SEB Research 4

SCOTTISH EXAMINATION BOARD

Birthdate and SCE Examinations

Introduction

Primary teachers are well aware of the effects of chronological age on pupils' educational readiness - cognitive, social and emotional. On the other hand, secondary teachers are probably less likely to consider age a variable in attainment within a year group, particularly at the S4-S5 stage when pupils face external examinations. By looking at the results of the 1994 SCE examinations, this paper investigates whether there is any birthdate effect in Standard Grade results in S4, and whether any effect carries through to the results of Higher Grades taken in S5.

Is birthdate a factor in Standard Grade results?

In 1994, 57 439 S4 secondary school pupils gained an overall subject award in at least one Standard Grade subject. 55 050 (96%) of them were of the expected age for their stage, being born between March 1978 and February 1979, with an additional 1889 (3%) being old for their stage (born before March 1978), and 500 (1%) young for their stage (born after February 1979). A grade point average was calculated for each of the 57 439 pupils, being the average Standard Grade result over all subjects in which the pupil gained an overall subject award. As Standard Grade is graded from 1 (high) to 7 (low), the smaller the grade point average, the better the average attainment. Pupils were then grouped according to gender and month of birth, and an average of the averages calculated for each group. The results are shown in Table 1 and Figure 1 in the Appendix. For the months of birth between March 1978 and February 1979, there was a clear linear trend, with the oldest pupils gaining on average over all subjects one fifth of a grade better than the youngest pupils. This would mean for example that an older pupil taking seven or eight Standard Grades might gain one grade better in one or two subjects than an otherwise similar younger pupil. For pupils born outwith this period, the opposite applies, with those born before March 1978 doing rather worse (0.14 of a grade worse on average than the March 1978 to February 1979 group), and the very young pupils born after February 1979 doing extremely well (0.68 of a grade better on average than the March 1978 to February 1979 group). Some of the very young group were exceptional presentations of pupils in S1, S2 and S3, which were not coded separately from S4 on the Board's computer system in 1994. For S4 pupils, there are likely to be special circumstances explaining why they are in a school cohort with pupils of a different age. While these patterns apply equally for boys and girls, they should be seen against a general background of girls' attainment being better than boys' on average at this stage of schooling (see SEB Research 3).

Is the birthdate effect similar in all subjects at Standard Grade?

In general, therefore, the older pupils did slightly better than the younger ones, averaged over all subjects. By comparing attainment in Standard Grade English and Mathematics it was possible to investigate inter-subject differences in performance. The data are shown in Table 2 in the Appendix. Both subjects showed the same patterns as the all subject grade point averages, with the oldest pupils in the

March 1978 to February 1979 range gaining on average one fifth of a grade better than the youngest pupils, those born before March 1978 doing rather worse, and the very young pupils born after February 1979 doing extremely well. The effects are independent of the fact that girls gain on average 0.4 of a grade better than boys in English, and gain similar grades to boys in Mathematics.

Among the other subjects attempted by at least 10 000 S4 candidates at Standard Grade, the age gradient was present for the social subjects of Geography, History and Modern Studies, but not for the science subjects of Biology, Chemistry, Physics or Science. It was present in French, but not in French Writing or in German, and in Computing Studies and Craft & Design but not in Office & Information Studies. Art & Design and Physical Education both showed evidence of an age gradient.

One factor influencing whether a subject has an age gradient might be the relative contribution of specific ability and general ability to a candidate's performance in that subject, with maturity being an ingredient of general ability. In subjects with small presentation numbers, the quite small age gradient effects may be swamped by variability from other sources.

Age effects in the 1994 Standard Grade examinations were therefore small on average, but widespread, although not present in all subjects. They were smaller than gender effects, but there did not appear to be interactions between the two factors. To investigate whether the age effects continue into Higher Grade, the results of S5 pupils taking Higher Grade in 1994 were analysed. Although this analysis therefore relates to a different year cohort, there is nothing to suggest that the 1995 cohort will be different.

Is birthdate a factor in Higher Grade results?

In 1994, 30 785 secondary school pupils were presented in at least one Higher Grade subject. 29 302 (95%) of them were of the expected age for their stage, being born between March 1977 and February 1978, with an additional 1 146 (4%) being old for their stage (born before March 1977), and 337 (1%) young for their stage (born after February 1978). Again, some of the very young group were exceptional presentations of pupils in earlier stages, who were not coded separately from S5 in 1994.

Table 3 and Figure 2 in the Appendix show the average S5 Higher Grade results, grouped by gender and month of birth. The numbers shown are average ranges, where ranges 1 to 5 are band A, ranges 6 and 7 band B, ranges 8 and 9 band C, ranges 10 and 11 band D, and ranges 12 to 14 no award. Again the smaller the average range, the better the attainment. For the all subject average, the pattern is less distinct than for Standard Grade, with pupils born before March 1977 obtaining similar average ranges to those born between March and June 1977. There is a slight gradient within the March 1977 to February 1978 group, with the older pupils gaining about one quarter of a range (or only one eighth of a band) better than the younger pupils. Thus for example an older pupil taking four Highers might gain one range better (an upper band B rather than a lower band B, or a lower band B rather than an upper band C) in one subject than an otherwise similar younger pupil. The very young pupils did extremely well, gaining 2 ranges (or 1 band) better than the main group, which means on average one band better in every subject they took. This perhaps illustrates that at Higher Grade, the maturity gap is closing. It might also reflect the greater specialisation in the curriculum, with pupils choosing their strongest subjects, and specific abilities having a larger impact on results. Some of the older pupils who did poorly at Standard Grade may have left school by S5, or if still at school may not have attempted Higher Grade, so were not there to depress the statistics. The very young pupils were likely to be exceptional presentations in subjects in which they were particularly strong.

Is the birthdate effect similar in all subjects at Higher Grade?

Consideration of individual subjects was hampered by small numbers, which made it difficult to see any small age effect. Table 4 in the Appendix shows average range at Higher Grade for S5 secondary school pupils in English (Revised plus Unrevised) and Mathematics (Revised plus Unrevised), the two subjects with the largest presentation numbers. Whereas at Standard Grade, both subjects showed the same patterns as each other and the all subject averages, at Higher Grade there were subject differences. The pattern for Higher Grade English was similar to the patterns observed at Standard Grade, with the oldest pupils in the March 1977 to February 1978 group gaining on average one third of a range (one sixth of a band) better than the youngest pupils, those born before March 1977 doing rather worse than the main group, and the very young pupils born after February 1978 doing extremely well. For Higher Grade Mathematics on the other hand, there was no clear age effect among the March 1977 to February 1978 group, but the pupils born after February 1978 did rather better than the main group. The most striking difference in both subjects is in the results of the small number of very young pupils who did much better than the main group.

Among the other subjects attempted by at least 3 500 S5 candidates at Higher Grade, a slight age gradient was present for Biology, Geography, History and Art & Design in addition to English, but not for French, Chemistry, or Physics. In all of these subjects, the very young candidates did much better than the main group. It is interesting that Biology, where there was no age gradient at Standard Grade, showed a slight age gradient at Higher Grade, and vice versa for French.

To summarise: a link is discernible between age and performance in SCE examination results, with older pupils performing slightly better, on average by about one fifth of a grade at Standard Grade and one eighth of a band at Higher Grade. Pupils older than their presentation cohort generally did worse however, and those younger than their presentation cohort did better. Not all subjects shared the effect. The findings should be treated with some caution, being based on the results for large groups of pupils, with the averages masking considerable variability within each month group. They should not be used to make conclusions about small groups or individual pupils.

Some questions for consideration

- Should 5-14 attainment targets be linked to chronological age bands rather than to stages of schooling?
- Is there scope for secondary schools to do small-scale illuminative research on the experience of schooling and the attainment of the youngest in the class ("Christmas leavers" and potential "Christmas leavers")?
- Should teachers at the secondary stage be more aware of the birthdate effect? Are there any disadvantages to such awareness?
- Given that it would be difficult to organise teaching groups in secondary schools to take account of this effect, what teaching strategies/policies might reduce it?
- SEB Research 3 described how girls tend to do better than boys in their Standard Grade examinations. Would it therefore be reasonable to suggest that boys aged 4 years and 6 months when eligible to start school would benefit from a further year at the nursery stage?

The effect of birthdate on attainment: background research

There is little doubt that age has an effect on school attainment. Over the years research has been carried out on four possible explanations of this effect, namely

- seasonality: the possible effect of climate during pregnancy;
- season of birth as it relates to school attendance;
- length of schooling. This is of interest particularly in school systems with more than one intake of primary 1 pupils per year;
- age-position ie age relative to other pupils in the class or year group. This is linked to the concept of "readiness", with a line of research reaching back to Piaget (eg Shephard and Smith 1986).

There was particular interest in this issue in the UK - mainly England - in the 1960's because of the existence of the qualifying examinations/11+ and streaming in the secondary sector. The pass scores on IQ tests at that time were standardised for month of birth (and for gender). Jinks (1964), Jackson (1964) and Freyman (1965) found that in primary schools which operated streaming, there were significantly more older pupils in the top streams. Age effects were also investigated at the secondary stage: Thomson (1971) found a similar disadvantage at the stage of GCE O Level presentation. With the demise of streaming there has perhaps been less attention given to age effects. However, the increase in national testing in relation to attainment targets, expressed in relation to stage of schooling rather than age, raises interest in this topic once again.

Researchers have investigated all 4 possible explanations for these effects. Ojha *et al* (1966) investigated the 'seasonality' explanation for differential attainment (season of birth and intelligence). Martindale and Black (1970), however, found no evidence to support it, except perhaps in the small proportion of neurologically damaged children.

Carroll (1992) presented evidence linking attendance rates to season of birth, and postulated that teachers' perceptions of relative maturity could be a reason for poorer attainment and consequently poor attendance amongst younger pupils.

The 'length of schooling' effect is perhaps of less interest in Scotland as all pupils have 7 years of primary education, with the relative disadvantage to younger pupils in a year group manifested as the "Christmas leaver" effect, ie at the end of their compulsory schooling. In their comprehensive article on the birthdate effect, Bell and Daniels (1990) conclude that "whereas the evidence for the age-position effect is conclusive, there is evidence that the length of schooling effect, if it exists (and it would be somewhat surprising if it did not exist at all), diminishes with time." Again much of the research on the effects of length of schooling was done in the 1960s, offering comparisons with similar studies in countries with later admission ages.

Such a conclusion would point to the salience of the fourth postulated effect, ie that age, or relative maturation, or the cumulative effect of, year after year, being the youngest in the class, is the important age-aspect of attainment within any year group. Bell and Daniels compared their results of 11, 13 and 15 year-olds in the Assessment of Performance Unit's Science Survey tests in England and Wales with similar foreign studies and found this general conclusion corroborated in the context of science. In particular, while their findings showed the effect to be strongest among the youngest of the 3 age groups tested, it was still visible among the 15 year olds. Their conclusions tend to substantiate what they call their optimistic model which postulates that "the effect of birthdate diminishes as pupils get older". (Their pessimistic model on the other hand postulates that "the younger pupils in a year group start their education at a disadvantage and are unable to regain the lost ground".) They also refer to a study in Kentucky (Davis *et al,* 1980) into possible age-effects on reading, language and mathematics which tends to support their optimistic model. In this study pupils were tested at age 6, 9 and 13, and while age effects in performance were significant in all 3 curricular areas at age 6 and 9, by the age of 13 this was only the case for reading. This is an interesting study as it was conducted on a group of similar size to a year cohort in Scotland, (54 000) and with a similar one-intake admission policy to Scotland.

The findings of the SEB study corroborate the overall conclusions of Bell and Daniels, namely that being one of the youngest pupils in a school year generally has a detrimental effect on performance throughout compulsory schooling. However the SEB study highlights individual variability within this broad finding. It also quantifies the effect and shows the relative size of the effect diminishing from Standard Grade to Higher Grade attainments. Finally it demonstrates that the small proportion of very gifted pupils do well despite early presentation for external examinations, and those older than cohort when taking examinations tend to do rather worse than average.

Bell and Daniels seek to explain the general trend through the possibility of lower expectations in the primary school (with teachers making allowance for maturation differences) and conversely, secondary teachers making little or no allowance for the youngest in the age group when assessing performance. This interpretation, while reasonable, does not appear to provide a full explanation. In primary schools teachers generally group pupils according to ability in language and again in mathematics. Birthdate would be a less important variable. Teacher expectation would tend to be related to these attainment groupings. Also the teacher expectation explanation does not account for the differences found between subjects at Standard Grade. These findings would suggest that maturation may still exert its own intrinsic effect, irrespective of how pupils respond to always being the youngest in the class and whether or not teachers make allowances for the youngest. Whatever the explanation, the research evidence suggests that teachers in the early years of secondary education should be aware of the salience of the birthdate effect on attainment.

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Comments on the contents of this Research Bulletin are welcomed by the Board's Research Division (0131 663 6601 ext 2281/2293)

Appendix

Table 1: Grade Point Average, Standard Grade 1994

Month of birth	Total	Male	Female
before March 1978	3.38	3.47	3.25
March 1978	3.14	3.29	2.98
April 1978	3.14	3.25	3.02
May 1978	3.16	3.28	3.04
June 1978	3.22	3.36	3.07
July 1978	3.22	3.34	3.09
August 1978	3.26	3.42	3.10
September 1978	3.27	3.42	3.11
October 1978	3.30	3.47	3.13
November 1978	3.24	3.40	3.08
December 1978	3.30	3.46	3.14
January 1979	3.34	3.45	3.23
February 1979	3.30	3.45	3.14
after February 1979	2.56	2.78	2.38

Table 2: Average Grade in English and Mathematics, Standard Grade 1994

Month of birth	Average English Grade			Average Mathematics Grade		
	Total	Male	Female	Total	Male	Female
before March 1978	3.04	3.19	2.83	3.67	3.67	3.67
March 1978	2.78	2.98	2.58	3.33	3.36	3.29
April 1978	2.79	2.98	2.61	3.31	3.31	3.32
May 1978	2.80	2.98	2.62	3.35	3.35	3.35
June 1978	2.85	3.05	2.64	3.42	3.44	3.39
July 1978	2.85	3.03	2.67	3.42	3.41	3.43
August 1978	2.89	3.08	2.70	3.46	3.49	3.42
September 1978	2.91	3.12	2.69	3.46	3.50	3.41
October 1978	2.93	3.15	2.73	3.50	3.55	3.45
November 1978	2.92	3.12	2.71	3.43	3.48	3.37
December 1978	2.95	3.13	2.77	3.51	3.55	3.47
January 1979	2.99	3.13	2.85	3.53	3.52	3.55
February 1979	2.97	3.17	2.77	3.49	3.54	3.44
after February 1979	2.47	2.70	2.26	2.76	2.90	2.64

Table 3: Average Range, All Subjects, Higher Grade 1994

Month of birth	Total	Male	Female
before March 1977	8.46	8.56	8.34
March 1977	8.44	8.51	8.37
April 1977	8.43	8.63	8.26
May 1977	8.44	8.54	8.36
June 1977	8.44	8.56	8.34
July 1977	8.61	8.75	8.50
August 1977	8.58	8.67	8.51
September 1977	8.47	8.57	8.38
October 1977	8.62	8.79	8.49
November 1977	8.63	8.82	8.47
December 1977	8.68	8.74	8.62
January 1978	8.67	8.78	8.58
February 1978	8.61	8.88	8.35
after February 1978	6.55	6.37	6.71

Table 4: Average Range in English and Mathematics, Higher Grade 1994

Month of birth	Average English Range			Average Mathematics Range		
	Total	Male	Female	Total	Male	Female
before March 1977	8.13	8.28	7.97	8.14	8.28	7.89
March 1977	7.67	7.80	7.58	8.12	8.13	8.11
April 1977	7.59	7.75	7.48	8.12	8.17	8.07
May 1977	7.64	7.79	7.53	8.09	8.00	8.18
June 1977	7.78	7.95	7.66	8.09	8.10	8.09
July 1977	7.90	8.13	7.74	8.25	8.23	8.27
August 1977	7.79	7.88	7.73	8.03	8.07	7.99
September 1977	7.85	8.02	7.74	8.05	8.07	8.03
October 1977	7.91	8.14	7.76	7.79	8.02	7.96
November 1977	7.84	8.13	7.63	8.07	8.06	8.07
December 1977	7.93	8.01	7.87	8.06	7.97	8.15
January 1978	7.99	8.23	7.82	8.29	8.34	8.25
February 1978	7.89	8.12	7.72	8.10	8.15	8.05
after February 1978	6.53	6.57	6.50	7.17	6.97	7.37

Figure 1: Grade Point Average,Standard Grade 1994

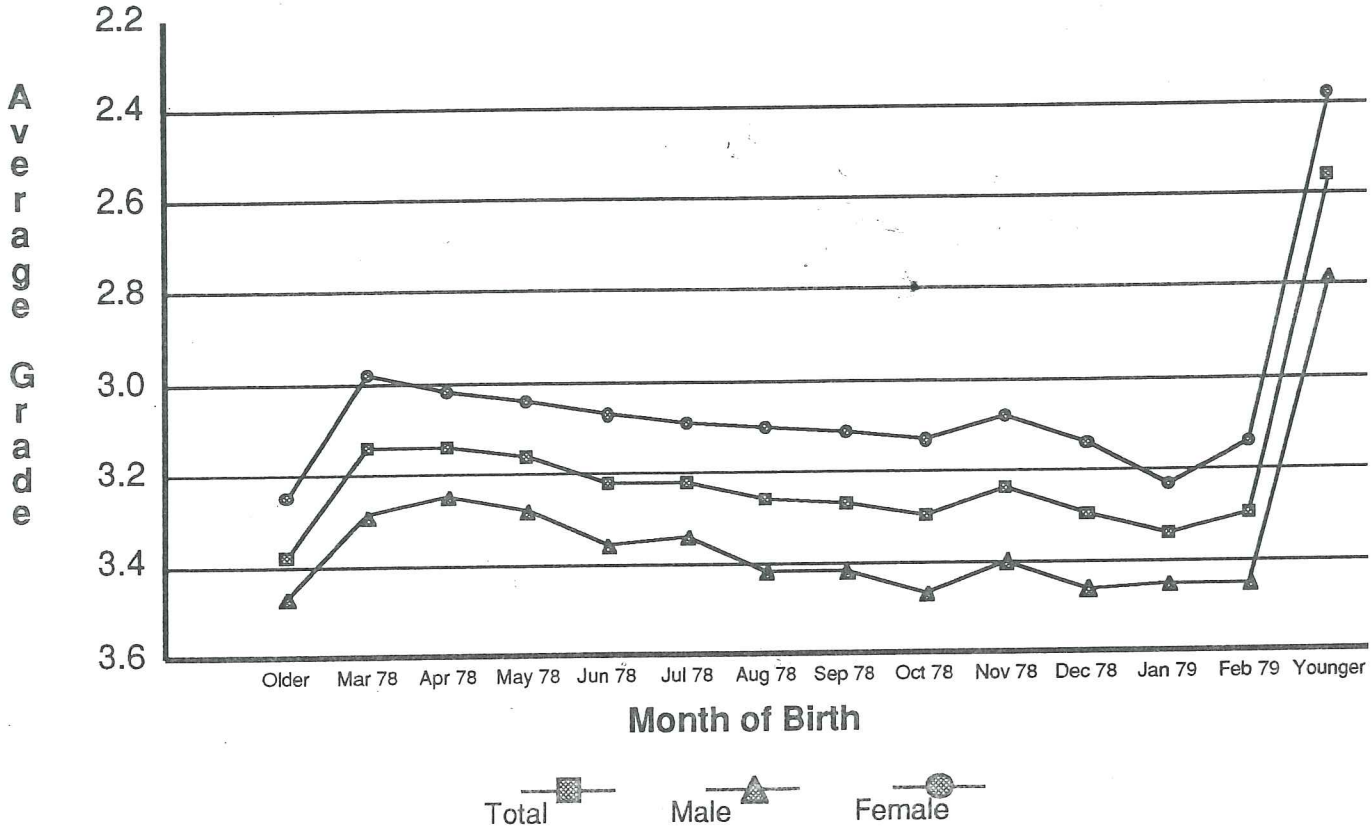

Figure 2 : Average Range, Higher Grade 1994