, as several have done, describe the great feeling of relief they experienced at discovering they were not "from another planet" (one of the Web sites is called Oops. . . . Wrong Planet!), but that there were many others in the world just like themselves. The Internet and its many chat groups dedicated to people diagnosed with autistic spectrum disorders has encouraged the rapid growth of a thriving community, where normal social contact is unnecessary.

Not all psychologists recognise the Asperger syndrome as a distinct condition in the autistic spectrum; even those that do may still prefer different terminology, such as "autistic psychopathy" or "autism spectrum disorder." Others, such as Anthony Storr [22], prefer to use the term "schizoid personality" for a condition which seems, to the lay person, to be somewhat similar. Although certain of the symptoms can be alleviated, there is no cure for the Asperger syndrome, and some of those who have it, such as Luke Jackson [13], say that on the whole they are glad of this (one of the e-mail groups is called AS-and-proud-of-it). What would be appreciated is more understanding of their difficulties from other people, such as fellow-students, teachers, and colleagues, so that their lives are not made unnecessarily difficult. The syndrome is not properly understood by otherwise well-informed people, who find it

"It seems that for success in science or art a dash of autism is essential."

hard to realise what some of those who have it may be capable of achieving.

Francis Galton, in his well-known book on Hereditary Genius [9], discusses the tendency for intellectual distinction to run in families. There is some evidence that mathematical ability is inherited; the case of the Bernoullis seems exceptional, but one might also instance the Artins, the Ascolis, the Birkhoffs, the Cartans, the Knesers, the Neumanns, the Noethers, the Novikovs and many more. Of course this may be partly a matter of upbringing (although a number of the great mathematicians, including Banach, d'Alembert, Hamilton, Kolmogorov, and Newton, were adopted or fostered). Even so, there may be a genetic factor at work, possibly causing a disposition towards abstract thought and visual thinking (Temple Grandin explains what this means in [11]).

According to Camilla Benbow [5], American high school students with exceptionally high mathematical or verbal reasoning ability are more likely to be myopic, left-handed, or allergic than are students generally; the difference is most striking in the case of myopia, which occurs four times as often. Myopia affects the personality as well as the eyesight (Patrick Trevor-Roper describes some famous myopes in [24]). Among the great mathematicians of the past, Sophus Lie, Henri Poincaré, Tullio Levi-Civita, and Emmy Noether were strongly myopic. Other ocular defects, such as cataracts, do not appear to be particularly common among mathematicians. There is certainly a genetic factor in myopia; and it has been suggested that the condition may be genetically related to autism.

The precocious usually excel, at an early age, either in mathematics, languages, or music. Some famous mathematicians who had such a gift for mathematics include Abel, Jacobi, Galois, Borel, Wiener, and von Neumann. Others were also calculating prodigies, for example Euler, Gauss, Hamilton, Poincaré, Ramanujan, and Banach. Such savant skills [12] are often related to autism, but are more striking when they occur in individuals of generally low intelligence.

There is an extensive literature concerning the psychology of mathematical ability in schoolchildren. For example Thomas Sowell [21] writes about exceptionally bright children who are also exceptionally slow to develop the ability to speak, which he calls the *Einstein syndrome*. According to V. A. Krutetskii [18], a hundred years ago it was believed in the United States that gifted children were inferior to ordinary, normal children in every respect except intelligence. Gifted children were alleged to be physically weak, sickly, unattractive, emotionally unstable, and neurotically inclined. Subsequent study by psychologists not only failed to confirm this but led to the establishment of what was in almost every way the opposite picture. Possi-

bly the old stereotype has lingered on in the case of mathematicians.

Why do people who interview students sometimes claim that they can spot a mathematician the moment he or she enters the room? Why are mathematicians, along with computer scientists, commonly regarded as loners and placed in a group with geeks and nerds? Could it be that the type of personality which inclines people towards mathematics has something to do with this? And could it also be that here is part of the explanation for the difference in the relative numbers of men and women to be found in mathematics? I hope to discuss such questions in another article, but first would like to hear what readers of *The Intelligencer* think about what I have said so far. I would be particularly interested to hear from people with Asperger syndrome.


The precocious usually excel, at an early age, either in mathematics, languages, or music.

ative numbers of men and women to be found in mathematics? I hope to discuss such questions in another article, but first would like to hear what readers of *The Intelligencer* think about what I have said so far. I would be particularly interested to hear from people with Asperger syndrome.

REFERENCES

1. Arshad, M., and Fitzgerald, Michael. *Did Nobel Prize winner John Nash have Asperger's syndrome and schizophrenia?* Irish Psychiatrist 3 (2002), 90–94.

AUTHOR



IOAN M. JAMES
Mathematical Institute
24–29 St. Giles
Oxford OX1 3LB
England
e-mail: imj@maths.ox.ac.uk

Ioan James, F.R.S., was until 1995 Savilian Professor of Geometry at Oxford, and is now Emeritus; he has also long association with New College Oxford and with the Mathematical Institute. He has held visiting positions at numerous other universities, including Harvard, Yale, Princeton, Paris, Kyoto, Madras, and British Columbia. He is known primarily for his many research publications in topology and his editing, including the journal *Topology*; he also has a continuing interest in history of mathematics.


2. Asperger, H. *Die 'autistischen Psychopathen' im Kindesalter*. Archiv für Psychiatrie und Nervenkrankheiten 117 (1944), 76–136.
3. Baron-Cohen, S., Wheelwright, S., Stone, V., and Rutherford, M. *A mathematician, a physicist and a computer scientist with Asperger syndrome*. Neurocase 5 (1999), 475–483.
4. Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J. and Clubley, L. *The Autism-Spectrum Quotient (AQ): Evidence from Asperger Syndrome/ High-Functioning Autism, Males and Females, Scientists and Mathematicians*. Journal of Autism and Developmental Disorders 31 (2001), 5–17.
5. Benbow, C.B. *Possible biological correlates of precocious mathematical reasoning ability*. Trends in the Neurosciences 10 (1987), 17–20.
6. Fitzgerald, Michael. *Did Isaac Newton have Asperger's syndrome?* European Journal of Child and Adolescent Psychiatry 9 (1999), 204.
7. Fitzgerald, Michael. *Did Ramanujan have Asperger's disorder or Asperger's syndrome?* Journal of Medical Biography 10 (2000), 167–169.
8. Frith, Uta (ed.). *Autism and Asperger Syndrome*. Cambridge University Press, Cambridge, 1991.
9. Galton, Francis. *Hereditary Genius*. Macmillan, London, 1869.
10. Gillberg, Christopher. *A Guide to Asperger Syndrome*. Cambridge University Press, Cambridge, 2002.
11. Grandin, Temple. *Thinking in Pictures*. Vintage Books, New York, 1996.
12. Hermelin, Beate. *Bright Splinters of the Mind*. Jessica Kingsley, London, 2001.
13. Jackson, Luke. *Freaks, Geeks and Asperger Syndrome: a User Guide to Adolescence*. Jessica Kingsley, London, 2002.
14. James, Ioan. *Singular Scientists*. Journal of the Royal Society of Medicine 96 (2003), 36–39.
15. James, Ioan. *Remarkable Mathematicians*. Cambridge University Press, Cambridge, and Mathematical Association of America, Washington, DC, 2002.
16. James, Ioan. *Remarkable Physicists*. Cambridge University Press, Cambridge, 2003.
17. Keynes, Milo. *The personality of Isaac Newton*. Notes and Records of the Royal Society 49 (1995), 1–56.
18. Krutetskii, V.A. *The psychology of mathematical abilities in school-children*, (ed. by Kilpatrick, J. and Wirzup, I., trans. by Teller, J.). University of Chicago Press, Chicago, IL, 1976.
19. Pickering, George. *Creative Malady*. George Allen & Unwin, London, 1974.
20. Prince-Hughes, Dawn (ed.). *Aquamarine Blue: Personal Studies of College Students with Autism*, Ohio University Press, Athens OH, 2002.
21. Sowell, Thomas. *The Einstein Syndrome*. Basic Books, New York, NY, 2001.
22. Storr, Anthony. *The Dynamics of Creation*. Martin Secker and Warburg, London, 1972.
23. Storr, Anthony. *Isaac Newton*. British Medical Journal 291 (1985), 1779–1784.
24. Trevor-Roper, Patrick. *The World Through Blunted Sight*. Allen Lane, London, 1988.

CAMBRIDGE

New from Cambridge in 2004
With a 33% reduction in subscription prices as of 2004

**COMPOSITIO
MATHEMATICA**
Foundation Compositio
Mathematica
London Mathematical
Society


Managing editors:
Bas Edixhoven, Leiden University
Gerard van de Veer,
University of Amsterdam



Compositio Mathematica provides first-class research papers in the mainstream of pure mathematics, including such areas as algebra, number theory, topology, algebraic and analytic geometry, and geometric analysis.

In 2004, the pricing is as follows: Institutions print and electronic: **£750/\$1200**
Institutions electronic only: **£712/\$1140**

Further information about the journal can be found at: <http://www.compositio.nl>
To order, please contact Cambridge University Press at tel: +44 (0) 1223 326070

www.cambridge.org  **CAMBRIDGE**
UNIVERSITY PRESS