August's child is . . . favoured by fortune

Our last issue[1] told how some children born under Sagittarius are denied childcare. Here **Lauren M. Brewer** and **James J. Cochran** tell how the disadvantage of birth-month can pursue a child through later education – and through life.

Were you the youngest in your class at school? All these years later does it still make a difference?

Suppose you have a young daughter who was born on July 31st, 2008. She will soon be starting kindergarten. The local school district tells you that August 1st is the birthday cut-off; that is, all children born on or after August 1st, 2007 and before August 1st, 2008 will be admitted to kindergarten for the 2013–14 academic year. You buy clothes, shoes, pencils, crayons, and the rest in preparation. On the first day of the academic year you drop your child off at the schoolhouse to start her year of kindergarten with all the other local children who are of the same age. But are all of the children in your child's kindergarten class of the same age, or even of the same approximate age?

Think about this; if your daughter is assigned a seat next to a child who was born on August 1st, 2007, she is sitting next to a classmate who is effectively 1 year older than she is. In fact, if this classmate had been born a few hours earlier (on July 31, 2007), she or he would have entered kindergarten in the previous year and would likely now be in the first grade.

"Wait a minute", you might think. "This classmate is only 364 days older than my child. This small difference in age surely cannot be meaningful, can it?" But seen in a relative perspective, your child is in the same kindergarten class as a child who is approximately 20% older.

As any parent knows, a 20% age difference can be dramatic, particularly among younger children. Your child's older classmates will generally be more physically, intellectually, and emotionally mature. Parental love aside, surely the differences in maturity between kindergarteners who are approximately the same age as your child and kindergarteners who are almost 1 year older can be extreme. In fact, studies have shown[2] that a just-10-year-old child is approximately 0.2 m shorter and 27 kg lighter than an almost-11-year-old child. Consequently, a difference of 12 months *five years after kindergarten* can result in significant physical differences among 10-year-old children. Similar differences in intellectual and emotional maturity can surely be expected as well.

Now pause for a minute and consider the ramifications if your young kindergartener was a boy, not a girl, and the older classmate is female. Given that it is accepted that young girls mature earlier than young boys, the relative advantage in development (intellectual, emotional, and physical) would be even more pronounced.

This phenomenon has a name – in fact several. It is called the *birth-date effect*, *month of birth bias*, *season of birth bias*, *or age-group position effect*. We shall call it the *relative age effect* or RAE. And the suspected source of

this effect? The grouping of children into age-based cohorts based on an arbitrary and static birth-date deadline. It happens in schools, it happens in sports. That August 1st cut-off determines whether your child will be the youngest or the oldest in his or her group: the most or least physically advanced, the most or least emotionally and intellectually advanced, the most or least experienced in all aspects of life. And it will have lasting effects – advantages for the older children, disadvantages for the younger – that may last throughout their adult lives.

Scientists have found evidence of the effect in a wide range of activities. Much of the published research deals with the disadvantages faced by the youngest athletes in an age-based cohort.

The relative age effect in athletics

This phenomenon has been speculated on for decades, but the recent flurry of systematic scientific studies of the RAE is thought to have started one evening in January 1983 when Roger and Paula Barnsley, both trained psychologists, attended a Canadian Junior Hockey League game. Glancing through the programme, they noticed that the players had a disproportionately high number of birthdates between January and April.

The Barnsleys are analytically inclined, and so naturally an analysis of the birthdays of professional ice hockey players in Canada followed. Before they published their results, Grondin *et al.*[3] showed that unequal distributions across birth quartiles existed in Canadian ice hockey and volleyball: a higher proportion of players at recreational, competitive, and senior professional levels were born shortly after the cut-off dates for their sports. Soon after, the Barnsleys[4] showed these players were much more likely to have been born early in the year. Their data show players are over four times more likely to be born in the first quarter than the last quarter, and differences between observed and expected values are statistically significant ($p < 0.001$). Given that entry to Canadian Junior League Hockey was based on an arbitrary birth-date cut-off of December 31st, these results suggested that the older players had a distinct advantage over younger players in the age-based cohort.

They followed this up with evidence that the RAE was greater among elite youth teams. Of players who were 9 or 10 years old, approximately two-thirds were born in the first half of the year and only 10% had birthdays in the last three months of the year. The effect has been confirmed in more recent data.

On the other hand, Daniel and Janssen[5] found no evidence of the RAE in professional ice hockey in the 1960s. This result is particularly interesting because professional hockey players of the 1960s did not generally play in regimented youth hockey leagues with standard age cohorts when they were young – youth hockey leagues were in their infancy then and not so widespread. This means they were not subject to the suspected cause of the RAE. Addona and Yates[6] reached similar conclusions when they applied change point analysis to a data set containing information on every player who has played in the National Hockey League. They found the RAE began for players born since 1951 and argued that what initiated this change was the establishment and enforcement of standard age cohorts in youth hockey leagues in the late 1950s and the 1960s.

Similar results have been reported in world youth (male) soccer and in youth soccer leagues across several cultures, despite the use of different cut-off dates by these cultures. Romann and Fuchslocher[7] found that the RAE exists in Swiss female soccer, but, bizarrely, that the effect differs by position. Chi-square tests show significant differences for defenders and strikers ($p < 0.05$). Defenders are overrepresented in the first two quarters of the year (36.6% and 31.0%, respectively) and underrepresented in the fourth quarter (5.9%), while strikers are overrepresented in second and third quarters (41.2% and 31.4%, respectively) and underrepresented in the fourth quarter (5.9%). A second analysis indicates defenders and goalkeepers are significantly overrepresented ($p < 0.05$) in the beginning of the year compared to midfielders.

Delorme *et al.*[8] found it among female soccer players affiliated with the French Soccer Federation – though without the curiosities of the Swiss effect. But it is important that Delorme also found the dropout rate for female soccer players was inversely related to the relative ages of the players: younger players dropped out of the league at a higher rate than did the older players in their cohort. Players in the under-10 ($p < 0.01$), under-14 ($p < 0.05$), and under-17 ($p < 0.01$) age categories show significant differences of observed dropout compared to the theoretical expected distribution. This suggests the relative age effect may persist or even amplify as the youth participants move into older cohorts. Other findings support this troubling conclusion. Sports in which the existence of the RAE has been observed include but are not limited to Australian rules football, baseball, basketball, handball, rugby, volleyball, and, recently, winter youth Olympics. Note that these sports feature a wide variety of cut-off dates for determining age cohorts, so the existence of the RAE across

these sports provides evidence that it is not related to a particular date in the year, but to the cut-off date for each sport.

The relative age effect at school

The evidence of RAE in youth sports is compelling; but the inability of a child to compete on a level playing field in world football, hockey, or baseball hardly seems too tragic. For most of us our sporting pursuits eventually become recreational hobbies or are abandoned as we move into adulthood. This leads to an important question: does the RAE occur in more important areas that have long-term ramifications for the rest of us?

First, let us not be too quick to dismiss the impact of the competitive disadvantages in sports. Musch and Grondin[9] linked the RAE to negative consequences for personal development of those who are the youngest in their cohorts in youth sport programmes. Even so, we will now return to our original scenario: the 5-year-old kindergartener who is essentially a full year younger than a classmate. Will this child's disadvantages in physical, intellectual, or emotional development manifest themselves in academic achievement?

Several studies, from a few early efforts in the 1960s to much more frequent efforts in recent years, suggest that this is so. The RAE is also associated with a greater likelihood of being diagnosed with a learning disability for students born from June to August compared to students born from September to May ($p < 0.001$)[10], and a 13 percentage point increase of being retained for an additional year in kindergarten, first, or second grade[11]. They are significantly more likely to be referred for a psychological evaluation than those born in other months ($p < 0.05$)[12], and summer-born 5–7-year-olds are more likely ($p < 0.001$) to be designated for remedial instruction[13].

But the news for our young kindergarten student gets worse. The impact of the RAE on academic achievement has been shown to last well beyond primary education[14] and through college[15]. Scientific creativity has been correlated with relative age, and it has been found that the oldest students in a cohort are more likely than their younger classmates to hold positions of leadership throughout their educations[16]. It has even been reported that the likelihood of matriculating into prestigious universities such as Cambridge or Oxford has a strong negative correlation with an applicant's relative age

A report from the Institute of Fiscal Studies[16] published in April 2013 has found that children born in August rather than September are:

- 5.4 percentage points more likely to be labelled at age 11 as having mild special educational needs;
- 6.4 percentage points less likely to achieve five General Certificate of Secondary Education passes or equivalent at grades A*–C; and
- 2 percentage points less likely to attend classes at a university when they are 18 or 19 years old.

August-born English children who enter a university at age 18 or 19 are:

- 2.3 percentage points less likely to attend a high-status Russell Group institution; and
- 1 percentage point less likely to graduate with a degree.

They further report that while the difference relative to those born in September is largest for children born in August, even a one-month difference in age has an effect.

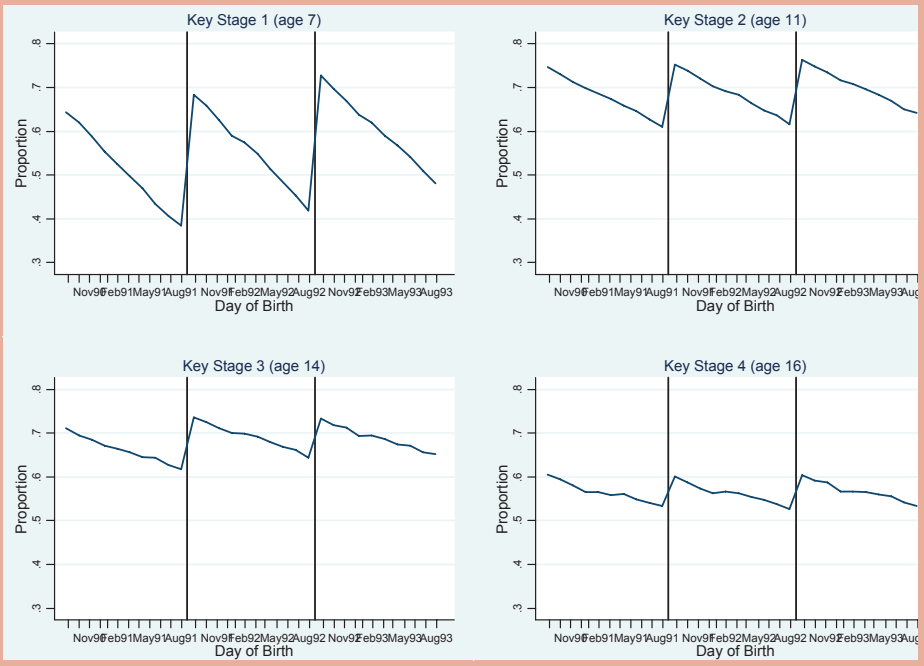
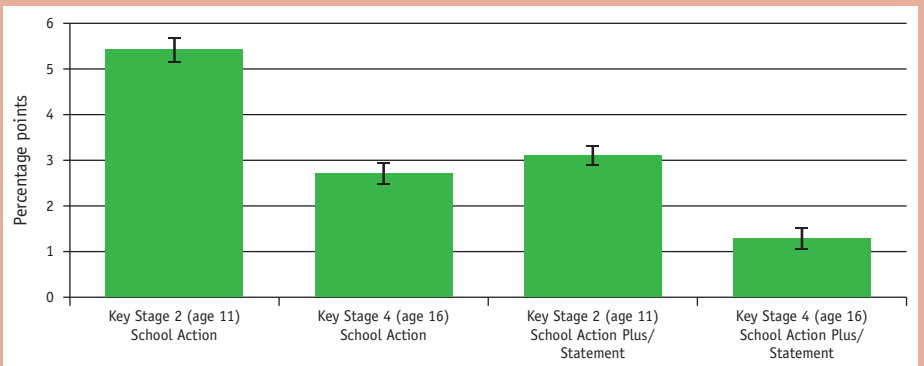


Figure 1. Proportion of pupils obtaining at least the expected level at Key Stages 1, 2, 3 and 4 (ages 7, 11, 14 and 16), by date of birth



Note: "School Action" identifies needs that require the mildest level of support from the school
"School Action Plus/Statement" identifies needs that require additional support to be resourced in from outside the school.
Source: authors' calculations using the National Pupil Database for pupils born in 1990–91, 1991–92 and 1992–93

Figure 2. Percentage of pupils identified as having special educational needs: August-born children relative to September-born children

within her or his academic age cohort! Data shows that there are 25% more autumn-born applicants to Oxford or Cambridge than summer-born applicants, and winter and spring births are respectively 17% and 15% more likely to apply than summer-born applicants. Those figures are reflected in the students who are accepted.

And most recently, in a report delivered just before we went to press, the Institute of Fiscal Studies[17] found astonishing differences between children born in England in September – just after the cut-off date for the academic year – and in August – just before the cut-off date. The August-born children are more likely to exhibit poorer socio-emotional development, more likely to have lower self-confidence, less likely to believe that their own actions make a difference, and more likely to engage in risky behaviours such as smoking (see box).

August-born children are more likely to have special educational needs, less likely to get five GCSE passes, and less likely to attend university

But wait – even now the bad news for young kindergarteners is not over. Some studies show that the RAE coincides with differences in professional achievement and wages even in adulthood. It has repercussions in development of leadership skills, and because these differences in developmental outcomes persist throughout adulthood, they result in substantial long-term economic detriments. Bedard and Dhuey[18] conducted a cross-sectional study of adults who had been children in the period 1959–1980; during that time the cut-off date to enter kindergarten changed from January 1st to December 1st . They found that a 1% increase in hourly salary in white males coincides with that shift of entry date. Du *et al.*[19] found that most chief executive officers are born in the winter (28.5%) and the lowest number of CEOs are born in July and August ($p < 0.05$) than in other months. Even more worrisome is that youth in Alberta who had committed suicide were more likely to have suffered from the RAE when entering the first grade ($p < 0.001$)[20].

However, not all research reports such a bleak picture. The Institute of Fiscal Research study discussed in the box reported that the detrimental effects decrease as children grow older and found little evidence that they persist into adulthood. They say that happiness and wages earned by British adults who were born in August, at the end of the academic year, do not differ from those for adults born in other months.

Age-based cohorts and the relative age effect – cause and effect?

The evidence presented in scientific journals overwhelmingly suggests that when age-based cohorts based on a fixed cut-off date are established, there is a relative age effect. However, this is not sufficient to establish a causal relationship between them. It might be that younger children do worse in tests simply because they are younger, and that being grouped with older children in teaching or training is irrelevant to that. The fixed cut-off date may not be what is doing the damage. Studies of the RAE are necessarily observational studies; the researcher cannot control and manipulate various factors such as the relative age of a child who is a subject of an RAE study and observe the resulting impact on the child's athletic or academic achievement. Furthermore, we have scant information on whether the effect exists in situations where children are *not* placed in age-based cohorts based on a fixed cut-off date. However, we did note earlier that the emergence of the RAE in hockey coincided with the establishment and enforcement of standard age cohorts in youth hockey leagues. And in our own work we provide even stronger evidence that when the suspected cause does not exist, the RAE does not occur.

As our test case we assessed competitive youth swimming. The existence or non-existence of the RAE for this sport is particularly interesting because it is generally an indoor, year-round sport and there is no arbitrary birth-date deadline used to establish age-based cohorts. Youths are placed in cohorts by their calendar age in years on the date of a swim meet. So the day before a youth swimmer has her or his 12th birthday, she or he is the oldest participant in her or his cohort (the 11-year-olds). On the next day, she or he moves into the 12-year-olds cohort and becomes the youngest participant in that cohort. In this manner every participant is at some point the youngest, the oldest, and the median-aged participant in the cohort. Once these youth swimmers reach high school they all compete against each other, but to that point they have not been subjected to any arbitrary birth-date deadline.

Given this lack of suspected cause, we would expect to see little or no suspected effect. We would expect to find no relative age effect in high school swimmers. That is, we would expect the distribution of swimmers' birth-dates by month to be the same as the distribution of their classmates' birth-dates by month. In order to test this hypothesis we collected and analysed data on birth-date and gender for the 2010–2011 academic year from 738 high school varsity swimmers across 29 Texas high schools in nine Texas school systems. We also obtained the same information for all other students in these high schools, 57 528 students in all; these data were treated as the population, and the data on the swimmers was treated as the sample. Chi-square tests and regression analyses of these data consistently show no significant evidence of the RAE among high school swimmers[21]. The sample distribution of all swimmers ($\chi^2 = 15.724$, $p = 0.152$), female swimmers ($\chi^2 = 8.386$, $p = 0.678$) and male swimmers ($\chi^2 = 16.413$, $p = 0.126$) is equal to the sample distribution for the respective populations. Our conclusion has to be that our swimmers do not suffer from the relative age effect. Because of the manner in which participants are placed into aged-based cohorts, they are in that happy minority of sporting youth for whom the month of their birthday makes no difference.

Conclusions

Our analysis of Texas high school swimmers, who compete as youths in a system that is based on age on the date of a meet rather than on an arbitrary and static birth-date deadline, finds no significant evidence of a relative age effect. Our result supports the conclusion that a causal relationship exists between age-based cut-offs and the RAE. Happily, they also suggest a means by which the RAE can be, to a large extent, mitigated. A promising strategy is one that allows each child to be the oldest, youngest, and median-aged member of her or his cohort by turns. For some sports, as we have seen in swimming, this would be easy. However, for large field sports such as soccer, baseball, or American football it might not be economically feasible. For such sports some

more creative approach will be necessary to mitigate or partially mitigate the effect.

It is even harder to mitigate the relative age effect in school. A staggered entry cannot be maintained for students to be by turns the oldest, youngest, and median-aged members of their class.

The IFS authors have a possible solution: they suggest adjusting pass marks instead, using a sliding scale "so the oldest children would have to perform slightly better than they do at the moment in order to reach the expected level, which would now be an expected level for a given age rather than at a particular point in time". Under this scheme the minimum passing mark would be increased by two points for children born in October and November, increased by one point for children born in December and January, remain the same for children born in February and March, reduced by one point for children born in April or May, reduced by two points for children born in June or July, and reduced by three points for children born in August. But it makes for complexities, and cries of "unfair" might well arise from parents (or from children). Another approach, perhaps more practical, came from Dame Sally Coates, the head of a school in west London: it is "intensive intervention for younger children in early primary school" – giving extra resources and teaching time to the youngest children in the class. Understandably, these and other potential resolutions of the RAE are controversial and force us to confront the issue of what is fair. What is certain is that the youngest children in a class are at present exposed to a serious degrees of unfairness that may follow them throughout their lives.

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Lauren M. Brewer is a marketing student in the doctoral programme in the College of Business at Louisiana Tech University. James J. Cochran is Bank of Ruston Barnes, Thompson, & Thurman Endowed Research Professor in the College of Business at Louisiana Tech University.