Introduction

It has been suggested that the season in which you are born can affect your scholastic achievement and your chances of being diagnosed with a neurodevelopmental disorder. Three hypotheses have been put forward to explain this effect:

- The **seasonality hypothesis** – the season of your birth has a biological effect upon your development through in utero effects (e.g. maternal exposure to flu or sunlight during pregnancy).
- The **length of schooling hypothesis** – In England, children who are born in the summer used to enter school in the summer term and therefore received two terms less schooling than their peers.
- The **relative-age hypothesis** – In England, summer-born children are almost a year younger than Autumn-born children at school intake putting them at a disadvantage in the classroom setting.

Aims

- To explore the evidence for a season of birth effect in a large population cohort from the UK (ALSPAC).
- To investigate the relationships between season of birth, scholastic ability, scholastic achievement and the presence of neurodevelopmental disorders.
- Where a relationship is found, to examine the evidence for each of the three season of birth hypotheses shown above.

Participants

14691 children from the ALSPAC longitudinal study were included in this study. The children were born in the Avon area between 1991 and 1993. Children for whom English was not a first language, children who did not attend state school or children who had started school or taken exams early were excluded from leaving 11162 individuals. This sample was categorised by season of birth according to the English school system:

- **Autumn born** – birth date 1st September to 30th November (n=3184).
- **Winter born** – birth date 1st December to 28th February (n=2071).
- **Spring born** – birth date 1st March to 31st May (n=2565).
- **Summer born** – birth date 1st June to 31st August (n=3342).

Measures

The following measures were examined in relation to the season of birth:

- **Scholastic Ability**: - Single word reading at age 7 (n=6704). - Single word spelling at age 7 (n=6589). - Mental arithmetic at age 8 (n=6263). - Total IQ at age 8 (n=6227).
- **Scholastic Attainment**: - KS1 SAT levels – reading at age 6-7 (n=8910). - KS1 SAT levels – maths at age 6-7 (n=8849). - Number of GCSEs passed at grades A-C at age 15-16 (n=9384). - Number of GCSEs passed at grades A*/A at age 15-16 (n=9384).
- **NB.** For KS1 SATs, Level 1 is “below expectations”, level 2 is “at expected level”, level 3 is “beyond expectations” and level 4 is “exceptional”.
- **Diagnoses of Neurodevelopmental Disorders**: - Clinical diagnoses - ADHD, phobia, depression, anxiety, conduct disorder, pervasive developmental disorder at age 7½ (N=7300) - Parental reports - “has your child been diagnosed with...” (autistic spectrum disorders and learning difficulties such as dyslexia, dyspraxia and dyscalculia) at age 7½ (N=6600) - Scholastic support – “does your child require special support for reading difficulties or speech and language difficulties?” at age 7½ (N=7000).

Analyses

- Measures of scholastic ability and scholastic attainment were tested as quantitative traits by examining differences between group means using the T-test.
- Diagnostic rates were tested as categorical traits using the Fisher’s exact test.
- Effect sizes are given as Cohen’s d-values (0.2-0.5 = small effect size, 0.5-0.8=medium effect size, 0.8-1.2=large effect size, >1.3=very large effect size).

Results - Scholastic Data

- Summer-born children performed significantly better than non-summer-born children in all tests of scholastic ability (reading, spelling, arithmetic and IQ - Figure 1). The effect sizes for these were small (d=0.07-0.16) but consistent.
- However, summer-born children performed significantly worse than non-summer-born children in tests of scholastic achievement (KS1 SATs and GCSEs - Figure 1). Again, the effect sizes were small (d=0.13-0.43) but consistent.

Results – Scholastic Achievement in Relation to School Terms

- The month-by-month breakdown of the relationships showed that scholastic achievement was clearly related to the scholastic year (Figure 2).
- Children born in September scored almost a level higher on KS1 SATs and achieved 1 more high-grade pass at GCSE than August-born children.

Results – Neurodevelopmental Disorders

- Significantly more Summer-born children reported a diagnosis of learning-related disorders (dyslexia, dysgraphia, dyspraxia and dyscalculia) than non-summer-born children (Figure 3).
- More summer-born children were diagnosed with inattentive ADHD than non-summer-born children (Figure 3).
- Summer-born children required special arrangements at school more often than non-summer-born children (Figure 3).
- Rates of diagnoses were again related to scholastic intakes (Figure 3).

Conclusions

- We find no evidence for a season-of-birth effect upon scholastic ability in summer-born children.
- Nonetheless, summer-born children achieve lower SATs levels and fewer high-grade GCSEs than non-summer-born children.
- Summer-born children are also more likely to be diagnosed with learning-related disorders than non-summer-born children.
- These data suggest that the summer-born effect represents an artefact created by the subjective rating of children compared within year groups and therefore support the relative-age hypothesis.
- Although small in real-terms, these effects persist throughout school-life and probably, as a consequence, beyond.

A manuscript describing these findings is currently in submission.

Any questions contact: dianne@well.ox.ac.uk
You can read more about our research at www.well.ox.ac.uk/newbury

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Relationship Between Season of Birth And Educational Attainment in ALSPAC Support Existence of Relative Age Effect

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