

## 'Obsessions' in children with autism or Asperger syndrome

Content analysis in terms of core domains of cognition

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**Background** We report a survey of the content of obsessions in children with autism spectrum conditions. We use the term 'obsessions' narrowly, to indicate strong, repetitive interests. We predicted that obsessions would not cluster randomly, but rather would occur significantly more often in the domain of 'folk physics' (an interest in how things work), and significantly less often in the domain of 'folk psychology' (an interest in how people work). These predictions were tested relative to a control group of 33 children with Tourette syndrome.

**Aims** To examine the content of autistic obsessions, and to test the theory that these reflect an evolved cognitive style of good folk physics alongside impaired folk psychology.

**Method** Ninety-two parents returned a questionnaire designed to determine the subject of their child's obsessional interests. The results were analysed in terms of core domains of cognition.

**Results** Both predictions were confirmed.

**Conclusions** These results suggest that impaired folk psychology and superior folk physics are part of the cognitive phenotype of autism. A content-free theory of obsessions is inadequate.

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Obsessional interests are a major diagnostic feature of autism spectrum conditions (American Psychiatric Association, 1994). They have received relatively little research attention directly, by comparison with the other major diagnostic features of social, communicative and imaginative impairments. There is no evidence that in autism the obsession is distressing or unwanted ego-dystonic (Baron-Cohen, 1989). In the present study we asked parents to report on the content of their child's obsessions, with the aim of establishing a taxonomy of obsessions in autism spectrum conditions.

### THE EVOLUTIONARY FRAMEWORK: CORE DOMAINS OF COGNITION

We use the evolutionary framework to constrain this study. According to this framework, the human mind should be considered in terms of its evolved adaptiveness to the environment (Pinker, 1997). Two broad challenges to human survival would have been predicting object motion in the physical and the social environments. The specialised core cognitive domains of folk physics and folk psychology can be seen as the brain's adaptations to each of these challenges. Folk physics refers to our basic knowledge of how the physical world of objects works (e.g. that inanimate objects only move when touched, fall if unsupported, can have mechanical properties, etc.). Folk psychology refers to our basic knowledge of how the social world works (e.g. that animate objects are capable of self-propulsion, goal-directedness, emotional expression and perception). Folk psychology appears to be present from at least 12 months of age in humans (Rochat *et al*, 1997). Folk physics is present even earlier in human ontogeny (Leslie & Keeble, 1987). There is considerable evidence that

there are impairments in folk psychology in children with autism (Baron-Cohen, 1995).

Folk physics, by contrast, appears to be intact, and it may even be superior in autism, relative to normally developing children (Baron-Cohen *et al*, 1986; Leekam & Perner, 1991). For example, while there are reports of extremely high-achieving individuals with Asperger syndrome in the fields of mathematics, physics and computer science, there are few if any equivalents from the humanities (Baron-Cohen *et al*, 1999).

Such cognitive domains are considered 'core' because the basic knowledge appears to be acquired rapidly, early and universally, and may therefore be partly innate (Hatano & Inagaki, 1994). What makes them 'domains' is that they may be independent of each other, although this may only be apparent via dissociations following neural insult. They are said to be 'folk' theories of how the world works because the knowledge is not the result of explicit teaching, but rather comprises the intuitions that all folk possess. Other core cognitive domains, beyond folk psychology and folk physics, may also exist (Wellman, 1990). The principal others are folk mathematics (counting) and folk biology (classification of the animate world into species, predators, prey, etc.). It remains to be convincingly demonstrated that these are independent domains, since it is plausible that folk mathematics is simply part of folk physics, for example.

The above studies lead to the prediction that if obsessions in autism reflect what the child is interested in and what they may be good at, such obsessions should not be random with respect to content, but instead should cluster in certain core cognitive domains rather than others. Specifically, we predicted that obsessions would cluster in the domains of folk physics, and be under-represented in the domain of folk psychology. We made no prediction for the domain of folk mathematics, as this has been studied so little in autism.

### METHOD

The Cambridge University Obsessions Questionnaire (see Appendix) was posted to parents who had a child with autism or Asperger syndrome, and who were members of the National Autistic Society (UK). This questionnaire asks parents whether their child has an obsession in any one of 19 categories, chosen to cover the full range



of objects and activities. A 20th category, 'other', existed to ensure that any omission among the 19 categories could be recorded somewhere. We did not design the questionnaire around the core domains, since the questionnaire was intended to ensure that obsessions in any area of life could be recorded. Thus, data collection was as broad and as neutral as possible. We did not attempt to code the responses in terms of core domains until after data collection. There was no attempt to define 'obsession' for the parents, since this is notoriously difficult. It was, however, expected that parents would have their own notion of what this was.

### Coding

Following receipt of the completed questionnaires, the two authors (blind to case-control status) independently re-coded the results into the following 15 categories, guided by the evolutionary framework discussed earlier.

#### Six core cognitive domains

- (a) Folk physics (including machines, vehicles, spinning objects, physical systems, computers, astronomy, other sciences, building (e.g. Lego) and lights).
- (b) Folk mathematics (including numerical information, dates, timetables, diaries, maths, measuring, calendars, time and counting).
- (c) Folk biology (including plants, animals, life, death, illness, reproduction, biology, geography and nature).
- (d) Folk psychology (including imagination, relationships, gossip, desires, beliefs, intentions, emotions and pretending).
- (e) Language (including echoing, collecting words, phrases and learning languages).
- (f) Taxonomy (including sorting, categorising, lists, taxonomy and collecting).

These latter two categories were included because of claims that language might be modular (Pinker, 1997) and hence to some extent independent of the other core domains; and because taxonomising is also seen universally, and, while a number of theorists see taxonomising as part of folk biology (stemming from our evolved drive to categorise things into edible/inedible, or living/not-living, or predator/prey, etc.) it is clear that much categorising is unrelated to biological entities.

#### Eight other areas of everyday life

These were included so as to code obsessions that did not fit into one of the above core domains, in order to test for group differences (unpredicted) beyond the core domains. These comprised the following.

- (g) Attachments (to a specific object).
- (h) Crafts (including painting, drawing, Play-Doh, knitting and models).
- (i) Everyday life (including routines and tidiness).
- (j) Facts (including non-fiction books, and memorising facts).
- (k) Food (including dietary habits, types of food, restaurants, menus, etc.).
- (l) People (i.e. being obsessed with a particular person).
- (m) Sports or games (including playing or watching).
- (n) Television/audio (including films, videos, cartoons, listening to tapes, etc.).

#### One other clinically relevant domain

- (o) Sensory phenomena (including touching, smelling, sights and sounds).

These 15 categories, operationally defined as above, were used by two coders. Interrater agreement on this coding was 100%, presumably reflecting how clear-cut these categories are. From the previous work summarised earlier, we predicted that in autism, more children would show obsessions in folk physics, and fewer in folk psychology, relative to controls. We predicted that the groups may not differ in the eight other areas of everyday life. Finally, we predicted that the control group (children with Tourette syndrome) might show more obsessions relating to sensory phenomena, because tic disorder includes involuntary touching and vocalisations. Regarding scoring, we made no attempt to count how many obsessions a child had in any given category; if they had ever had an obsession in a particular category, they scored one point in that category.

### Sample

Group 1 comprised 92 parents of children with autism ( $n=50$ ), Asperger syndrome ( $n=32$ ), or autism spectrum ( $n=10$ ). As diagnosis was simply reported by parents, it was re-checked using the Autism Screening Questionnaire (ASQ) (Berument *et al*, 1999). All subjects scored above the suggested cut-

off (i.e. 13 or more) on this questionnaire. Since there was no independent assessment of age of language onset beyond parental report, no attempt was made to distinguish between these three subtypes in later analyses. The mean age of the children was 11.2 years (s.d.=2.1), and the male to female ratio was 76:16 (or 4.75:1).

Group 2 comprised 33 parents of children with Tourette syndrome, seven of whom had comorbid attention-deficit hyperactivity disorder (ADHD) and nine of whom had obsessional behaviour. The mean age of the children was 12.8 years (s.d.=2.4), and the male to female ratio was 30:3 (or 10:1). This control group was chosen because it controls for several different factors: (a) both Tourette syndrome and autism are neuropsychiatric conditions, (b) affecting boys more often than girls, (c) with a genetic aetiology, (d) with childhood onset, (e) involving obsessionality, (f) with a degree of comorbid ADHD, (g) and often disrupting normal schooling. All had been diagnosed by a leading expert psychiatrist at the Institute of Neurology, London.

We did not include a group of non-psychiatric controls simply because asking parents about obsessions in children who do not have them raises the difficulty of how to define 'obsession'. In psychiatric samples one can assume that parents will have a good idea of what this word entails. Furthermore, in a random sample, one would have to ask simply about 'patterns of interests' rather than obsessions, and these may not be comparable.

### RESULTS

Of 120 questionnaires sent out to the autism group and 45 sent out to the Tourette syndrome group, we received back 92 (76.7%) and 33 (73%), respectively. These return rates are reasonably high for postal questionnaire research. Since the main issue tested here was in terms of the core domains of cognition, we show (in Table 1) the raw number of children from each group scoring in each of the 15 re-coded categories.

In order to avoid artefacts arising from multiple statistical testing, we carried out Pearson  $\chi^2$  tests only on the three domains in which a difference was predicted, in a hypothesis-driven approach to testing significance. We set our significance level at  $P=0.05$ . The three domains were folk physics, folk psychology and sensory phenomena.

As predicted, group differences were found in each of these domains, in the expected direction: more children with autism spectrum conditions had obsessions which fell into the domain of folk physics ( $\chi^2=7.45$ ,  $P=0.006$ ) and fewer had obsessions in the domain of folk psychology ( $\chi^2=4.92$ ,  $P=0.027$ ), while more children with Tourette syndrome had obsessions relating to sensory phenomena ( $\chi^2=9.05$ ,  $P=0.003$ ). Finally, for completeness, we tested all other categories, but this time we set the significance level at  $P=0.01$ . No other categories differed significantly at this level except for television/audio, in which more children with autism spectrum conditions were obsessed ( $\chi^2=15.54$ ,  $P=0.00008$ ). Attachment to specific objects differed at the  $P=0.05$  level ( $\chi^2=3.38$ ,  $P=0.05$ ), being more common in the autism spectrum group, but this is not discussed further since it did not meet our more stringent test of significance controlling for multiple comparisons.

## DISCUSSION

We predicted that obsessions would not be random in children with autism spectrum conditions with respect to content, but would cluster in the domain of folk physics, and be significantly reduced in the domain of folk psychology. These predictions were confirmed. (An additional but unpredicted difference was that more children with autism spectrum conditions were also more obsessed with television. This latter finding probably relates to the predictability of television programmes, and to the repeatability of videos, which would be attractive to such children. Indeed, parents often noted that their child watched the same video over and over again.) In addition, we expected that in the Tourette syndrome control group a different pattern would be seen, namely that obsessions relating to action and sensory phenomena (involuntary touching and vocalising) would be more common. This was also confirmed. We consider below how such results relate to clinical accounts and family studies.

### Clinical accounts

The finding that children with autism and Asperger syndrome show significantly more obsessional interests in the area of folk physics fits with clinical reports. There is no shortage of clinical descriptions of children

with autism being fascinated by machines (the paradigm of non-intentional systems). One of the earliest clinical accounts was by Bettelheim (1968), who describes the case of "Joey, the mechanical boy". This child with autism was obsessed with drawing pictures of machines (both real and fictitious), and with explaining his own behaviour and that of others in purely mechanical terms. On the face of it, this would suggest that he had a well-developed folk physics.

This clinical literature reveals many cases of children similarly obsessed by machines. Parents' accounts (e.g. Hart, 1989) are a rich source of such descriptions. Indeed, it is hard to find a clinical account of autism that does not involve the child being obsessed by some machine or another. Typical examples include extreme fascinations with electricity pylons, burglar alarms, vacuum cleaners, washing machines, video players, trains, planes and clocks. Sometimes the machine that is the object of the child's obsession is quite simple (e.g. drain-pipes, windows, etc.).

Of course a fascination with machines need not necessarily imply that the child understands the machine, but in fact most of these clinical reports reveal that children with autism have a precocious understanding too. The child (with enough language, such as is seen in children with Asperger syndrome) may be described as holding

forth, like a 'little professor', on their favourite subject or area of expertise, often failing to detect that their listener may have long since become bored of hearing more on the subject. The apparently precocious mechanical understanding, coupled with relative obliviousness to the listener's level of interest, is consistent with the idea that the child's folk physics is outstripping his or her folk psychology in development.

### Family studies

Autism and Asperger syndrome appear to have a strong heritable component (Bailey *et al.*, 1995). Parents of children with Asperger syndrome also show mild but significant deficits on an adult folk psychology task, mirroring the deficit in folk psychology seen in patients with autism or Asperger syndrome (Baron-Cohen & Hammer, 1997). Parents of children with autism or Asperger syndrome are also over-represented in occupations in which possession of superior folk physics is an advantage but in which a deficit in folk psychology does not necessarily lead to any disadvantage. The paradigm occupation for such a cognitive profile is engineering. A recent study of 1000 families found that fathers and grandfathers (patri- and matrilineal) of children with autism or Asperger syndrome were more

**Table 1** Numbers of children in each group showing an obsession in each of the 15 coding categories

Category	Autism spectrum group (n (%))	Tourette syndrome group (n (%))
Biology	35 (38)	10 (30)
Language	22 (24)	4 (12)
Maths	32 (35)	9 (27)
Physics	77 (84)	20 (61) <sup>1</sup>
Taxonomy	67 (73)	21 (64)
Psychology	5 (5)	6 (18) <sup>2</sup>
Attachment	49 (53)	11 (33)
Crafts	17 (18)	9 (27)
Facts	17 (18)	5 (15)
Sensory phenomena	58 (63)	30 (91) <sup>3</sup>
Sports/games	23 (25)	9 (27)
Television/audio	59 (64)	8 (24)
People	13 (14)	5 (15)
Food	58 (63)	15 (45)
Everyday life	14 (15)	10 (30)
Total	92 (100)	33 (100)

1. Pearson  $\chi^2=7.45$ ,  $P=0.006$ .
2. Pearson  $\chi^2=4.92$ ,  $P=0.027$ .
3. Pearson  $\chi^2=9.05$ ,  $P=0.003$ .

than twice as likely to work in the field of engineering, than were control groups (Baron-Cohen *et al.*, 1997). Indeed, 28.4% of children with autism or Asperger syndrome had at least one relative (father and/or grandfather) who was an engineer. This may reflect the possibility that the genes shared by the child with an autism spectrum condition and a parent shape the brain towards interests in folk physics, and away from folk psychology.

Related evidence comes from a family study of psychiatric conditions including autism. Students at Cambridge University studying either sciences (physics, engineering or maths) or humanities (English or French literature) were surveyed about the family history of a range of psychiatric conditions (schizophrenia, anorexia, autism, Down's syndrome or manic depression). The students in the science group showed a rate of autism in the families six times greater than the humanities students, and this was specific to autism (Baron-Cohen *et al.*, 1998). The explanation for this finding may also be that the genes involved in autism cluster with the genes involved in good folk physics.

### Alternative accounts

Early accounts tended to assume that obsessions were a form of repetitive behaviour functioning to control high arousal (Hutt & Hutt, 1968). However, the concept of arousal itself has been hard to define. More recently, researchers have considered obsessions in terms of how they might be secondary to a specific cognitive deficit. For example, Russell suggested that obsessions and other repetitive behaviours seen in autism are the result of an executive dysfunction, probably mediated by frontal lobe damage (Russell, 1997). Executive function is the umbrella term covering those processes involved in attention switching, flexible responding, and planned behaviour (Luria, 1969). Patients with frontal lobe damage show executive dysfunction (Shallice, 1988), and so do patients with autism (Hughes *et al.*, 1994). Patients with obsessive-compulsive disorder (OCD) also show executive dysfunction (Christensen *et al.*, 1992), so the notion that obsessionality in autism may be caused by executive dysfunction has some face validity.

However, executive dysfunction does not account for the fact that the obsessional interests in autism are wholly different from

the neurotic obsessionality seen in patients with OCD. For example, a child with autism may have an obsessional collection of names and types of lizard, or an obsessional collection of meteorites. In contrast, a patient with OCD may have checking obsessions (e.g. a need to check the gas taps repeatedly) or washing obsessions (an excessive need to get rid of germs on their hands or clothes). Hence, whereas the patient with OCD has obsessions that typically involve fears of danger and harm, and unwanted thoughts that are ego-dystonic and intrusive, and which the patient tries to get rid of through performing compulsions (Rachman & Hodgson, 1980), people with autism spectrum conditions typically follow their interests or hobbies to an extreme and narrow degree, so that they become experts in their chosen field (Wing, 1988). In sum, the executive dysfunction theory ignores the *content* of the obsession, and so would not have predicted the present results. A further problem for the executive dysfunction theory is that neither patients with frontal lobe damage (Owen *et al.*, 1991) nor those with schizophrenia (Elliot & Sahakian, 1995) or attention-deficit hyperactivity disorder (Chelune *et al.*, 1986) necessarily develop obsessions, despite also showing executive dysfunction.

One other cognitive account of obsessions in autism spectrum conditions suggests that they are the child's attempt to impose order or control in a world where social behaviour appears unpredictable and confusing (Baron-Cohen, 1989). This account stems from the theory-of-mind hypothesis of autism. In brief, the child's deficit in making rapid sense of people's actions and intentions (Baron-Cohen, 1995) is held to trigger high levels of anxiety, which the child seeks to control by retreating into the predictable world of things and systems. However, it is yet to be demonstrated that social anxiety is always the cause of the child's obsessionality, though this may be true for a subgroup. The child may just be fascinated by the particular topic.

The present study shows the value of a content analysis of obsessions: children with autism spectrum conditions show more obsessional interests in mechanical systems (such as light switches or water taps) or other systems that can be understood in physical-causal or other law-based terms. Rather than these being a sign of executive dysfunction, it is suggested that the obsessions reflect the child's intact or even superior folk physics. The child's 'need

for sameness' or attempt to hold the environment constant might therefore be a sign of the child being a superior folk-physicist: conducting mini-experiments in his or her surroundings, in an attempt to identify laws governing events. The present study suggests that obsessions in autism spectrum conditions are not random with respect to content, but cluster positively in the domain of folk physics, and negatively in the domain of folk psychology. This may provide clues to the cognitive phenotype of this spectrum of conditions (Baron-Cohen, 1999).

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**CLINICAL IMPLICATIONS**

- Obsessions in autism may reflect cognitive strengths.
- Obsessions in autism may not simply exist as signs of executive dysfunction.
- As obsessional topics are pursued with strong spontaneous motivation, their potential use in education in autism should be explored.

**LIMITATIONS**

- These data derive from parental report alone.
- It remains unclear whether obsessional interests and stereotypies in autism have a shared cause.
- The relationship between autistic obsessions and their 'weak central coherence' remains unknown.

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## APPENDIX

## CAMBRIDGE UNIVERSITY OBSESSIONS QUESTIONNAIRE

We are interested to collect basic information on obsessional interests and behaviours in people with autism or Asperger syndrome. We would be grateful if you would answer the following questions.

Your child's name: ..... Sex: .....

Date of birth: ..... Diagnosis: .....

For each category of obsession, please **tick whether your child has ever had an obsession** in that category. If "YES", please specify the exact obsession(s).

**I. MACHINES (how things work)** e.g. computers, radios, TVs, washing machines, clocks, burglar alarms, etc.

YES  NO

If YES, please specify .....

**2. SYSTEMS** e.g. toilet flushing, drains, light switches, etc.

YES  NO

If YES, please specify .....

**3. SORTING/CATEGORISING** e.g. lining objects up, arranging objects in alphabetical order or by size, shape, colour, etc.

YES  NO

If YES, please specify .....

**4. BELIEF SYSTEMS** e.g. religion, politics, etc.

YES  No

If YES, please specify .....

**5. NUMERICAL INFORMATION** e.g. timetables, number plates, calculators, charts or tables of information, calculations, prime numbers, calendars, etc.

YES  NO

If YES, please specify .....

**6. SPORTS/GAMES** e.g. football, tennis, walking, mountain climbing, swimming, cycling, ice skating, snooker, playing cards, board games, etc.

YES  NO

If YES, please specify .....

**7. STRONGLY ATTACHED TO A PARTICULAR ITEM** e.g. an article of clothing, a rag, a bottle top, etc.

YES  NO

If YES, please specify .....

**8. SENSORY EXPERIENCES** e.g. touching things, hearing specific sounds, lights, smells, tearing paper, etc.

YES  NO

If YES, please specify .....

**9. CRAFTS** e.g. model making, knitting, sewing, cooking, carpentry, etc.

YES  NO

If YES, please specify .....

**10. FACTUAL INFORMATION** e.g. writing, reading or memorising lists of things, writing letters, reading encyclopaedias, newspapers, etc.

YES  NO

If YES, please specify .....

**II. THE CREATIVE ARTS/FICTION** e.g. theatre, cinema, art work, opera, watching drama on TV/videos, playing an instrument, listening to music, writing/reading fiction, etc.

YES  NO

If YES, please specify .....

**12. THE SCIENCES** e.g. astronomy, chemistry, geography, physics, engineering, biology, geology, etc.

YES  NO

If YES, please specify .....

**13. ANIMALS** e.g. pets, wild or farm animals, dinosaurs, insects, fish, birds, etc.

YES  NO

If YES, please specify .....

**14. COLLECTING THINGS** e.g. bottles, matchboxes, stamps, catalogues, etc.

YES  NO

If YES, please specify .....

**15. PEOPLE** e.g. talking to people, a specific person, etc.

YES  NO

If YES, please specify .....

**16. VEHICLES** e.g. trains, buses, planes, boats, model railways, etc.

YES  NO

.....

**17. SPINNING OBJECTS** e.g. tops, wheels, plates, frisbees, coins, etc.

YES  NO

If YES, please specify .....

**18. FOOD AND DRINK** e.g. consuming particular food and drink, etc.

YES  NO

If YES, please specify .....

**19. PLANTS** e.g. gardening, house plants, woodland plants, seaweed, etc.

YES  NO

If YES, please specify .....

**20. OTHER** Please list any other obsessions which do not feel are covered by the other categories .....

.....