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Simon Baron-Cohen [a]
[a] Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK

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Autism, hypersystemizing, and truth

Simon Baron-Cohen
Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK

Evidence is reviewed suggesting that, in the general population, empathizing and systemizing show strong sex differences. The function of systemizing is to predict lawful events, including lawful change, or patterns in data. Also reviewed is the evidence that individuals on the autistic spectrum have degrees of empathizing difficulties alongside hypersystemizing. The hypersystemizing theory of autism spectrum conditions (ASC) proposes that people with ASC have an unusually strong drive to systemize. This can explain their preference for systems that change in highly lawful or predictable ways; why they become disabled when faced with systems characterized by less lawful change; and their "need for sameness" or "resistance to change". If "truth" is defined as lawful patterns in data then, according to the hypersystemizing theory, people with ASC are strongly driven to discover the "truth".

It is a privilege, a pleasure, and an honour to contribute to a Special Issue of this journal celebrating the remarkable scientific career of Uta Frith. Like many in this anthology, I have known her over more than a quarter of a century and have enjoyed her elegant empirical and theoretical contributions to the field of autism; at the same time my own work has been deeply influenced by hers. It is said that science makes progress by each generation standing on the shoulders of giants in the preceding generation. She, more than any autism scientist in the UK, has supported and enabled a whole raft of research programmes.

I count myself as fortunate in being in an academic lineage that dates back to her doctoral supervisors, Neil O'Connor and Beate Hermelin, the codirectors of the MRC Developmental Psychology Unit in Gordon Square in London. Hermelin and O'Connor (1970) were one of the first to define a rigorous experimental cognitive method in this area and to employ the mental-age-matching strategy in the search for autism-specific deficits. Uta Frith in her own PhD in 1970 took this at least one step further in using this method to identify autism-specific assets as well as deficits. Her move in 1982 to the MRC Cognitive Development Unit, also in Gordon Square, continued the important tradition in autism studies. I was lucky enough to be supervised by her there in my own doctorate. Over the subsequent decades she has moved ever deeper, from cognition to functional magnetic resonance imaging (fMRI), in pursuit of a clearer understanding of the nature of autism.

In this paper, I discuss two cognitive processes, *empathizing* and *systemizing*, and their relevance not only to autism but also to the field of sex differences. I review some of the evidence that links sex

Correspondence should be addressed to Simon Baron-Cohen, Autism Research Centre, Department of Psychiatry, University of Cambridge, Douglas House, 18b Trumpington Road, Cambridge CB2 8AH, UK. E-mail: sb205@cam.ac.uk
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differences and systemizing to foetal testosterone. I then discuss the new idea that the autistic cognitive style searches for *truth* (defined as precise, reliable, consistent, or lawful patterns or structure in data) that can lead people with autism to perceive patterns with remarkable accuracy but at the same time renders them challenged by fiction and by information that is ambiguous or unlawful.

Viewed in this light, their difficulties with empathy are the result of a mind that is seeks the truth in a domain (emotions) that is not very lawful. The truth of another's feelings is ultimately unknowable and requires representing multiple, different perspectives on reality, rather than a single truth. Equally, when viewed in this light, their hypersystemizing reflects the same kind of mind exquisitely adapted to identifying key details in how systems work. Such a view may help us make sense of the recent evidence of an association between autistic traits and scientific talent.

Empathizing and the female advantage

Empathizing is the drive to identify another person's emotions and thoughts and to respond to these with an appropriate emotion (Davis, 1994). This definition suggests there are (at least) two "fractions" to empathy: a cognitive component (overlapping with what is also called "Theory of Mind" or mind reading), and an affective component (responding emotionally to another's mental state). Uta and I worked together on what today we could think of as cognitive empathy (inferring another's mental state), but in recent years I have found it important to broaden the focus to consider affective empathy too.

Empathy is a skill (or a set of skills). As with any other skill, we vary in it. We can therefore think about individual differences in empathy. Many studies converge on the conclusion that there is a female superiority in empathizing. For example, girls show more turn-taking (Charlesworth & Dzur, 1987), and women are better at decoding nonverbal communication, picking up subtle nuances from tone of voice or facial expression, or judging a person's emotional state (Hall, 1978). Questionnaires measuring empathy typically find that women score higher than men (Davis, 1994). Girls' speech is more cooperative, reciprocal, and collaborative. Girls are also more able to keep a conversational exchange with a partner going for longer. When they disagree, girls are more likely to express their different opinion sensitively, asking a question, rather than making an assertion. Boys' talk is described as more "single-voiced discourse" (the speaker presents their own perspective alone). The female speech style is described as more "double-voiced discourse" (girls spend more time negotiating, trying to take the other person's wishes into account; Smith, 1985). Women's conversation involves much more talk about feelings, whilst men's conversation with each other is more object or activity focused (Tannen, 1991). From birth, females look longer at faces, particularly at people's eyes, and males are more likely to look at inanimate objects (Connellan, Baron-Cohen, Wheelwright, Ba'tki, & Ahluwalia, 2001).

Why might this sex difference in empathy exist? One possibility is that it reflects natural selection of empathy among females over human evolution. Good empathizing would have led to better care giving, and since care giving can be assumed to have been primarily a female activity until very recent history, those mothers who had better empathy would have succeeded in reading their infant offspring's emotional and physical needs better, which may have led to a higher likelihood of the infant surviving to an age to reproduce. Hence, good empathy in the mother would have promoted her inclusive fitness. This is unlikely to have been the only factor, but it illustrates how empathy could have been shaped by natural selection. Having spent some time discussing empathizing, I want to now turn to a very different cognitive process, systemizing.

Systemizing and the male advantage

Systemizing is a new concept. By a "system" I mean something that takes inputs and deliver outputs. To systemize, one uses "if–then" (correlation) rules. The brain attends to a detail or parameter of the system and observes how this varies. That is, it treats a feature of a particular object or event as a variable. Some systemizing occurs purely as the result of passive observation, but in other cases a person actively, or systematically, manipulates a given variable. In such cases, the person notes the effect(s) of operating on one single input in terms of its effects elsewhere in the system (the output). If I do x, a changes to b. If z occurs, p changes to q. Systemizing thus requires an exact eye for detail.

Systemizing involves observation of *input–operation–output* relationships, leading to the identification of laws to predict that event x will occur with probability p (Baron-Cohen, 2002). Some systems are totally lawful (e.g., an electrical light switch, or a mathematical formula). Systems that are 100% lawful have zero variance, or only 1 degree of freedom, and can therefore be predicted (and controlled) 100%. A computer might be an example of a 90% lawful system: The variance is wider—there are more degrees of freedom. The weather might be only 70% lawful, whilst the social world may be only 10% lawful. This is why systemizing the social world is of little predictive value.

Systemizing involves five phases. Phase 1 is *Analysis*: Single observations of input and output are recorded in a standardized manner, at a low level of detail. Phase 2 is *Operation*: An operation is performed on the input, and the change to the output is noted. Phase 3 is *Repetition*: The same operation is repeated over and over again, to test whether the same pattern between input and output is obtained. Phase 4 is *Law derivation*: A law is formulated of the form "If X (operation) occurs, A (input) changes to B". Phase 5 is *Confirmation/disconfirmation:* If the same pattern of input–operation–output holds true for all instances, the law is retained. If a single instance does not fit the law, Phases 2–5 are repeated, leading to modification of the law, or a new law.

Systemizing nonagentive change is effective because these are *simple* changes: The systems are moderately lawful, with narrow variance (or limited degrees of freedom). Agentive change is less suited to systemizing because the changes in the system are *complex* (wide variance, or many degrees of freedom). Systemizing works for phenomena that are ultimately lawful, finite, and deterministic. The explanation is exact, and its truth-value is testable. Systemizing is of little use for predicting moment-to-moment changes in a person's behaviour. To predict human behaviour, empathizing is required. Systemizing and empathizing thus have different functions.

Just as there are sex differences in empathy, so too are there (different) sex differences in systemizing, pointing to a stronger drive to systemize in males. For example, boys are more interested in toy vehicles, building blocks, and mechanical toys, all of which are open to being systemized (Jennings, 1977). In adulthood, certain occupations are largely male. These include metalworking, weapon making, manufacture of musical instruments, and the construction industries, such as boat building. The focus of these occupations is on creating systems (Geary, 1998). Similarly, maths, physics, and engineering all require high systemizing and are largely male. The Scholastic Aptitude Math Test (SAT-M) is the mathematics part of the test administered nationally to college applicants in the United States. Males on average score 50 points higher than females on this test (Benbow, 1988). Considering only individuals who score above 700, the sex ratio is 13:1 (men to women; Geary, 1996). Men also score higher in an assembly task in which people are asked to put together a three-dimensional (3-D) mechanical apparatus. Boys are also better at constructing a 3-D structure from just an aerial view in a picture (Kimura, 1999). A general feature of systemizing is good attention to relevant detail, and this is superior in males. One measure of this is the Embedded Figures Test. On average, males are quicker and more accurate in locating a target object from a larger, complex pattern (Elliot, 1961). Males, on average, are also better at detecting a particular feature (static or moving) than are women (Voyer, Voyer, & Bryden, 1995).

The Mental Rotation Test provides another example of a test on which males are quicker and more accurate. This involves systemizing because it is necessary to treat each feature in a display as a variable that can be transformed and then predict how it will appear after transformation (Collins & Kimura, 1997). Reading maps is another everyday test of systemizing, because features from 3-D input must be transformed to a two-dimensional representation. In general, boys perform better than girls in map reading and are more likely to use directional than landmark cues. The directional strategy represents an approach to understanding space as a geometric system (Galea & Kimura, 1993). The Systemizing Quotient is a questionnaire that includes items that ask about a subject's level of interest in a range of different systems (e.g., technical, abstract, and natural systems). Males score higher on this measure (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). Finally, the Physical Prediction Questionnaire (PPQ) is based on a method for selecting applicants to study engineering. The task involves predicting which direction levers will move when an internal mechanism of cog wheels and pulleys is engaged. Men score significantly higher on this test (Lawson, Baron-Cohen, & Wheelwright, 2004). Evolutionary accounts of the male advantage in systemizing include the argument that males were primarily involved in hunting and tracking of prey, and that a male who was a good systemizer would have had greater success in both using and making tools for hunting, or navigating space to explore far afield. Both could have affected a male's reproductive success.

Biology plays a part in empathy and systemizing

Although evidence exists for differential socialization contributing to sex differences, this is unlikely to be a sufficient explanation. Connellan and colleagues showed that among 1-day-old babies, boys look longer at a mechanical mobile, which is a system with predictable laws of motion, than at a person's face, an object that is hard to systemize. One-day-old girls show the opposite profile (Connellan et al., 2001). These sex differences are therefore present very early in life. This raises the possibility that, while culture and socialization may partly determine the development of a male brain with a stronger interest in systems or a female brain with a stronger interest in empathy, biology also partly determines this.

There is ample evidence to support both cultural and biological determinism (Eagly, 1987; Gouchie & Kimura, 1991). For example, the amount of time a 1-year-old child maintains eye contact is inversely correlated to the level of foetal testosterone (FT) (Lutchmaya, Baron-Cohen, & Raggatt, 2002). This inverse relationship to FT is also seen in relation to social skills at age 4 years (Knickmeyer, Baron-Cohen, Raggatt, & Taylor, 2005) and empathizing at age 8 years, as measured on the Reading the Mind in the Eyes Test and the Empathy Quotient (Chapman et al., 2006). In contrast, a positive correlation with FT is seen in relation to "narrow interests" (Knickmeyer et al., 2005), the Systemizing Quotient (Auyeung et al., 2006), and ability on the Embedded Figures Test (Auyeung et al., 2007). The evidence for the biological basis of sex differences in the mind is reviewed elsewhere (Baron-Cohen, 2003).

One can envisage five broad types of profile or "brain type", as Table 1 shows. The evidence reviewed here suggests that not all men have the "male brain", and not all women have the "female brain". That is, some women have the male brain, and some men have the female brain. Using the Systemizing Quotient (SQ) and Empathy Quotient (EQ), more males than females have a brain of type S, and more females than males have a brain of type E (Goldenfeld, Baron-Cohen, & Wheelwright, 2005).

Autism: Hypersystemizing alongside impaired empathizing?

The autistic spectrum comprises two major subgroups: Asperger syndrome (AS) (Asperger, 1944; U. Frith, 1991), and classic autism (Kanner, 1943). They share the phenotype of social difficulties and obsessional interests (American Psychiatric Association, 1994). In AS,

Table 1. *The main brain types*

Profile of individuals	*Shorthand notation*	*Type of brain*
Empathizing more developed than systemizing	E > S	"female" (or Type E)
Systemizing more developed than empathizing	S > E	"male" (or Type S)
Systemizing and empathizing both equally developed	S = E	"balanced" (or Type B)
Systemizing hyperdeveloped and empathizing hypodeveloped (the autistic end of the spectrum)—may be talented systemizers, but at the same time may be "mind blind"	S >> E	extreme male brain
Hyperdeveloped empathizing skills and systemizing hypodeveloped—may be "system blind"	E >> S	extreme female brain (postulated)

the individual has normal or above-average IQ and no language delay. In classic autism there is typically some degree of language delay, and level of functioning is indexed by overall IQ, with learning difficulties in those with below-average IQ. I use the term autism spectrum conditions (ASC) to refer to both of these subgroups.

The consensus is that ASC have a genetic aetiology (Bailey et al., 1995), leading to altered brain development (Courchesne, 2002), affecting social and communication skills, and leading to the presence of narrow interests and repetitive behaviour (American Psychiatric Association, 1994). There is considerable evidence for empathy impairments in ASC (Baron-Cohen, 1995) not just using child-level tests of false-belief understanding (Baron-Cohen, Leslie, & Frith, 1985) but also more subtle tests of complex emotion recognition (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001a), recognition of faux pas (Baron-Cohen, O'Riordan, Jones, Stone, & Plaisted, 1999a), and spontaneous ascription of intentional states (Castelli, Happé, Frith, & Frith, 2000). In this sense, people with ASC can be said to show hypoempathizing. This is apparent using neuroimaging during empathy tasks, where there is reduced blood flow in key brain regions such as the amygdala and medial prefrontal cortex (Baron-Cohen et al., 1999b; Courchesne, 2002; C. Frith & Frith, 1999; Happé et al., 1996).

Alongside the hypoempathizing there is also evidence for hypersystemizing in autism. For example, people with ASC have an increased rate of savant skills, often in lawful systems such as calendars, calculation, or train timetables (Hermelin, 2002). People with ASC score higher than average on the SQ (Baron-Cohen et al., 2003), on tests of folk physics (Baron-Cohen, Wheelwright, Scahill, Lawson, & Spong, 2001b; Jolliffe & Baron-Cohen, 1997; Lawson et al., 2004; Shah & Frith, 1983) and on tests of attention to detail (O'Riordan, Plaisted, Driver, & Baron-Cohen, 2001; Plaisted, O'Riordan, & Baron-Cohen, 1998). People with AS can achieve high levels in domains such as mathematics, physics, or computer science (Baron-Cohen, Wheelwright, Stone, & Rutherford, 1999c) and may have an "exact mind" when it comes to art (Myers, Baron-Cohen, & Wheelwright, 2004). On the picture-sequencing task, they perform above average on sequences that contain temporal or physical-causal (i.e., systematic) information (Baron-Cohen, Leslie, & Frith, 1986). Their obsessions cluster in the domain of systems, such as watching electric fans go round (Baron-Cohen & Wheelwright, 1999). Given a set of coloured counters, they show extreme "pattern imposition" (U. Frith, 1970)—they hypersystemize.

The evidence for systemizing being part of the "broader autism phenotype" includes the finding that fathers—and even grandfathers—of children with ASC are twice as likely to work in the occupation of engineering (a clear example of a systemizing occupation) (Baron-Cohen, Wheelwright, Stott, Bolton, & Goodyer, 1997b). Students in the natural sciences (engineering, mathematics, physics) also have a higher number of relatives with autism (Baron-Cohen et al., 1998). Mathematicians have a higher rate of AS, and so do their siblings (Baron-Cohen, Wheelwright, Burtenshaw, & Hobson, in press). Both mothers and fathers of children with AS have been found to be strong in systemizing on the Embedded Figures Test (Baron-Cohen & Hammer, 1997a). Finally, there is some evidence that above-average systemizers have more autistic traits. Thus, scientists score higher than nonscientists on the Autism Spectrum Quotient (AQ). Mathematicians score highest of all scientists on the AQ (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001c). These findings suggest a link between systemizing talent and autistic traits, the link being likely to be genetic. We will need molecular genetic studies of both systemizing and ASC to understand the nature of this link.

Truth

In trying to understand both the assets and the deficits in ASC, it may be useful to consider the role of truth in what the brain is trying to do. The term "truth" is associated with religious beliefs or with those who claim to have privileged access to some absolute knowledge. I am not using the term "truth" in either of these senses. Rather, I am defining it (as in the Introduction) as precise, reliable, consistent, or lawful patterns or structure in data. If a wheel is spinning round and round, there are consistent, lawful patterns to be detected. Sometimes the pattern will occur with 100% predictability (this particular person's birthday always falls on April 4th), sometimes with relatively high predictability (daffodils typically bloom in the second week of March in England). Systemizing is the means by which we identify lawful patterns in data.

When we systemize, we make the implicit assumption that the pattern of data coming into our senses tells us about the nature of reality. The pattern in the data reveals the truth. If all we detected was random noise, we would have no clue about the nature of the outside world that our brain inhabits. But just as a spy listens to the beeps and clicks and starts to discern pattern, such as Morse code, treating it as intentional communication by the enemy, so the brain processes data and treats the data as information not just from intentional agents, but from a physical reality. Data are our only route to the truth.

My contention is that the autistic brain is highly tuned to systemize: It is the ultimate pattern detector and truth detector (Baron-Cohen, 2006). The low-functioning child with autism who loves to spend hours bouncing repetitively on a trampoline, or swinging on a swing repetitively, or "twiddling" a piece of string repetitively, or spinning the wheel of a toy car repetitively, or watching the cycles of a washing machine repetitively is hypersystemizing. Such repetitive behaviour was traditionally described as "purposeless" and as a "symptom", suggesting it lacks purpose or value. In fact, within the hypersystemizing theory, it has a very clear purpose: to provide input for a neural mechanism whose sole function is to seek and find patterns in data.

In a high-functioning individual on the autistic spectrum, such pattern seeking can reveal scientific truths about the nature of reality, since their systemizing can help the individual understand how things work. These may be mechanical systems (like computers or car engines), abstract systems (like mathematics or syntax), natural systems (like a biological organ, or the weather), collectible systems (like a library or a lexicon), or even social systems (like a legal code or a historical chronology). What was previously dismissed as an "obsession" can be viewed more positively as a "strong, narrow interest" in a topic that, when harnessed, can lead the person with autism or AS to excel in a highly specific field.

Such a view of systemizing, which by definition requires massive repetition in order to check and recheck the consistency of patterns, to establish that the truth so discovered actually holds, is clearly at odds with the old view of "obsessions" and repetitive behaviour being the result of perseveration due to an executive dysfunction (Russell, 1997). An executive dysfunction sees repetitive behaviour as a routine that the person would like to interrupt but they cannot. The hypersystemizing view in contrast sees the same behaviours as driven by the need for patterned data. Just as hunger drive is attracted by a food source, and there is pleasure attached to the satiation of this drive, so the systemizing drive is attracted towards patterns, and there is pleasure (sometimes referred to as "stimming" by people on the autistic spectrum) in finding such patterns.

Consider an example of a system: a car engine that we might hypothetically say has 100 components. Systemizing requires an initial pass at the data using strong "local" processing. The local level of analysis allows one to see all 100 features as distinct and different to each other. It then requires a "global" level of analysis to allow one to see three relationships: (a) if Component 37 is "on", Component 84 may or may not be "on"; (b) if Component 84 is "on", Component 37 is always "on"; and (c) Component 37 always fires up just before Component 84. These three global or relational bits of data allow the inference that Component 84 is dependent on Component 37, but not vice versa.

Notice that such systemizing would benefit from the data being represented in a matrix of rows and columns, so that the relation between two data points can be tracked with ease. Figure 1 shows the notebook from a man with Asperger syndrome who collects meteorological data as his "obsession", going out at midnight every night into his garden to measure a set of variables (e.g., rainfall, wind speed, temperature, humidity, and wind direction) and recording these "systematically" against the day and month,

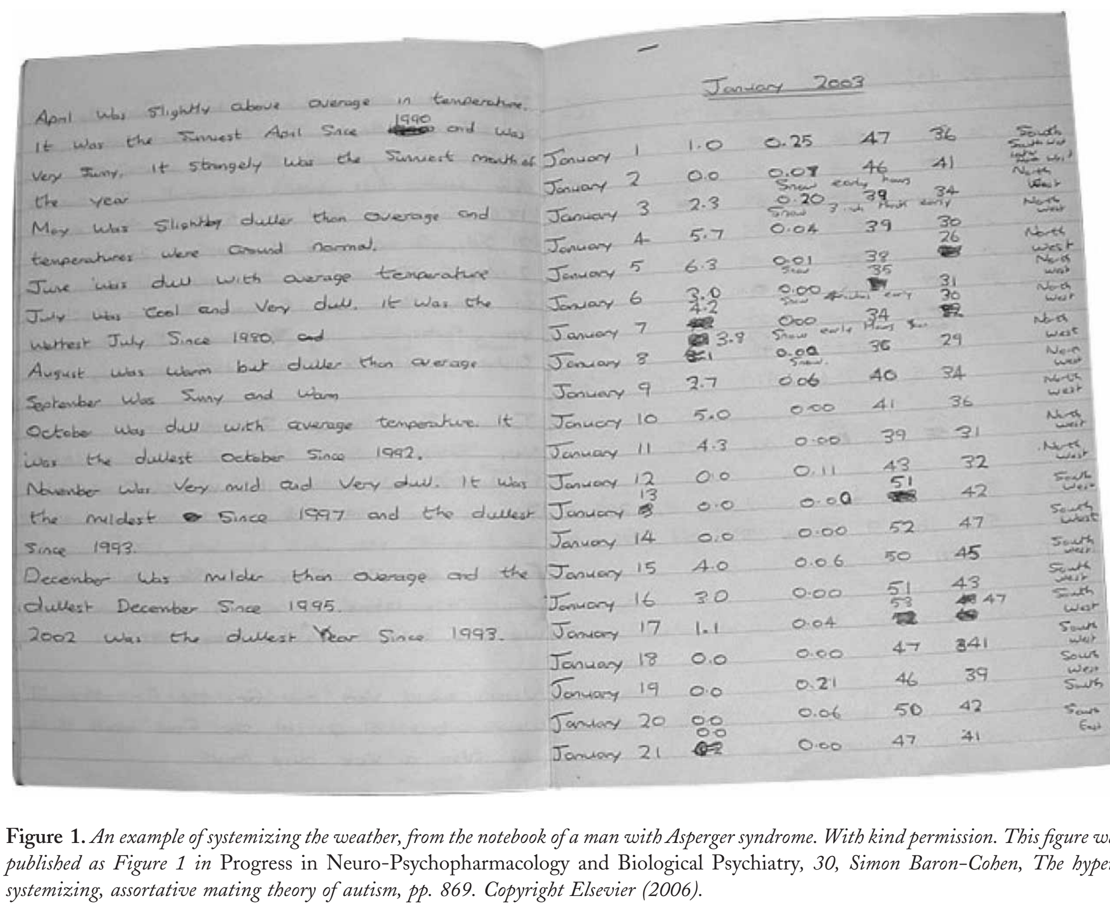

Figure 1. *An example of systemizing the weather, from the notebook of a man with Asperger syndrome. With kind permission. This figure was published as Figure 1 in* Progress in Neuro-Psychopharmacology and Biological Psychiatry, *30, Simon Baron-Cohen, The hyper-systemizing, assortative mating theory of autism, pp. 869. Copyright Elsevier (2006).*

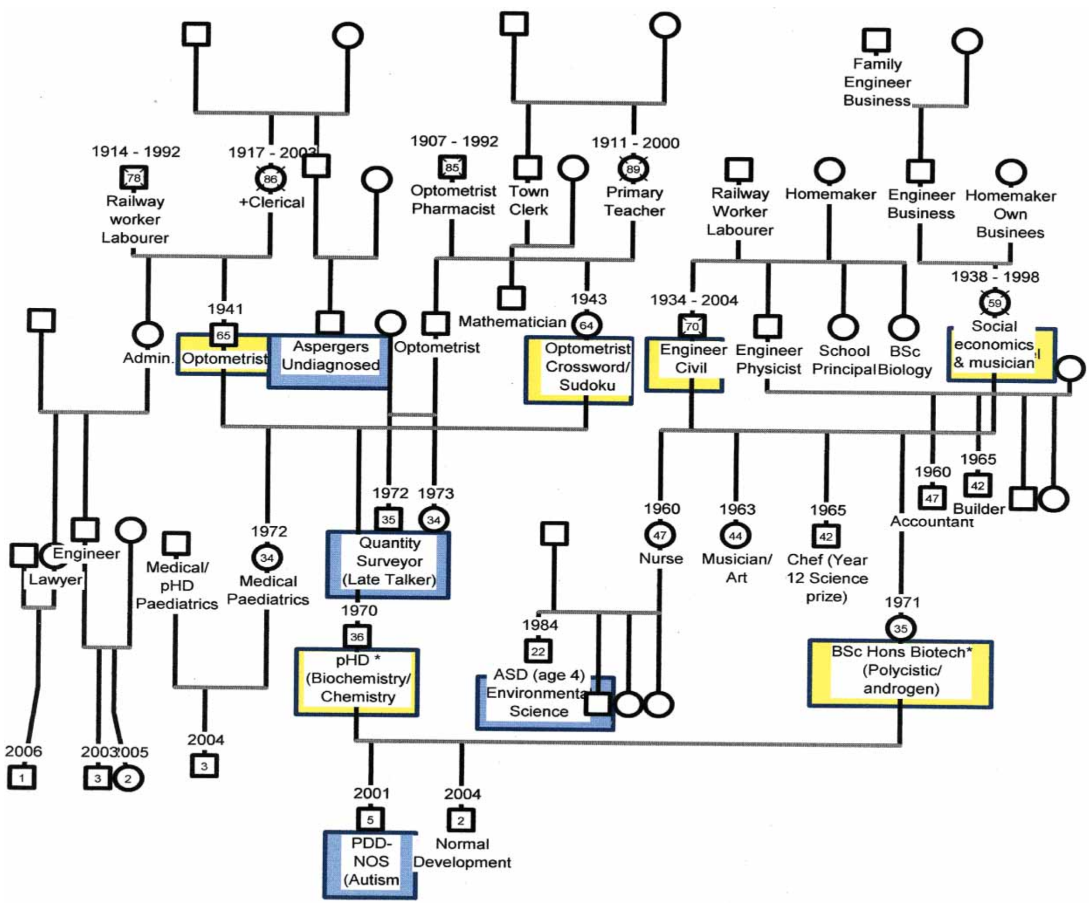

Figure 2. *A family pedigree. The informant recorded occupational data where known and any suggestion of strong systemizing interests, again where known. She also indicated definite diagnoses of autism spectrum conditions (ASC; shaded blue) and strongly suspected cases of ASC (shaded yellow). Also indicated is one case of polycystic ovary syndrome (PCOS), which is testosterone related. Such one-off pedigrees are not very informative, but are suggestive of a genetic association between strong systemizing and ASC liability. Current research is investigating whether the rate of ASC is higher in such families and whether this reflects assortative mating between two strong systemizers. To view the figure in colour, visit the Journal's website (http://www.psypress.com/qjep) and navigate to the online version of the paper.*

to identify patterns. What we see in a man with AS, who has no formal training as a scientist, is that his mind is naturally prone to representing information in a rows-by-columns matrix, which allows for inferences of the sort "If A and B, then X". If repetition of A and B always delivers X, then one has identified a truth. It may not be an earth-shattering one (if I push the light switch from up, A, to down, B, the light on the landing goes on, X), but it is nevertheless a truth about the world. Seen in this light, hypersystemizing is truth oriented. Interestingly, in families where there are many strong systemizers (like the one depicted in Figure 2) it is anecdotally observed that one finds multiple cases of autism or Asperger syndrome. Research is underway to determine if the rates of ASC are higher in such families (especially when both parents are hypersystemizers), as a test of the assortative mating theory.

Whilst systemizing can deliver truths in the form of laws, it can only do so in domains that are ultimately lawful. One reason why people with ASC (postulated to be hypersystemizers) may struggle with empathy and be less interested in topics such as pure fiction, pretence, or deception is that these are not and never will be truth oriented. (I use the term "pure" here because some literary genres, such as science fiction or historical fiction, are more systemizable than others, e.g., fictional romance). Regarding the domain of emotions, human behaviour is not 100% lawful. Different people can expression the same emotion differently, or an emotion may even have no external expression. I can be depressed and look sad, or I can be depressed and act as if nothing is wrong. Regarding the domain of mental states, as Alan Leslie pointed out (when Uta and I worked with him now 25 years ago), the domain of mental states plays havoc with "truth relations". This is because of the opacity of mental states like "belief" or "pretence" (Leslie, 1987). The sentence "Mary believes that 'John is having an affair with his colleague'" is true if Mary believes it, irrespective of whether John really is having an affair. When we mind read, we have to keep track of what we believe to be true (John is not having an affair) whilst representing someone else's different (possibly false) belief—what they believe to be true (Mary believes he is).

Empathy is therefore arguably impossible without such an ability to play with and even suspend the truth. Recent efforts to teach people with ASC to mind read have succeeded only when taking the quite artificial approach of presenting mental states (such as emotional expressions) as if they are lawful and systemizable, even if they are not (Golan, Baron-Cohen, Wheelwright, & Hill, 2006). Such an approach tailors the information to the learning style of the learner so that at least they can begin to process it.

Conclusions

This article has reviewed evidence that empathizing and systemizing show strong sex differences in the general population. The function of systemizing is to predict lawful events, including lawful change. Also reviewed is the evidence that individuals on the autistic spectrum have degrees of empathizing difficulties alongside hypersystemizing. The hypersystemizing theory of ASC can explain the preference that such individuals have for systems that change in highly lawful or predictable ways (such as mathematics, repetition, objects that spin, routine, music, machines, collections) and why they become disabled when faced with systems characterized by less lawful change (such as social behaviour, conversation, people's emotions, or pure fiction), since these cannot be easily systemized and are not oriented towards discovering "truth" (defined as lawfulness). It also explains their "need for sameness" or "resistance to change" (Kanner, 1943) in such unsystemizable contexts as the social world.

Whilst ASC are disabling in the social world, hypersystemizing can in principle lead to talent in areas that are systemizable. For many people with ASC, their hypersystemizing never moves beyond Phase 1—massive collection of facts and observations (lists of trains and their departure times, watching the spin-cycle of a washing machine)—or Phases 2 and 3—massive repetition of behaviour (spinning a plate or the wheels of a toy car). But for those who go beyond Phase 3 to identify a law or a pattern in the data (Phases 4 and 5), this can constitute original insight. In this sense, it is likely that the genes for increased systemizing have made remarkable contributions to human history (Fitzgerald, 2000, 2002; James, 2003). Finally, the assortative mating theory (Baron-Cohen, 2006) proposes that the cause of ASC is the genetic combination of having two strong systemizers as parents. This theory remains to be fully tested, but if confirmed, may help explain why the genes that can cause social disability have also been maintained in the gene pool, as they confer all the fitness advantages that strong systemizing can bring on the first-degree relatives of people with such conditions.

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