How do season of birth and length of schooling affect children's attainment at Key Stage 1? A question revisited

Caroline Sharp and Dougal Hutchison

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This paper was first presented at the Annual Conference of the
British Educational Research Association
10-14 September, 1997
University of York

ISBN 0 7005 1475 9

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Summary
In 1994, the NFER published results of an analysis of the 1991 National Curriculum assessments for Key Stage 1, looking at the relationship between children's results, their age and the length of time they had been at school (Sharp, Hutchison and Whetton, 1994). This monograph presents the results of a similar study, looking at assessment results in 1995.

A sample of over three thousand children was drawn for the NFER's evaluation of the Key Stage 1 assessment results. This was a national random sample of 114 schools in 50 English and Welsh local education authorities (LEAs). The results showed that autumn-born children did best and summer-borns did least well. This result was not entirely unexpected because older children have the advantage of greater maturity, and the assessment results were not adjusted to take account of age differences. Length of schooling was related to assessment results, but not in a straightforward manner. For autumn-born children there appeared to be a slight advantage to having experienced the full nine terms at school by the end of KS1. However, for spring-born children, those who had nine terms at school did less well than those who had been in school for eight terms. The results of summer-borns showed that those who had been at school for six terms did least well, but those who had been at school for the full nine terms did not do much better. The paper ends with a discussion of the implications of these findings for policy and practice.

Introduction
A few years ago the NFER published the results of an analysis of the 1991 National Curriculum assessments for Key Stage 1 which focused on the relationship between children's results, their age and their length of schooling (Sharp, *et al.*, op. cit.). The study found that children who were among the oldest in the year-group performed significantly better than their younger classmates in mathematics, English and science ($p<.001$). Children born in the autumn (September to December birthdates) did best of all; spring-born children (January to April birthdates) did less well than autumn-borns, but better than summer-borns; and summer-born children (May to August) did least well. This result was not entirely unexpected because older children have the advantage of greater maturity, and the assessment results were not adjusted to take account of age differences.

The research added to the growing body of evidence in this and other countries, which has found that children who are the youngest in the year group do least well at school (see Sharp and Benefield, 1995 for a summary of research in this field). In this country, the so called 'summer-born effect' is not confined to Key Stage 1 results. For example, it has been found to operate in teachers' identification of children in need of special education (Bibby *et al.* 1996) and in students' results at GCSE (Massey *et al.*, 1996).

The influence of length of schooling

It has been argued that the admission system used in certain areas of this country may disadvantage summer-born children because, in a termly or biannual entry system, the oldest (autumn-born) children enter school first, followed by the spring- and summer-born. This means that summer-born children can miss out on up to three terms of schooling: a deficit that is never made good. An inequality in length of schooling is one of the reasons given in support of an annual entry system, whereby the whole year group starts school at the beginning of the academic year in which they become five. It is suggested that, by giving all children the same length of schooling, the 'summer-born effect' can be greatly reduced or even completely eliminated.

However, the previous NFER study of Key Stage 1 results (Sharp *et al.*, 1994) did not support this view. The researchers gathered information on each child's age and length of schooling. The results of an analysis of variance for each subject (English mathematics and science) indicated that not only was season of birth affecting a child's results, but that it was the major factor. Length of schooling was not significantly related to performance in the assessments once season of birth was taken into account.

Some further analysis enabled the researchers to study the relationship between season of birth and length of schooling in more detail. The results showed an interesting pattern: among those born in the autumn and spring, children who had experienced longer at school appeared to have a slight advantage in terms of their assessment results. But for summer-borns this pattern was not apparent. Summer-born children who had experienced only six terms at school by the end of KS1 performed at the same (relatively poor) level as summer-borns who had started school a whole year earlier.

The aim of this current study is to determine whether the same relationships are evident in an analysis of the 1995 Key Stage 1 assessment results.

Outline of the current study

The current study of 3,288 children is drawn from the NFER's evaluation of the 1995 Key Stage 1 assessment results. The NFER selected a national random sample of 114 schools in 50 English and Welsh local education authorities. The sample was drawn from the NFER's register of all the schools in the country. It was stratified by type of school (infant, first, primary, special; independent/state sector), school size, region and type of LEA (metropolitan/non-metropolitan). Teachers were asked to supply information on each child in their class, including the child's sex, date of birth, whether or not they had attended nursery education, whether or not they were eligible for free school meals and the number of terms of schooling the child would have completed by the end of the summer term. This was a similar methodology to that adopted in the previous study, but with a different sample of LEAs and schools. (However, unlike the 1991 sample, data were collected from more than one class in some schools.)

The previous research had been carried out on the 1991 KS1 results. That was the first year of National Curriculum assessments: the tests themselves were new and teachers were unfamiliar with the assessment procedures (including their role in teacher assessment). By 1995, although the assessments themselves had been changed, teachers had become much more familiar with the assessment arrangements and with the performance expected of children at different levels of attainment.

Assessments included in the study

In 1995, a combination of teacher assessments, tasks and paper and pencil tests was used to gauge children's level of attainment in mathematics and English. Statutory assessments in science were no longer a requirement at KS1, so these results were not available in 1995.

For mathematics, the researchers used the overall teacher assessment and the child's task or test result. There were several different English assessments, and the results were analysed separately for the overall teacher assessment, the reading task or test, and the writing task. Children could obtain one of four levels on each of the selected assessments: W (working towards level 1) level 1, level 2, level 3 (or above).

The relationship between attainment and season of birth

The researchers obtained all the children's KS1 results and divided the sample into three groups according to their season of birth. The sample was composed of roughly equal numbers of children born in the summer (32 per cent), spring (34 per cent), and autumn (34 per cent).

In order to compare attainment for different groups, a mean National Curriculum level was calculated. The mean level obtained by each children in each of the three seasons of birth are shown in Table 1. (*TA denotes teacher assessment.*)

Table 1
Season of birth and mean 1995 National Curriculum results for English and mathematics

	Summer		*Spring*		*Autumn*		
	Mean	N	Mean	N	Mean	N	P
Mathematics (TA)	1.83	1040	1.97	1135	2.05	1113	<.001
Mathematics task/test	1.92	1039	2.09	1333	2.18	1111	<.001
English (TA)	1.97	1040	2.09	1135	2.17	1113	<.001
Reading task/test	2.09	1039	2.22	1133	2.32	1109	<.001
Writing task	1.92	1026	2.05	1115	2.12	1106	<.001

The table shows the expected association between season of birth and 1995 Key Stage 1 assessment results. In each case, the oldest in the age-group (the autumn-born) performed better than spring-born children, with the summer-borns doing least well. The associations were highly significant for each of the five assessments.

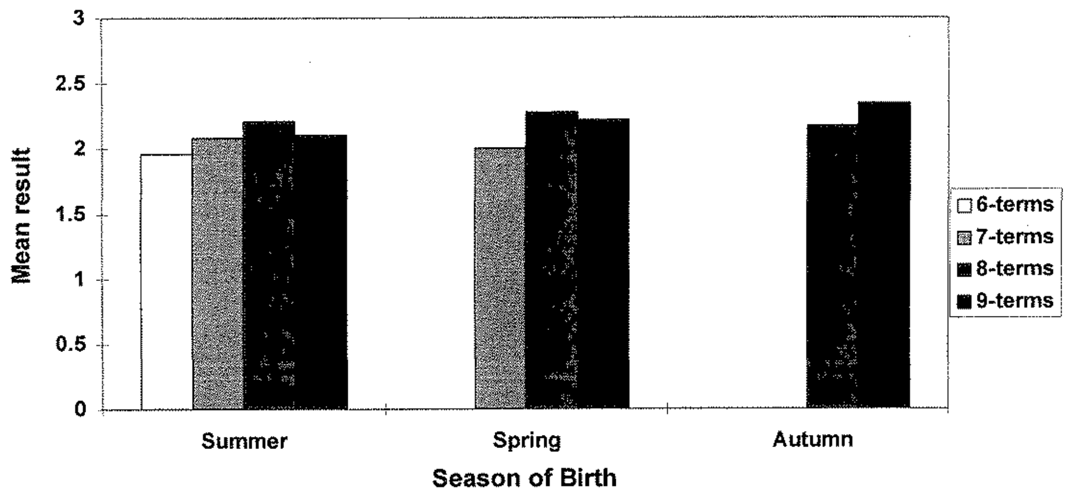
The relationship between length of schooling and season of birth

The children in the sample had experienced between six and nine terms of schooling by the end of the summer term in 1995. Over half (58 per cent) of the sample had experienced nine terms of schooling; 22 per cent had eight terms; 15 per cent had seven terms and only five per cent had experienced six terms.

In order to explore the relationships between season of birth, length of schooling and Key Stage 1 results, these data were displayed graphically (see Figure 1). The figure shows the results achieved by children of different age-groups and with different lengths of schooling. Each bar represents the mean outcome for the mathematics task/test for children of the same age and length of schooling. The number of children represented by each bar ranges from 89 to 1098.

The figure shows a complex relationship between age, amount of time at school and mean mathematics results. For autumn-born children there appears to be a slight advantage to having experienced the full nine terms at school. However, for spring- and summer-born children, those who had nine terms at school did less well than those who had been in school for eight terms.

Figure 2: Season of Birth and Length of Schooling (Reading Task/Test: N=3131)



A similar pattern was evident in the teacher assessments for mathematics, and in the English results. However, in two cases (teacher assessment for English and writing task/test) summer-borns with seven terms at school achieved a higher mean score than summer-borns with nine, eight, or six terms.

Analysis of the relative effects of season of birth, length of schooling, sex and social deprivation

In order to examine further the relationship between achievement, season of birth and length of schooling, an analysis of variance was carried out for these factors. Because girls tend to perform better than boys (especially in English), this factor was entered into the analysis. It is also known that children from deprived backgrounds perform less well at school. In order to examine the relative impact of social deprivation on children's assessment scores, eligibility for free school meals was entered into the analysis.

Participation in nursery education is also an important factor which may influence a child's later performance. Unfortunately, this information was not available for 28 per cent of children, so it was decided not to enter this variable into the analysis.

The full results of the analyses of variance for each of the five assessments are given in Appendix 1. The results show that season of birth was significantly related to attainment in all five assessments, even when taking into account the effects of the other variables.

It is also apparent that pupils who were eligible for free school meals did significantly less well than others in all five assessments. Girls performed significantly better than boys in the three English assessments but there were no significant differences between boys and girls in the mathematics results.

The number of terms of schooling was significantly related to attainment on all of the measures except for the teacher assessment in mathematics. However, this was not a straightforward, linear relationship. The fitted constant values show a tendency for children with six terms at school to do least well and for those with eight (rather than nine) terms to do best.

The overall results of these analyses are broadly similar to those obtained by colleagues at NFER (Schagen and Sainsbury, 1996) who used multilevel modelling techniques to explore the relationships between children's performance in the 1995 assessments and other characteristics at the individual and school level.

Interactions

The interactions between variables were explored, to see whether factors were contributing differently among different groups of children.

There was a significant relationship between season of birth, length of schooling and assessment result in four out of the five assessments. This would seem to indicate that there is a different relationship between attainment and length of schooling for children born at different times of year.

There was also an interaction between the number of terms of schooling and a child's eligibility for free school meals in relation to two of the five assessments (teacher assessment for mathematics and the writing task). This relationship is examined in greater detail in the following section.

The effect of length of schooling on results for summer-borns

It was decided to run a further analysis, focusing specifically on the 1040 children born in the summer months. The question at issue was: do summer-borns who have experienced longer at school perform better at KS1?

It has been suggested (Tymms, 1996) that the results of the previous analysis of 1991 data (Sharp *et al.*, 1994) could have been affected by a failure to take account of the effects of social disadvantage. If children from socially disadvantaged backgrounds were not randomly distributed in relation to season of birth and length of schooling (for example, if a disproportionate number of summer-born children with nine terms of schooling were from disadvantaged backgrounds) social deprivation could be an underlying cause of the apparent lack of benefit derived by summer-borns who had experienced longer at school.

Therefore free school meals was included as a variable in the analysis of the data for summer-born children, to see whether length of schooling was significantly related to assessment outcome *once a child's eligibility for free school meals had been taken into account.*

The full results for the analysis of variance for summer-borns in relation to the five assessment measures are shown in Appendix 2.

The analyses showed that number of terms of schooling was related to mean scores for summer-borns in two of the English outcomes (teacher assessment and reading task/test) after controlling for the effect of free school meals. For the English teacher assessment, summer-borns with six terms at school performed less well than children with seven, eight, or nine terms (who all achieved a similar result). For the reading task/test, summer-borns with six terms performed least well and those with eight terms did best. There was no significant relationship between length of schooling and mean attainment in the other three measures.

Social deprivation (as indicated by a child's eligibility for free school meals) was strongly related to assessment outcome for summer-borns on all five measures. There was one significant interaction between free school meals and length of schooling: there was an interaction between these two variables for the reading task/test result ($p < .05$).

Looking closely at the fitted constant values, there is evidence of a curvilinear relationship between length of schooling and achievement at KS1. After taking the effect of free school meals into account, summer-borns with six terms at school did least well in all five assessment measures and those with seven or eight terms performed best. This is similar to the pattern noted in the 1991 analysis.

In order to check on the effect on significance levels of including free school meals, the analyses of variance were re-run without this variable. The resulting significance levels for length of schooling were exactly the same for three of the assessments (the two mathematics assessments and the reading task/test). For the English teacher assessment, the effect of including free school meals was to decrease the significance level from p = <.01 to <.05. For the writing task/test, the effect of including free school meals in the analysis was to decrease the level of significance from a probability of <.05 to non-significant.

If the effect of social deprivation had been to artificially decrease the impact of length of schooling for summer-borns, the effect of including free school meals should have been to *increase* the significance levels for length of schooling. As this was not the observed trend, it seems unlikely that social deprivation is an underlying cause of the observed relationships between length of schooling and outcomes for summer-born children.

Discussion

The results from the NFER's evaluation of the 1995 Key Stage 1 results have confirmed the trends shown in the earlier study. Children who are oldest in the age-group performed significantly better than their younger classmates. The most obvious reason for this is that assessment performance is linked to age: older children are more mature and appear to be more capable than younger ones. The findings show that season of birth is a strong factor, which operates irrespective of many other factors affecting children's performance at KS1.

Children's KS1 assessment results were also related to their length of schooling, but in a less straightforward manner. The relationship between attainment and length of schooling appears to be different for children of different age-groups. For those born in the autumn, children who had nine terms of schooling (i.e. those who entered school at 'rising five') had a slight advantage over those with eight terms (who were admitted at statutory age). For the spring-born children, those with eight terms experience at school by the end of KS1 seemed to perform slightly better than those with nine or seven terms. For summer-borns, those with six terms did least well, but those with the full nine terms did not do much better.

These results are broadly similar to those obtained in our examination of the 1991 Key Stage 1 results, with the following exceptions.

- The assessments themselves had changed between 1991 and 1995.
- Teachers had become more familiar with the assessment process.
- The 1995 analysis included eligibility for free school meals.
- In 1991, length of schooling was not significantly related to outcomes at KS1, once the effects of season of birth were taken into account. However, the 1995 results showed that length of schooling was significantly related to KS1 results on four of the five measures, even after controlling for the effects of season of birth.
- The 1991 results showed a tendency for autumn- and spring-born children with nine terms at school to perform best. In 1995, autumn-borns with nine terms again performed best, but spring-borns with eight terms did better than children of the same age who had experienced longer at school.

Conclusion and implications

So what are we to make of these results? First, it appears that, being younger in the age-group (i.e. having a birthday in May, June, July or August) is a disadvantage at KS1. The observed differences in performance of children born in different 'seasons' is most likely to be due to differences in age when taking the test. However, although these differences are statistically significant, we are talking about fairly small effects which show up when looking at mean scores in a relatively large population. There are many summer-born children who perform very well at Key Stage 1 and continue to do so throughout their time at school.

Second, an implication of these results is that there does not appear to be an easy way of helping summer-born children through the mechanism of school entry policies. It would seem incontrovertible that exposing children to more schooling should give them an advantage, yet this does not appear to be the case for children of all ages. There are some clear effects in our research for length of schooling: autumn-borns who experienced longer at school appeared to do better, and summer-borns who experienced only six terms at school did least well. However, on the basis of their KS1 results, neither the spring- nor the summer-born group appeared to derive an additional benefit from spending the full nine terms at school.

In our previous discussion of this subject (Sharp *et al.*, 1994) we suggested that age on entry to school could be an important factor. An autumn-born child who has experienced the full nine terms by the end of KS1 will have started school close to his or her fifth birthday. But a summer-born child with nine terms will have started school soon after the age of four. There have been concerns expressed about the appropriateness of a reception class environment for such young children. Perhaps the benefits of spending longer at school are counter-balanced by a mis-match between provision offered in reception classes and the developmental needs of the younger four-year-old child?

The research has raised some questions about the ability of school reception classes to cater for the needs of younger four-year-olds. The number of children starting school at four has been increasing (see for example, Daniels, 1995; Sharp, 1995; Pre-school Learning Alliance, 1997), and although some LEAs and schools have made strenuous efforts to improve the provision in reception classes, funding on a national basis to provide teacher training, improve teacher-pupil ratios and enhance buildings and equipment has been slower to materialise.

This study would seem to indicate that equalising all children's length of schooling by adopting a policy of annual entry to reception class in the year of a child's fifth birthday would not necessarily boost the performance of younger children. In fact, based on these analyses, the optimum school entry policy (i.e. the one associated with highest KS1 outcomes for children in each season of birth) would appear to be either termly, or biannual entry (e.g. twice a year, in September and January) at rising five. This is obviously a topic in need of continued research. For example, an evaluation of results in LEAs with enhanced provision for four-year-olds could help to illuminate the critical factors in reception class provision and to examine the possibility of differential effects related to children's pre-school experience, ability and home background.

Finally, the results of this research have some key implications for LEAs, parents and schools. It is important to raise awareness of the influence of age on assessment results. Children who are younger in the year-group are likely to do less well than their older classmates, unless an age-correction is applied to their KS1 results. (Age corrections for the test results have been made available since 1996). The comparatively poorer performance of summer-borns could affect their sense of self-efficacy and self-esteem. If decisions are made on the basis of KS1 data (e.g. allocation to sets or streams) these age-related differences could have longer-lasting consequences for the children concerned.

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Appendix 1
Analysis of variance for three seasons of birth

Analysis of variance: KS1 teacher assessment in mathematics (N = 3157)

Grand mean = 1.95   SD = 0.48

Variable	Fitted constant	P
Season of birth		
Summer	-.11	
Spring	.01	
Autumn	.10	<.001
No. of terms at school		
6	.01	
7	-.05	
8	.01	
9	.01	n.s.
Sex		
Boys	-.01	
Girls	.01	n.s.
Free school meals		
Yes	-.18	
No	.03	<.001

Interactions

Season of birth x no. terms	<.01
No. terms x free school meals	<.05

Analysis of variance: KS1 mathematics task/test (N = 3152)

Grand mean = 2.07 SD = 0.61

Variable	Fitted constant	P
Season of birth		
Summer	-.13	
Spring	.02	
Autumn	.13	<.001
No. of terms at school		
6	-.03	
7	-.03	
8	.07	
9	-.01	<.05
Sex		
Boys	.02	
Girls	-.02	n.s.
Free school meals		
Yes	-.18	
No	.03	<.001

Interactions

Season of birth x no. terms	<.05

Analysis of variance: KS1 teacher assessment in English (N = 3157)

Grand mean = 2.08 SD = 0.51

Variable	Fitted constant	P
Season of birth		
Summer	-.10	
Spring	-.01	
Autumn	.10	<.001
No. of terms at school		
6	-.08	
7	-.01	
8	.05	
9	-.01	<.01
Sex		
Boys	-.09	
Girls	.09	<.001
Free school meals		
Yes	-.25	
No	.04	<.001

Interactions

Season of birth x no. terms		<.001

Analysis of variance: KS1 reading task/test (N = 3150)

Grand mean = 2.22 SD = 0.68

Variable	Fitted constant	P
Season of birth		
Summer	-.10	
Spring	-.01	
Autumn	.10	<.001
No. of terms at school		
6	-.10	
7	-.09	
8	.05	
9	.01	<.01
Sex		
Boys	-.09	
Girls	.09	<.001
Free school meals		
Yes	-.28	
No	.05	<.001

Interactions

No statistically significant interactions.

Analysis of variance: KS1 writing task (N = 3117)

Grand mean = 2.04 SD = 0.53

Variable	Fitted constant	P
Season of birth		
Summer	-.11	
Spring	.00	
Autumn	.10	<.001
No. of terms at school		
6	-.07	
7	.01	
8	.05	
9	-.02	<.05
Sex		
Boys	-.07	
Girls	.08	<.001
Free school meals		
Yes	-.25	
No	.04	<.001

Interactions

Season of birth x no. terms	<.01
No. terms x free school meals	<.05

Appendix 2
Analysis of variance for summer-born children

Summer-born children: analysis of variance for length of schooling and free school meals in relation to teacher assessment in mathematics (N = 1022)

Grand mean = 1.82 SD = 0.47

Variable	Fitted constant	P
No. of terms at school		
6	-.02	
7	.01	
8	.03	
9	.01	n.s.
Free school meals		
Yes	-.18	
No	.03	<.001

Interactions
No statistically significant interactions.

Summer-born children: analysis of variance for length of schooling and free school meals in relation to the mathematics task/test (N = 1021)

Grand mean = 1.93 SD = 0.60

Variable	Fitted constant	P
No. of terms at school		
6	-.10	
7	.01	
8	.07	
9	-.01	n.s.
Free school meals		
Yes	-.18	
No	.03	<.001

Interactions
No statistically significant interactions.

Summer-born children: analysis of variance for length of schooling and free school meals in relation to the teacher assessment in English (N = 1022)

Grand mean = 1.98   SD = 0.50

Variable	Fitted constant	P
No. of terms at school		
6	-.12	
7	.03	
8	.01	
9	.00	<.05
Free school meals		
Yes	-.26	
No	.04	<.001

Interactions
No statistically significant interactions.

Summer-born children: analysis of variance for length of schooling and free school meals in relation to the reading task/test (N = 1021)

Grand mean = 2.09   SD = 0.68

Variable	Fitted constant	P
No. of terms at school		
6	-.13	
7	-.04	
8	.11	
9	.03	<.05
Free school meals		
Yes	-.30	
No	.05	<.001

Interactions

No. terms x free school meals	<.05

Summer-born children: analysis of variance for length of schooling and free school meals in relation to the writing task/test (N = 1008)

Grand mean = 1.93   SD = 0.52

Variable	**Fitted constant**	**P**
No. of terms at school		
6	-.08	
7	.04	
8	-.03	
9	-.01	n.s.
Free school meals		
Yes	-.29	
No	.05	<.001

Interactions

No statistically significant interactions.