The Social Gradients of Autism Spectrum Disorders in England[*]

Alexander Upfill-Brown
Department of Sociology
University of Oxford

Tak Wing Chan
Department of Sociology
University of Oxford

September 27, 2013

Abstract

In this paper, we use administrative data to explore the social gradients of Autism Spectum Disorders (ASD) in England. We report some demographic correlates with ASD that are consistent with previous research. But we also report results that are quite different from those based on Californian data. In particular, we show that in England pupils from lower income households are *more* likely to be diagnosed with ASD. This raises some questions about how the health delivery and school systems of different countries might produce different social gradients of ASD, an hypothesis which we will explore with multilevel models in the full version of this paper.

1 Introduction

Autism Spectrum Disorders (ASD) is a diverse set of neuro-developmental conditions that have three core components: (i) impaired social interactions, (ii) communication difficulties, and (iii) rigid and repetitive behaviours.

As in many other countries, the measured level of ASD in the UK has risen very sharply over the past 50 years: from 4.5 per 10,000 children (Lotter, 1966) to more recent estimates of 77.2 per 10,000 (Baird *et al.*, 2006) or even 157 per 10,000 (Baron-Cohen *et al.*, 2009). What accounts for this twenty- to thirty-fold increase? Because the aetiology of ASD is not well understood (Happé *et al.*, 2006), this is a difficult question to answer.

---

[*] Our research is supported by an OUP John Fell Fund small grant, award number: 122/682.

To elaborate, although ASD has a clear genetic component, the degree of its heritability is very uncertain. Indeed, 'common genetic variants that GWAS [genome-wide association studies] detects explain only a small fraction of the symptoms of autism' (Williams, 2012, p. S5). Likewise, because our understanding of the biological underpinnings of ASD remains poor, there is no 'autism-detecting brain scan' (Lange, 2012, p. S17).

In the absence of reliable physical test or biological marker, ASD diagnosis has always been based on clinical observations and parental interviews (King and Bearman, 2011). As a result, social factors, such as increased awareness, changing diagnostic criteria, improved diagnostic and supporting services are likely to play an important role in the sharp rise of ASD caseloads (see e.g. Nassar *et al.*, 2009; Baron-Cohen *et al.*, 2009, p. 500).

This has been amply demonstrated in a series of important papers by Bearman and his colleagues (e.g. King and Bearman, 2009; Liu *et al.*, 2010a,b; King and Bearman, 2011). In particular, King and Bearman (2011) show that in California children with better educated parents and those from neighbourhoods of higher house price are more likely to have an ASD diagnosis, while the opposite is true of for children whose birth was paid for by Medi-Cal (a proxy of low household income). 'Individuals with greater resources were more likely to receive an autism diagnosis' (King and Bearman, 2011, p. 330).[1] This is because 'resources matter ... obtaining an autism diagnosis can be extremely difficult. In obtaining a diagnosis and services for their children, parents often confront a dizzying institutional maze and spend considerable resources navigating through it. Some communities do not have qualified diagnosticains. Accordingly, community resources ... have been tied to autism' (King and Bearman, 2011, p. 324). Which is why more resourceful individuals and those who live in richer communities are more likely to get ASD diagnosis.

In this paper, we ask whether this gradient also holds for England? In particular, we use administrative data to address the following questions. (1) What are the social gradients of ASD in England? (2) Have these gradients changed over time as ASD becomes more common? (3) How do the social gradients of ASD and their trends differ from those of other Special Education Needs (SEN) of school children?

---

[1] Their result is consistent with another study based on ecological data drawn from 12 states (Durkin *et al.*, 2010).

2 Data

The data we use come from the National Pupil Database (NPD), which is a census of all pupils attending state schools in England. We are given access to five years of NPD data, namely those for 2004, 2006, 2008, 2010 and 2012. NPD contains key demographic information of the pupils such as their age, gender, ethnicity, the language they speak at home, eligibility for 'free school meals' (a proxy for low household income), and their local IDACI(Income Deprivation Affecting Children Index) score, which is a measure of the percentage of children under 16 living in income-deprived households.

In addition, NPD data contains information on pupil's attainment on standardised tests taken at the end of 'key stages' (KS) of their school career. There are five key stages (KS) in the English school system, and we have given access to individual pupils' attainment data at KS1 (year 2, roughly age 7), KS2 (year 6, age 11) and KS3 (year 9, age 14).

Most importantly for our purpose, NPD also contains information on each pupil's Special Education Needs (SEN). This is an indicator of whether the pupil has particular learning difficulties or disabilities for which the school and/or the local authority have to make provision. Up to twelve types of SEN are distinguished in NPD. We focus on ASD. But for comparative purpose, we also carry out parallel analyses for three other types of SEN: Behaviour, emotional and social difficulties (BESD), Speech, language and communication needs (SLCN), and Severe learning difficulty (SLD).[2]

For our analytical purpose, the NPD data set is very attractive for several reasons. First, as it covers all children in state schools, the sample size is very large. Although the measured prevalence of ASD has been rising sharply, it remains a rare condition in the general population. And the large N of NPD will give us sufficient statistical power to discern relatively small differences in the population. Secondly, the NPD data set contains geocode information and school identifier. This allows us to link to individual pupil records some characteristics of their school and local authority, and the community in which they live. In the full version of the paper, we intend to use some of this information to carry out some multilevel analysis.

There are also some shortcomings about the NPD data. First, it does not contain prenatal, perinatal and other information (e.g. birth weight, birth order, prematurity, parental age) that are probable correlates of ASD. But we note that some of these factors are not consistently significant in previ-

---

[2] Other SEN identified in NPD are: Specific learning difficulty (SPLD), Moderate learning difficulty (MLD), Profound and multiple learning difficulty (PMLD), Hearing impairment (HI), Visual impairment VI), Multiple sensory impairment (MSI), Physical disability (PD) and Other Difficulty/Disability (OTH).

ous research. And King and Bearman (2011, p. 320) observe that '[w]hile individual-level factors, such as birth weight and parental education, have a fairly constant effect on likelihood of diagnosis over time, we find that community-level resources drive increased prevalence.' It seems likely that it is the social factors that we consider in this paper that play a larger role in the rise of ASD.

The second shortcoming of the NPD data is that full information is available for pupils attending state schools only. Overall, about 7% of all school children in England are educated in independent (i.e. non-state) schools, and they tend to come from financially better off families. But there is a good deal of variation by age, such that only 4% of school children aged 7, 6% of those aged 11 and 14% of those aged 16 or over attend independent schools (Lockhart *et al.*, 2013, p. 8, Figure 7). By focusing on early key stages (especially KS1 and KS2), the bias in the coverage of our sample is more limited.

3 Results

Figure 1 shows how the four types of SEN has changed over key stages and over calendar years.[3] Several points are notable. First, ASD has unambiguously become more common over the years. At each key stage, the prevalence rate of ASD has gone up at each successive calendar year. And, with the exception of 2006, the same is also true for SLCN. In contrast, it is not clear that the caseload for BESD or SLD has changed systematically between 2004 and 2012.[4] In short, there has not been a general 'epidemic' for all types of SEN.

Secondly, over the pupils' life course (key stages), SLCN tend to become less common, suggesting that many pupils grow out of this particular SEN. At the same time, BESD trends upwards over key stages, suggesting that some of the BESD caseloads have a late onset and/or that they are diagnosed later. The life course trajectory for SLN first goes up between KS1 (age 6) and KS2 (age 10) before dropping between KS2 and KS3 (age 13). As regards ASD, the pattern is more complex, with that for 2012 trends monotonically upwards between KS1 and KS3, that for 2004 trends monotonically downwards, while thost for 2006, 2008 and 2010 are non-monotonic. We believe this is consistent with the a general increase in ASD caseloads *and* a tendency for ASD to be diagnosed at progressively younger ages.

---

[3] Note that the scale of the y-axis of the four subgraph is different.

[4] Note also that the line for BESD in 2006 is an outlier.

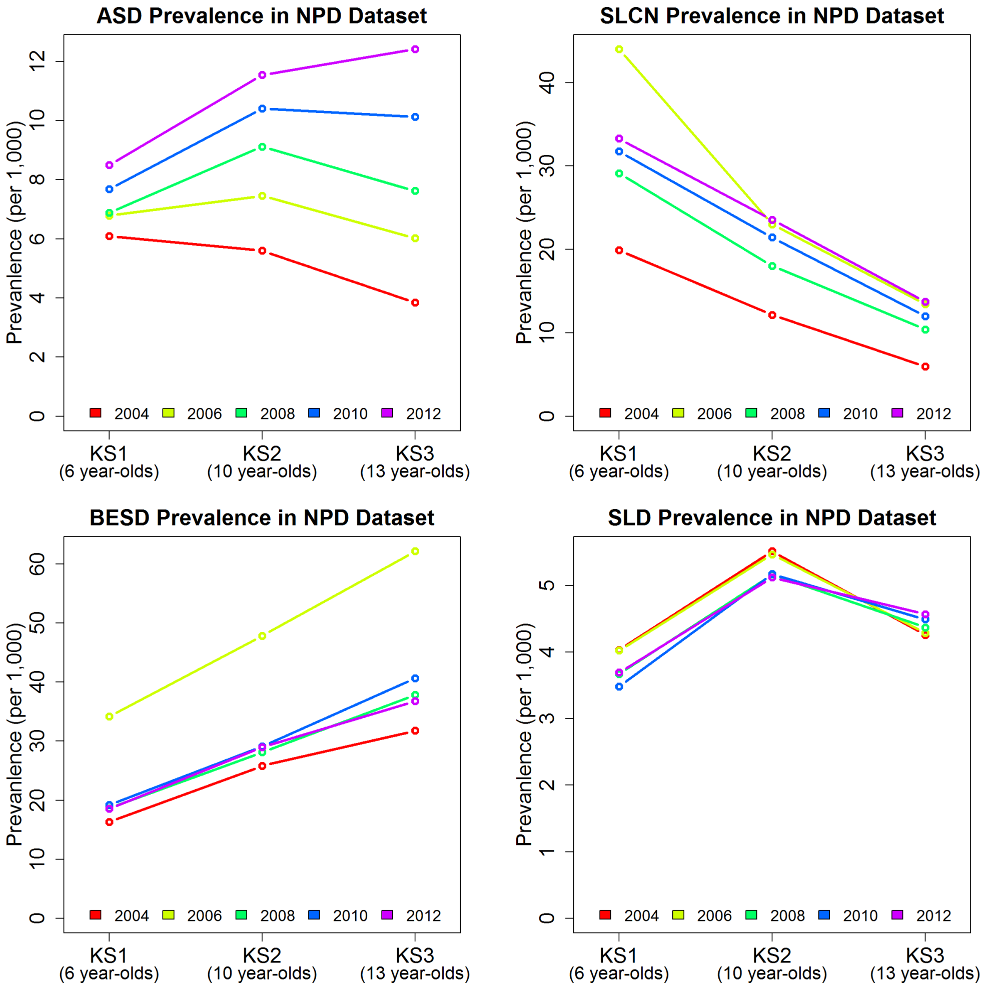

Figure 1: Trends of ASD, SLCN, BESD, SLD by calendar year and age

In Table 1 we report results from logistic regression models in which the four types of SEN serve as dependent variables. These models are based on pooled NPD data from all five years and we focus on KS2. Starting with the first column, it can be seen that boys are 6 times ($e^{1.798}$) more likely than girls to be diagnosed with ASD. This is consistent with previous reserarch. In terms of ethnicity, black school children are significantly more likely than whites to recieve a ASD diagnosis. But the opposite is true for Asian children.

Table 1: Determinants of SEN at KS2 (pooled data)

	ASD	BESD	SLCN	SLD
Intercept	−7.051***	−5.964***	−4.965***	−6.311***
	(0.041)	(0.022)	(0.023)	(0.046)
male	1.798***	1.543***	0.809***	0.616***
	(0.018)	(0.009)	(0.009)	(0.017)
black	0.327***	0.268***	0.188***	0.115**
	(0.031)	(0.015)	(0.019)	(0.039)
asian	−0.236***	−0.524***	−0.074***	0.203***
	(0.041)	(0.023)	(0.021)	(0.042)
others	0.043	0.139***	0.005	−0.041
	(0.027)	(0.013)	(0.018)	(0.035)
English	0.643***	0.784***	−0.123***	0.308***
	(0.033)	(0.016)	(0.017)	(0.037)
fsm	0.252***	0.941***	0.512***	0.86***
	(0.017)	(0.008)	(0.01)	(0.019)
IDACI (Q2)	0.067***	0.288***	0.164***	0.139***
	(0.02)	(0.014)	(0.016)	(0.03)
IDACI (Q3)	0.1 * **	0.604***	0.334***	0.316***
	(0.02)	(0.013)	(0.015)	(0.029)
IDACI (Q4)	0.066**	0.848***	0.464***	0.355***
	(0.021)	(0.013)	(0.015)	(0.029)
IDACI (Q5)	−0.048*	1.0 * **	0.507***	0.35***
	(0.023)	(0.013)	(0.016)	(0.03)
year	0.09***	−0.014***	0.055***	−0.01***
	(0.002)	(0.001)	(0.002)	(0.003)
N	2834369	2834369	2834369	2834369
LogLik	-134128	-362530	-264649	-91547
AIC	268281	725085	529323	183119

Those who speak English at home are almost twice ($e^{0.643}$) as likely to receive ASD diagnosis. This might be interpreted as consistent with the 'resources matter' argument, and parents not speaking English at home would probably find it more difficult to negotiate the process in getting their child an ASD diagnosis.

But Table 1 also shows that children eligible for free school meals (just under 20% of the sample) are *more* likely to receive ASD diagnosis. This is contrary to the pattern reported for California. As regards IDACI scores, the picture is quite complex. We have divided the sample into quintiles according to IDACI scores. Using the bottom (i.e. least deprived) quintile as the reference categories, it can be seen that the second through fourth quintiles are *more* likely, but the top (i.e. most deprived) quintile is *less* likely to be diagnosed with ASD.[5]

Comparing across the four columns, the corresponding estimates are mostly of the same sign. The notable exceptions are as follows. First, as noted above, the four types of SEN follow different time trends. Secondly, compared with Whites, Asian children are more likely to diagnosed with SLD, and children of other ethnicities are more likely to be diagnosed with BESD. Thirdly, speaking English at home is generally associated with higher odds of getting SEN diagnosis, but not for SLCN. Finally, the four IDACI parameters are of positive and significant and are monotonically increasing for BESD, SLCN and SLN. That is, children living in more deprived neighbourhoods are progressively more likely to get these SEN diagnosis. But, as discussed above, the pattern for ASD is non-monotonoic.

Next we fit the same logistic regression models separately for each key stage and for the five years. In Figure 2, we report the estimates for the free school meal parameter. It can be seen that for all three key stages, the fsm effect tends to trend upward. The rise is especially strong for KS1 and KS2.

The same upward trend can be seen for the contrast between the top and the bottom quintiles on the IDACI score (Figure 3), such that although the most deprived children used to be less likely to receive ASD diagnosis in 2004 at all three key stages, by 2010 and 2012 the difference between the top and the bottom quintiles are no longer statistically significant.

Figures 4 and 5 report the same trends for all four types of SEN.

---

[5] Our result is consistent with those of Russell *et al.* (2013) who use data from the UK Millennium Cohort Study and report a *negative* bivariate association between family income and the odds of receving ASD diagnosis. However, when other covariates are controlled for, this family income effect becomes statistically insignificant. This is probably related to the relatively modest sample size of the Millennium Cohort Study ($N = 8,449$ in the multivariate model). We might also add that in their paper, birth weight, length of labour, delivery methods, race, family size, maternal age at childbirth, maternal education are not statistical significant predictors for ASD even in unadjusted bivariate models.

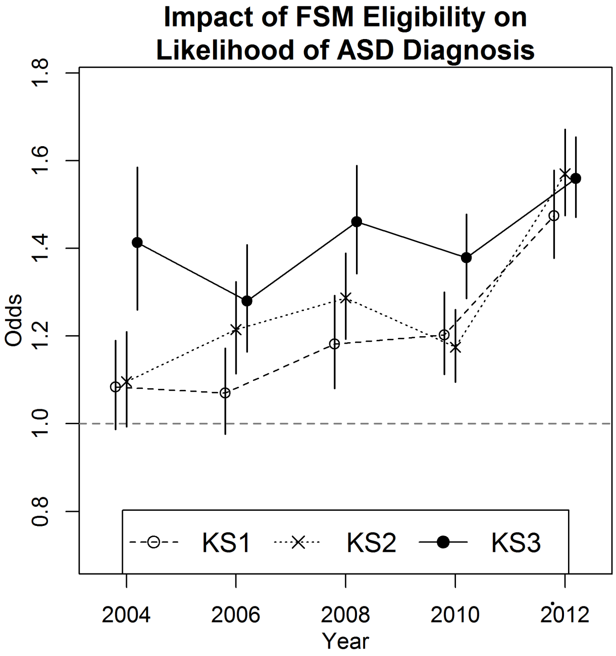

Figure 2: Association between fsm and ASD by year and key stags

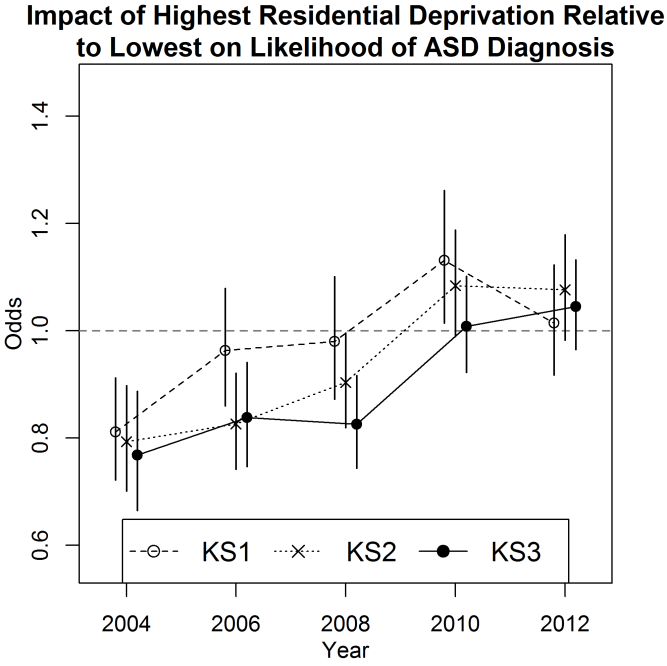

Figure 3: Association between fsm and ASD by year and key stags

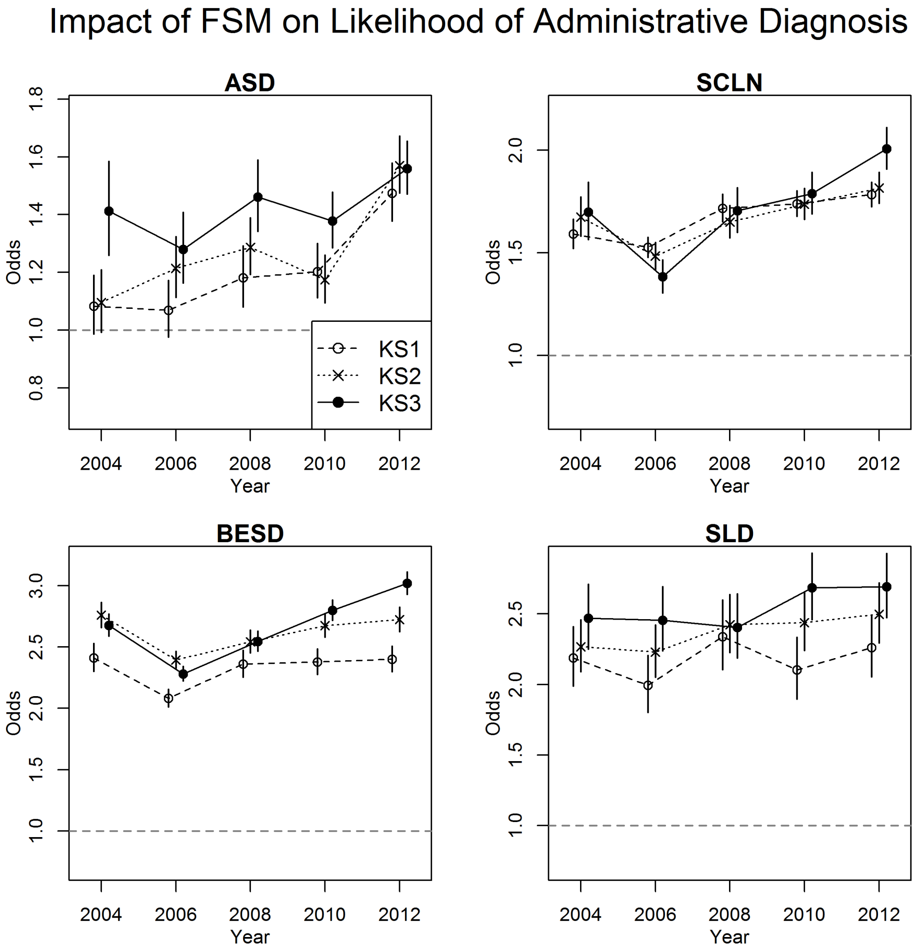

Figure 4: Association between fsm and ASD by year and key stags

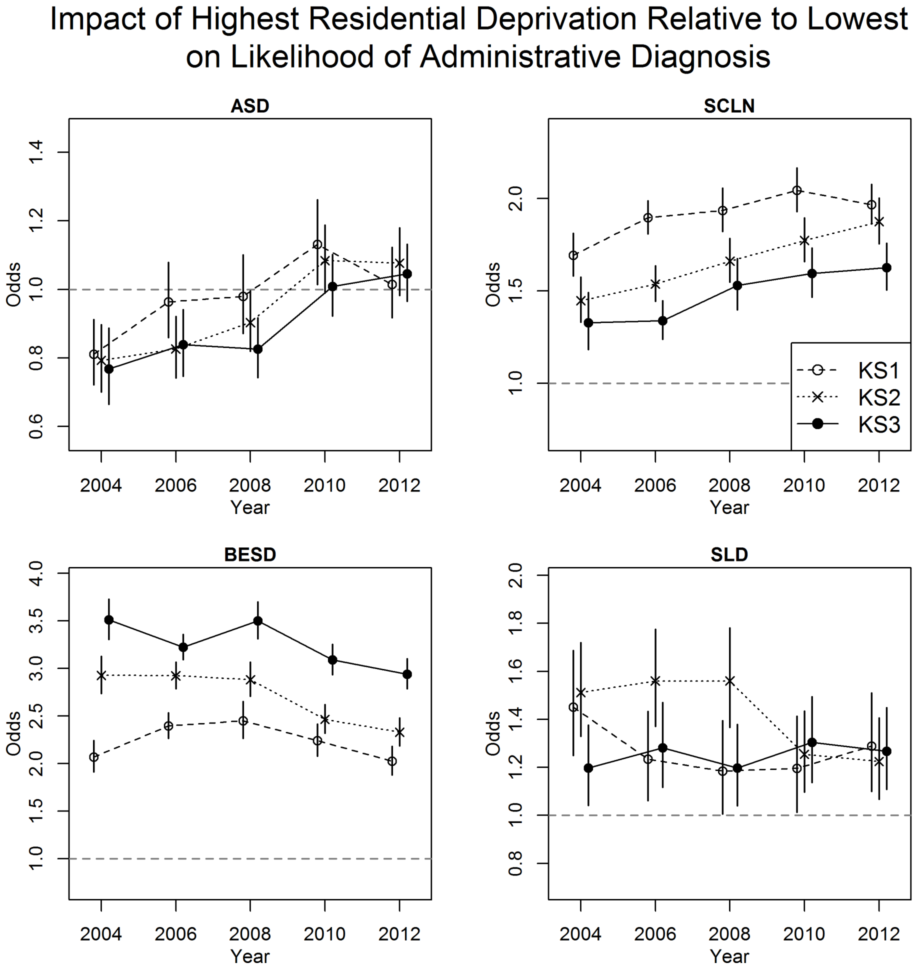

Figure 5: Association between fsm and ASD by year and key stags

4 Summary and further work

In this paper, we use administrative data to explore the social gradients of ASD and three other kinds of Special Education Needs of school children in England. Some of the results of this preliminary analysis are consistent with those reported for the US. But we also report some important differences. In particular, we show that in England pupils who are eligible for free school meals (a proxy for low household income) are more likely to receive ASD diagnosis. Furthermore, although the effect of neighbourhood income deprivation is non-monotonic, when disaggregated by year, we see a trend in which those living in the most deprived areas are becoming more likely to receive ASD diagnosis.

These are prima facie evidences to suggest that the social gradients for ASD are quite different between England and the US. In the coming months, we plan to bring in school, local authority and community information and explore the English pattern in greater detail with multilevel models. We also have plans to talk to professionals involved in ASD diagnosis in order to understand better how diagnosis is carried out on the ground. We are confident that we will be able to report a more complete picture in the PAA meeting in May 2014.

References

Baird, G., Simonoff, E., Pickles, A., Chandler, S., Loucas, T., Meldrum, D., and Charman, T. (2006). Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *The Lancet*, **368**, 210–215.

Baron-Cohen, S., Scott, F. J., Allison, C., Williams, J., Bolton, P., Matthews, F. E., and Brayne, C. (2009). Prevalence of autism spectrum conditions: UK school-based population study. *British Journal of Psychiatry*, **194**, 500–509.

Durkin, M. S., Maenner, M. J., Meaney, F. J., Levy, S. E., DiGuiseppi, C., Nicholas, J. S., Kirby, R. S., Pinto-Martin, J. A., and Schieve, L. A. (2010). Socioeconomic inequality in the prevalence of autism spectrum disorder: evidence from a U.S. cross-sectional study. *PLoS ONE*, **5**(7), 1–7. e11551.

Happé, F., Ronald, A., and Plomin, R. (2006). Time to give up on a single explanation for autism. *Nature Neuroscience*, **9**(10), 1218–1220.

King, M. and Bearman, P. (2009). Diagnostic change and the increased prevalence of autism. *International Journal of Epidemiology*, **38**, 1224–1234.

King, M. D. and Bearman, P. S. (2011). Socioeconomic status and the increased prevalence of autism in California. *American Sociological Review*, **76**(2), 320–346.

Lange, N. (2012). Imaging autism. *Nature*, **491**, S17.

Liu, K.-Y., Zerubavel, N., and Bearman, P. S. (2010a). Social demographic change and autism. *Demography*, **47**(2), 327–343.

Liu, K.-Y., King, M., and Bearman, P. S. (2010b). Social influence and the autism epidemic. *American Journal of Sociology*, **115**(5), 1389–1434.

Lockhart, R. E., Gilpin, A., and Jasiocha, E. (2013). *ISC Census 2013*. Independent Schools Council, London.

Lotter, V. (1966). Epidemiology of autistic conditions in young children. *Social Psychiatry*, **1**(3), 124–137.

Nassar, N., Dixon, G., Bourke, J., Power, C., Glasson, E., de Klerk, N., and Leonard, H. (2009). Autism spectrum disorders in young children: effect of changes in diagnostic practices. *International Journal of Epidemiology*, **38**, 1245–1254.

Russell, G., Rodgers, L. R., Ukoumunne, O. C., and Ford, T. (2013). Prevalence of parent-reported ASD and ADHD in the UK: findings from the Millennium Cohort Study. *Journal of Autism and Developmental Disorders*.

Williams, S. C. P. (2012). Searching for answers. *Nature*, **491**, S4–S6.