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Review article

The hyper-systemizing, assortative mating theory of autism

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Abstract

The hyper-systemizing theory of autism proposes that the systemizing mechanism is set too high in people with autism. As a result, they can only cope with highly lawful systems, and cannot cope with systems of high variance or change (such as the social world of other minds). They appear 'change-resistant'. This proposal extends the extreme male brain theory of autism. Finally, evidence is reviewed for autism being the genetic result of assortative mating of two high systemizers.

Keywords: Asperger Syndrome; Assortative mating; Autism; Systemizing

Contents

1. Introduction

There are two major ways to predict changing events. If the event is agentive, one can adopt the "intentional stance" (or 'empathize'). If the event is non-agentive, one can 'systemize'. In this article I outline a new theory that the systemizing mechanism has variable settings, and that people with autism spectrum conditions are hyper-systemizers, who can therefore only process highly systemizable (law-governed) information. In line with the focus of this special issue of this Journal on evolutionary perspectives, I also explore the evidence of the assortative mating theory: that autism is the result of both parents being high systemizers.

1.1. Systemizing non-agentive change

A universal feature in the environment that the brain has to react to is *change*. There are at least two types of structured change: (1) agentive change, (2) non-agentive change. Regarding the former, if change is perceived to be *self-generated* or *self-propelled* (i.e., there is no apparent external cause), the brain interprets it as agentive, that is, an agent with a *goal*. Goal detection (or intentionality detection (ID)) is a fundamental

Abbreviations: AS, Asperger Syndrome; AQ, Autism Spectrum Quotient; EDD, Eye Direction Detector; ID, Intentionality Detector; PPQ, Physical Prediction Test; SM, Systemizing Mechanism; SQ, Systemizing Quotient; TOMM, Theory of Mind Mechanism; SAM, Shared Attention Mechanism; TED, The Emotion Detector; TESS, The Empathy SyStem.

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aspect of how the human brain interprets and predicts the behaviour of other animals (Baron-Cohen, 1994; Heider and Simmel, 1944; Perrett et al., 1985). Structured non-agentive change is any change which is *not* self-propelled and where there is a precipitating event (interpreted as a possible cause of the change) or a pattern to the change. Some patterns are cyclical (the pattern repeats every fixed number of units), but there are many other types of pattern.

Structured non-agentive change occurs by degrees: some change occurs with total (100%) regularity or pattern (e.g., the sun always rises in the east and sets in the west). Other change occurs with a lower frequency or regularity but there is still a pattern to be discerned. Perception of structured non-agentive change matters because the change might be injurious or have a negative impact (e.g., planting your crops in February leads them to wither) or a positive impact (e.g., planting them in March leads to your crops thriving). Being able to anticipate change thus allows the organism to avoid negative consequences or benefit from positive change.

Systemizing is the most powerful way to predict change. Systemizing involves law-detection via observation of *input-operation-output* relationships (Baron-Cohen, 2002). Systemizing allows a search for structure (patterns, rules, regularities, periodicity) in data. The goal of systemizing is to test if the changing data is part of a system. Systems may be mechanical (e.g., machines), natural (e.g., a leaf), abstract (e.g., mathematics), collectible (e.g., a collection), motoric (e.g., a tennis stroke), or even social (e.g., the rules of etiquette). Thus, an engineer, a lawyer, a mathematician, a film-editor, a librarian, an astronomer, a meteorologist, a chemist, a musician, a grammarian, a company CEO, and a zoologist all systemize: they are all concerned with formulating *laws governing change* (laws of physics, laws of nature, mathematical laws, social laws, etc.,).

Systemizing allows the brain to predict that event x will occur with probability p, that is, to identify laws driving the system. Some systems are 100% lawful (e.g., an electrical light switch, or a mathematical formula). During systemizing, the brain represents the information as input and output separately, so that the pattern emerges (Tables 1 and 2). Systems that are 100% lawful have zero (or minimal) variance, and can therefore be predicted and controlled 100%. A computer might be an example of a 90% lawful system: the variance is wider, because the operating system may work differently depending on which other software is installed, or which version of the software you have, etc. The weather may be a system with only moderate lawfulness.

Table 1
Two examples of 100% lawful systems: (a) an electricity switch, and (b) a mathematical rule

A.	
Input = switch position	Output = light
	Operation = switch change
Up	On
Down	Off
B.	
Input = Number	Output = Number
	Operation = Add 2
2	4
3	5
4	6

Table 2
An example of systemizing hydrangea colouration

Hydrangea name	Acidic soil	Neutral soil	Alkaline soil
Annabelle	White	White	White
Ayesha	Blue	Purple	Pink
Alpengluhen	Purple	Red	Red
Altona	Blue	Purple	Red
All Summer Beauty	Blue	Purple	Pink
Ami Pasquier	Purple	Red	Red
Amethyst	Blue	Purple	Pink
Bodensee	Blue	Purple	Pink
Blauer Prinz	Blue	Purple	Purple
Bouquet Rose	Blue	Purple	Pink
Breslenburg	Blue	Purple	Pink
Deutschland	Purple	Red	Red
Domotoi	Blue	Purple	Pink
Dooley	Blue	Purple	Pink
Enziandom	Blue	Purple	Red

From http://www.hydrangeasplus.com.

A key feature of systemizing is that single observations are recorded in a standardized manner. A meteorologist will make measurements at fixed times and fixed places, measuring rainfall (in a cup), temperature (with a thermometer), pressure (with a barometer), wind speed (with an anemometer), etc. An astronomer will record the position of a planet at fixed times and fixed places, tracking its movement. Such systematic data collection (phase 1 of systemizing) can then lead to the observation of the pattern of law (phase 2 of systemizing). Systemizing thus has the power to reveal the structure or laws of nature.

1.2. Systemizing agentive change

Some aspects of agentive behaviour are highly lawful (e.g., cats typically use their right paw to swipe at a moving object). Some human behaviour is also sufficiently *scripted* to be moderately lawful (e.g., ballroom dancing). Human behaviour in film is of course highly lawful, since each time the film is replayed, the characters will do and say the same thing. But outside of these special cases, if there are laws governing human behaviour, they are complex and the variance is maximal. Maximal variance means that when change occurs, it could occur in a virtually infinite number of ways. Thus, a person's hands, eyes, mouth, posture, and facial expression might change in one of hundreds if not thousands of possible combinations. Nor is there a one-to-one mapping between facial expression and the underlying mental state that might be causing such changes in the face (Baron-Cohen et al., 2004). Nor do situations predict the subtlety of emotions, since in the same situation different people react differently. Finally, humans as moving, changing objects also require the agent they are interacting with to respond. They talk, and their words appear as novel, unique combinations on each occasion, unlike scripted behaviour. The right response to their

Box 1
Mechanisms for empathizing

The empathizing system has 6 key components:

(a) ID (the Intentionality Detector) automatically interprets or represents an agent's self-propelled movement as a goal-directed movement, a sign of its agency, or an entity with volition (Premack, 1990), and is evident from at least 12 months of age (Gergely et al., 1995).
(b) EDD (the Eye Direction Detector) automatically interprets eye-like stimuli as "looking at me" or "looking at something else". Cells in the superior temporal sulcus that respond to averted or direct gaze have been identified via single-cell recording (Perrett et al., 1985). EDD is active in early infancy (Connellan et al., 2001; Vecera and Johnson, 1995).
(c) SAM (the Shared Attention Mechanism) automatically represents if the self and another agent are perceiving the same event, by building 'triadic' representations. SAM is active from 9 months of age (Scaife and Bruner, 1975).
(d) ToMM (the Theory of Mind Mechanism) allows an epistemic mental state to be represented (Leslie, 1987), enabling understanding of false belief (Wimmer and Perner, 1983), and the relationships between mental states. ToMM is firmly established by 4 years of age (Wellman, 1990).
(e) TED (The Emotion Detector) represents affective states (Baron-Cohen, 2005). Infants can represent affective states from as early as 3 months of age (Walker, 1982). TED allows the detection of the basic emotions (Ekman et al., 1972).
(f) TESS (The Empathizing SyStem) allows an empathic reaction to another's emotional state (Baron-Cohen, 2005).

words isn't to reply with a script. Agentive change in the social world is too fast, and the laws — if they exist — are thus too complex to systemize. Skinner (Skinner, 1976) claimed human behaviour could be systemized if one had a complete record of all the historical antecedents (A) and all the consequences (C) for any piece of behaviour (B), such that A →B←C. The real social world is, of course, not a Skinner Box.

Systemizing only works when one can measure or count one thing at a time, ignoring or holding everything else constant. Systemizing is enormously powerful as a way of predicting and controlling events in the non-agentive world and has led to the technological achievements of the modern world. It has this power because non-agentive changes are *simple* changes to predict: the systems are at least moderately lawful, with narrow variance.

Because ordinary social behaviour defies a systematic approach, the second-by-second changes in agentive behaviour are more parsimoniously interpreted in terms of the agent's goals (Baron-Cohen, 1994; Heider and Simmel, 1944; Perrett et al., 1985). It appears that humans have specialized, inherited 'hardware' for dealing with the complex social world. The 'empathizing system' comprises basic instruments — like barometers, thermometers, and anemometers — that come compiled to help the normal infant make sense of the social world, and react to it, without having to learn it all from scratch. Empathizing is not the main focus of this article but is explained in more detail elsewhere (Baron-Cohen, 1995, 2003, 2005; Baron-Cohen and Goodhart, 1994) (Box 1). Such basic modules or neurocognitive mechanisms give the normal infant a foothold into making sense of and responding to the social world. The neural circuitry of empathizing has been extensively investigated (Baron-Cohen et al., 1999a,b; Frith and Frith, 1999; Happe et al., 1996); key brain areas involved in empathizing include the amygdala, the orbito and medial frontal cortex, and the superior temporal sulcus. Experience allows us to learn the subtleties of empathy, but such hardwired, innate mechanisms bootstrap the brain to make rapid sense of social change.

The hyper-systemizing theory (Box 2) posits that we all have a systemizing mechanism (SM), and this is set at different levels in different individuals. The SM is like a volume control or a dimmer switch. Genes and other biological factors (possibly fetal testosterone) turn this mechanism up or down (Knickmeyer et al., 2005). For some people, their SM is set high so that they systemize *any* changing input, analyzing it for possible structure. A high systemizer searches all data for patterns and regularities. For other people, their SM is set at a medium level, where they systemize some but not all of the time. For yet other people, their SM is set so low that they would hardly notice if regularity or structure was in the input or not.

1.3. Systemizing in the general population (Levels 1–4)

Evidence suggests that within the general population, there are 4 degrees of systemizing: Level 1 corresponds to individuals who have little or no interest or drive to systemize, and consequently they can cope with total change. This would be expressed as a talent at socializing alongside a lack of precision over details, and as someone who can easily cope with change. Most people have *some* interest in systems, and there are sex differences in this. More females in the general population have the SM turned up to Level 2, and more males have it turned up to Level 3. Those with an SM at Level 2 might show typical female interests (e.g., emotions (Baron-Cohen and Wheelwright, 2003)), and those with an SM at Level 3 typical male interests (e.g., in mechanics) (Baron-Cohen, 2003). These differences might be quite subtle, such that on a test of map-reading or mental rotation, males might perform higher than females (Kimura, 1999). Some evidence comes from the Systemizing Quotient, on which males score higher than females (Baron-Cohen et al., 2003). Another piece of evidence comes from the Physical Prediction Questionnaire (PPQ), a method for selecting applicants for engineering. The task involves predicting which direction levers will move when an internal mechanism (of cog wheels and pulleys) of one type or another is involved. Men score significantly higher on this test, compared to women (Lawson et al., 2004).

Box 2
Summary of the hyper-systemizing theory of autism

Principal axioms in the theory:

1. The systemizing mechanism (SM) drives the brain to look for input-operation-output relationships in any data, and to construct systems.
2. In different individuals, the SM is set at different levels, and the level of any given individual's SM is determined by one's biology.
3. The higher the SM is set, the more one will attempt to systemize, and the more one will be attracted by systems with low variance; correspondingly, the lower your SM is set, the more variance (or change) one will tolerate in a system. The variance in a system determines how lawful it is.
4. The higher one's SM is set, the more detailed one's perception, because systemizing depends on details as possible variables in the system.
5. In males, the SM is set at a slightly higher level than in females.
6. People with Asperger Syndrome (AS) have their SM set at a higher level than typical males.
7. Parents of children with autism spectrum conditions have their SM set mid-way between people with AS and typical males.
8. People with classic autism have their SM set at the maximum level, and higher than people with AS.
9. Autism as a hyper-systemizing condition is postulated to be the result of assortative mating of two high systemizers: in each parent, the SM is set at an above average level, but the result in their child with autism is that the SM is set to an extreme.
10. As a consequence, the child with autism is solely attracted to systems of low or minimal variance, and become distressed by systems (such as the social world) where there is maximal variance.

Level 4 corresponds to individuals who systemize at a higher level than average. There is some evidence that above average systemizers have more autistic traits. Thus, scientists (who by definition are good systemizers) score higher than non-scientists on the Autism Spectrum Quotient (AQ). Mathematicians (who by definition focus on abstract systems) score highest of all the sciences on the AQ (Baron-Cohen et al., 2001b). Another example of a group of people who are above average systemizers is parents of children with autism spectrum conditions (Baron-Cohen and Hammer, 1997; Happe et al., 2001). The genetic implications of this are discussed later, as these parents have been described as having the 'broader phenotype' of autism (Bolton, 1996). At Level 4 one would expect a person to be talented at understanding systems with moderate variance (the stock market, running a company, the law, engineering).

1.4. Systemizing in the autistic spectrum (Levels 5–8)

The autistic spectrum can be thought of as comprising at least 4 subgroups: Asperger Syndrome (AS) (Asperger, 1944; Frith, 1991), and high-, medium-, and low-functioning autism (Kanner, 1943). They all share the phenotype of social difficulties and obsessional interests (A.P.A., 1994). In AS, the individual has normal or above average IQ and no language delay. In the 3 autism sub-groups (high-, medium-, and low-functioning) there is invariably some degree of language delay, and the level of functioning is indexed by overall IQ.[1]

Evidence suggests that people on the autistic spectrum have their SM set at levels above those in the general population: anywhere from Level 5 to Level 8. Level 5 can be seen as corresponding to AS: the person can easily systemize totally lawful systems (those that are 100% lawful, such as train timetables, historical chronologies) or highly lawful systems (e.g., computers) (Hermelin, 2002). They might also show an interest in systems like the weather where the variance is quite high, so the system is only moderately lawful (perhaps 60% lawful). The clinical literature is replete with anecdotal examples (e.g., one man with AS collected information of the type shown in Table 2 or Fig. 1), but there is also experimental evidence for superior systemizing in AS: (i) People with AS score higher than average on the Systemizing Quotient (SQ) (Baron-Cohen et al., 2003); (ii) People with AS perform at a normal or high level on tests of intuitive physics (Baron-Cohen et al., 2001a; Jolliffe and Baron-Cohen, 1997; Lawson et al., 2004; Shah and Frith, 1983); (iii) People with AS can achieve extremely high levels in systemizing domains such as mathematics, physics, or computer science (Baron-Cohen et al., 1999a,b); (iv) People with AS have an 'exact mind' when it comes to art (Myers et al., 2004) and show superior attention to detail (O'Riordan et al., 2001; Plaisted et al., 1998b).

There is some evidence that in people with high-functioning autism the SM is set at Level 6, in those with medium-functioning autism it is at Level 7, and in low-functioning autism it is at the maximum setting (Level 8). Thus, the high-functioning individuals who try to mentalize are thought to do this by 'hacking' (i.e., systemizing) the solution (Happe, 1996), and on the picture-sequencing task, they perform above average on sequences that contain temporal or physical–causal (i.e., systemizable) information (Baron-Cohen et al., 1986). In the medium-functioning individuals, in contrast to their difficulties on the false belief task (an empathizing task) they perform normally or even above average on two equivalent systemizing tasks (the false photograph task (Leslie and Thaiss, 1992) and the false drawings task (Charman and Baron-Cohen, 1992)). In the low-functioning group, their obsessions cluster in the domain of systems (Baron-Cohen and Wheelwright, 1999); and given a set of coloured counters, they show their hyper-systemizing as extreme 'pattern imposition' (Frith, 1970). Box 3

[1] High functioning autism can be thought as within one standard deviation of the population mean IQ (i.e. IQ of 85 or above); medium functioning autism can be thought of as between one and three standard deviations below the population mean (i.e. IQ of 55–84). Low functioning autism can be thought of below this, (i.e. IQ of 54 or below).

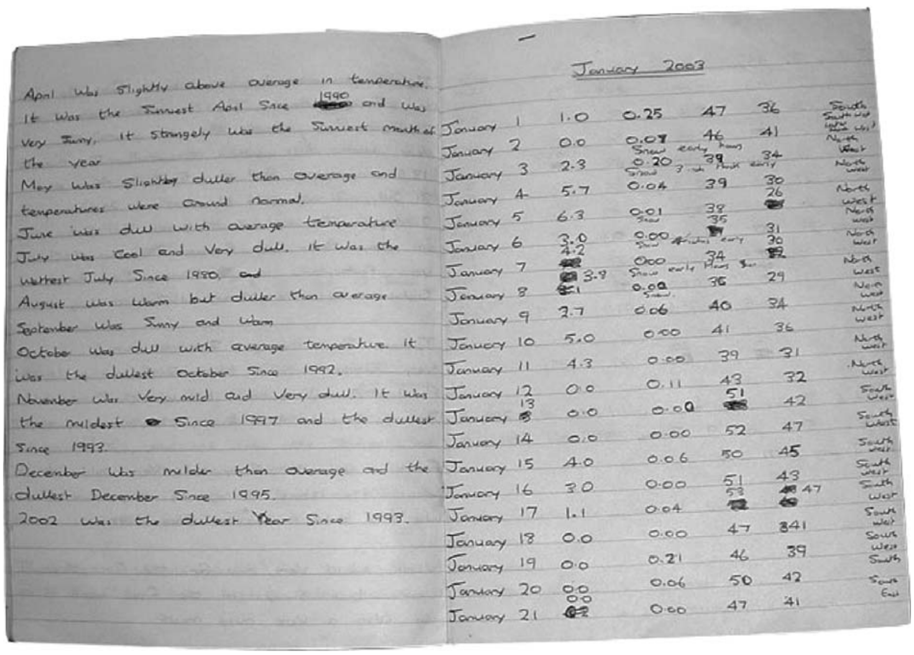

Fig. 1. An example of systemizing the weather, from the notebook of Kevin Phillips, a man with Asperger Syndrome. With kind permission.

lists 16 behaviours that would be expected if an individual had their SM turned up to the maximum setting of Level 8.

The hyper-systemizing theory thus has the power to explain not only what unites individuals across the autistic spectrum, but why the particular constellation of symptoms is seen in this syndrome. It also explains why some people with autism may have more or less language, or a higher or lower IQ, or differing degrees of mindblindness (Baron-Cohen, 1995). This is because, according to the theory, turning the SM dial *downwards* from the maximum level of 8, at each point on the dial the individual should be able to tolerate an increasing amount of change or variance in the system. Thus, if the SM is set at Level 7, the person would be able to deal with systems that were less than 100% lawful, but still highly (e.g., at least 90%) lawful. The child could achieve a slightly higher IQ (since there is a little more possibility for learning about systems that are less than 100% lawful), and the child would have a little more ability to generalize than someone with classic autism.[2] The higher the level of the SM, the less generalization, since systemizing involves identifying laws that might only apply to the current system under observation. Systemizing a 'Thomas the Tank Engine' video (a favourite for many children with autism) may not lead to a rule about *all* such videos, but just a rule that applies to *this* particular one with *this* unique sequence of crackles and hisses.[3]

At Level 7, one would expect some language delay, but this might only be a moderate (since someone whose SM is set at Level 7 can tolerate a little variance in the way language is spoken and still see meaningful patterns). And the child's mindblindness would be less than total. If the SM is set at Level 6, such an individual would be able to deal with systems that were slightly less (e.g., at least 80%) lawful. This would therefore be expressed as only mild language delay, mild obsessions, mild delay in theory of mind, and stilted social behaviour, such as attempts at systemizing social behaviour (e.g., asking for affirmation of the rule: "You mustn't shout in church, must you?") (Baron-Cohen, 1992).

1.5. Autism as a result of assortative mating of two high systemizers

It is well established that autism arises for genetic reasons (Bailey et al., 1995; Folstein and Rutter, 1988; Gillberg, 1991), but the evidence for systemizing being part of the genetic mechanism for autism includes the following: fathers and grandfathers of children with autism are twice as likely to work in the occupation of engineering (chosen as a clear example of a systemizing occupation), compared to men in the general population (Baron-Cohen et al., 1997). The implication is that these fathers and grandfathers (both maternal and paternal) have their SM set higher than average (Level 4). Consistent with this, students in the natural sciences (engineering, mathematics, physics, all of which require developed systemizing in relation to mechanical or abstract systems) have a higher number of relatives with autism than do students in the humanities (Baron-Cohen et al., 1998). If systemizing talent is genetic, such genes appear to co-segregate with genes for autism.

The evidence that autism could be the genetic result of having *two* systemizers as parents (assortative mating) includes

[2] I am indebted to Nigel Goldenfeld for suggesting this connection between hyper-systemizing and IQ.

[3] The 'reduced generalization' theory of autism (Plaisted et al., 1998a) is thus seen as a consequence of hyper-systemizing, rather than as an alternative theory. Reduced generalization has been noted in autism for many decades (Rimland, 1964) but is not discussed in any functional or evolutionary context. In contrast, systemizing (an evolved function of the human brain) presumes that one does not generalize from one system to another until one has enough information that the rules of system A are identical to those of system B. Good generalization may be a feature of average or poor systemizers, whilst 'reduced' generalization can be seen as a feature of hyper-systemizing.

Box 3

Systemizing mechanism at Level 8: classic, low-functioning autism

What does it mean for one's SM to be turned up to Level 8? The person by definition systemizes everything. Since in the social world the information is too complex to be systemized, such individuals focus on systems which are totally lawful (that is, with zero (or minimal) variance).

Key behaviours that follow from extreme systemizing include:

- highly repetitive behaviour (e.g., producing a sequence of actions, sounds, or set phrases, or bouncing on a trampoline);
- self-stimulation (e.g., a sequence of repetitive body-rocking, finger-flapping in a highly stereotyped manner, spinning oneself round and round);
- repetitive events (e.g., spinning objects round and round, watching the cycles of the washing machine; replaying the same video 1000 times; spinning the wheels of a toy car);
- preoccupation with fixed patterns or structure: (e.g., lining things up in a strict sequence, electrical light switches being in either an ON or OFF position throughout the house; running water from the taps/faucet);
- prolonged fascination with systemizable change (e.g., sand falling through one's fingers, light reflecting off a glass surface, playing the same video over and over again, preference for simple, predictable material such as “Thomas the Tank Engine” movies);
- tantrums at change: as a means to return to predictable, systemizable input with minimal variance;
- need for sameness: the child attempts to impose lack of change onto their world, to turn their world into a totally controlled or predictable environment (a ‘Skinner Box’), to make it systemizable;
- social withdrawal: since the social world is unsystemizable;
- narrow interests: in just one or two systems (types of windows; catalogues of information).
- mindblindness: since the social world is largely unsystemizable;
- immersion in detail: since a high systemizing mechanism needs to record each data-point: e.g., noticing small changes;
- reduced ability to generalize: since high systemizing means a reluctance to formulate a law until there has been massive and sufficient data-collection. This could also reduce IQ and breadth of knowledge;
- severe language delay: since other people's spoken language varies every time it is heard, so it is hard to systemize;
- islets of ability: since the high systemizer will channel their attention into the minute detail of one lawful system (the script of a video, or the video player itself, spelling of words, prime numbers), going round and round in this system to obtain evidence of its total lawfulness.

the following: (a) Both mothers *and* fathers of children with AS have been found to be strong in systemizing on the Embedded Figures Test (Baron-Cohen and Hammer, 1997). This study suggests that *both* parents may be contributing their systemizing genotypes. (b) Both mothers and fathers of children with autism or AS have elevated rates of systemizing occupations among their fathers (Baron-Cohen et al., 1997). (c) Mothers of children with autism show hyper-masculinized patterns of brain activity during a systemizing task (Baron-Cohen et al., in press). (d) The probability of having a brain of Type S (Level 3) in the male population is 0.44, and the probability of having a brain of Type S in the female population is 0.14 (Goldenfeld et al., 2006). If autism arises from assortative mating of two strong systemizers, then the probability of autism in the population should be $(0.44 \times 0.14) = 0.062$. This is remarkably close to the actual rate of autism spectrum conditions in the general population (Baird et al., 2000; Fombonne, 2001). It is unlikely that the liability genes for autism in males in the general population are common polymorphisms, but that these are relatively rare in females in the general population. Rather, it may be that in males the liability genes interact with some other (endocrine?) factor to increase risk, or that in females there is some protective factor that decreases risk.

1.6. Hyper-systemizing vs. weak central coherence vs. executive dysfunction theories

The hyper-systemizing theory predicts that when presented with information or tasks that can be systemized, and especially when presented with information that derives from a highly lawful system, people with autism spectrum conditions will perform at an intact or even superior level, always relative to a mental age matched control group. Such an account differs from the two dominant theories of the non-social features of autism, the weak central coherence theory (Frith, 1989) and the executive dysfunction theory (Russell, 1997).

Regarding the former, it has been shown that people with autism perform well on the Embedded Figures Test and on the Block Design Subtest (Shah and Frith, 1983, 1993), and these have been interpreted as signs of weak central coherence. But given that both of these are lawful systems, the same data can be taken as evidence for hyper-systemizing. People with autism have been shown to have deficits in contextual processing (Jolliffe and Baron-Cohen, 1999), but such material is harder to systemize. Regarding the latter, people with autism show perseveration on the Wisconsin Card Sorting Test (Rumsey and Hamberger, 1988), taken as a sign of an executive dysfunction. But their perseveration on this task suggests that people with autism spectrum conditions are focused on establishing a *rule* (a key aspect of systemizing) and as good systemizers one would not expect them to abandon testing the rule, but instead to keep testing the rule, ignoring the experimenter’s request to shift to a new, arbitrary rule. What appears as perseveration may therefore be a sign of hyper-systemizing. Equally, people with autism may take more moves on the Tower of London test (or its equivalents) (Hughes et al., 1994), but if they are more focused on systemizing the task (identifying any lawful regularities), issues such as solving the task in the minimum number of moves may be irrelevant to them. We should be careful not to attribute a deficit to people with autism spectrum conditions when they may simply be approaching the task from a different standpoint to the experimenter.

1.7. Conclusions

According to the hyper-systemizing theory, the core of autism is both a social deficit (since the social world is the ultimately unsystemizable domain) and what Kanner astutely observed and aptly named "need for sameness" (Kanner, 1943). Autism is the result of a normative systemizing mechanism — the adaptive function of which is to serve as a law-detector and a change-predicting mechanism — being set too high. This theory explains why people with autism prefer either no change, or systems which change in highly lawful or predictable ways (i.e, systems with 'simple' change, such as mathematics, physics, repetition, objects that spin, routine, music, machines, collections); and why they become disabled when faced with systems characterized by 'complex' change (such as social behaviour, conversation, people's emotions, or fiction). Because they cannot systemize complex-change, they become "change-resistant" (Gomot et al., 2006).

Whilst autism spectrum conditions are disabling in the social world, their strong systemizing can lead to talent in areas that are systemizable. For many people with autism spectrum conditions, their hyper-systemizing never moves beyond phase 1: massive collection of facts and observations (lists of dates and the rainfall on each of these, lists of trains and their departure times, lists of records and their release dates, watching the spin-cycle of a washing machine), or massive repetition of behaviour (spinning a plate or the wheels of a toy car). But for those who go beyond phase 1 to identify a law or a pattern in the data (phase 2 of systemizing), 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).

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