# A Proposal to Reduce the Age Discrimination in Canadian Minor Hockey

WILLIAM HURLEY, DAN LIOR AND STEVEN TRACZE
*Department of Business Administration*
*Royal Military College of Canada*
*Kingston, Ontario*

Pour un joueur canadien de hockey mineur, il existe un rapport étroit entre son mois de naissance et les chances qu'il aura de jouer dans une équipe de très haut niveau. Les joueurs nés dans les premiers mois de l'année sont avantagés. On attribue généralement ce fait au système de classification, dans le hockey mineur, qui groupe les joueurs en catégories selon l'âge. Dans cet article, nous commençons par un examen de la situation actuelle. Ensuite, nous montrons que le système de classification basé sur l'âge ne constitue pas une explication suffisante; il faut aussi compter avec une répartition qui s'opère très tôt (c-à-d. la division des joueurs en équipes représentatives et en équipes de ligue-maison.) Nous suggérons un système de classification plus équitable et, finalement, nous examinons les implications de politiques d'intérêt public.

There is strong relationship between birthmonth and the chance that a Canadian minor hockey player will play at an elite level. Players born in the early months of the year have an advantage. This is generally attributed to the slotting system: the way in which minor hockey groups players into age divisions. In this paper we first review the evidence. We then argue that there is more to the explanation of this relative age effect than just the slotting system; it also depends on early streaming (i.e., the partitioning of players into representative and house league teams). We suggest a more equitable slotting system, and finally, we discuss public policy implications.

## INTRODUCTION

It has been well documented in the literature that there is significant age discrimination within Canadian minor hockey. Players born in the early months of the year have an advantage. This is generally attributed to the slotting system: the way in which minor hockey groups players into age divisions. The purpose of this paper is to document the nature and extent of the discrimination, and then to suggest a new slotting system, the *Relative Age Fair (RAF) Cycle System*, to ensure fairness for all players.

In Canada, male birthdays are evenly distributed over the year. However, the same is not true for elite minor-hockey players. Here is an example. Each year the Greater Kingston Minor Hockey Association fields six teams at the AAA level, ranging from Major Atom to Midget. We examined the birthdays of registered players for the 1999-2000 season. Each

player was classified either as a First-Half birth (meaning the player was born in one of the first six months of the year) or a Second-Half birth (the last six months of the year). Table 1 shows the resulting distribution.

TABLE 1
Distribution of Greater Kingston Minor Hockey Players' Birthmonths

| | *First-Half* | *Second-Half* |
|---|---|---|
| Major Atom | 14 | 3 |
| Minor Peewee | 12 | 5 |
| Major Peewee | 14 | 3 |
| Minor Bantam | 13 | 3 |
| Major Bantam | 17 | 1 |
| Midget | 17 | 3 |
| Totals | 87 | 18 |

Note that the number of births in the first half of the year is almost five times the number in the second half. Why is it that most of the hockey talent in Kingston is born in the first six months of the year?

As it turns out, Greater Kingston is no different than any other elite hockey organization in Canada. This birthday phenomenon, which the academic literature has termed the *Relative Age Effect* (RAE), is observed throughout Canadian minor hockey, Major Junior, and the National Hockey League (NHL). For instance, the distribution of birthdays in the NHL for the seasons 1982-83 and 1996-97 are shown in Table 2.

TABLE 2
Distribution of Players' Birthmonths in the NHL

| | *First-Half* | *Second-Half* |
|---|---|---|
| 1982-83 Season | 442 | 273 |
| 1996-97 Season | 664 | 427 |

In each season the number of first-half birthdays is significantly greater than the number of second-half birthdays. All in, the published evidence is clear and decisive: the minor hockey system in Canada discriminates against players born late in the year. In view of this discrimination, we try to answer several questions:

*What is the evidence for the RAE in hockey?* The discovery of the RAE in hockey is generally attributed to Barnsley, Thompson and Barnsley (1985). Other important contributors include Daniel and Janssen (1987) and Barnsley and Thompson (1988). A good summary of the empirical evidence can be found in Montelpare, Scott and Felino (1998). The impetus for this research in hockey was motivated by similar research in education. Among others, Davis, Trimble and Vincent (1980) have found that younger students entering Grade 1 do not do as well as their older classmates in early scholastic achievement. However, unlike hockey, it is not clear that this advantage persists as children progress through the system. See Angrist and Kreuger (1992) on this last point.

*What is the likely explanation of the RAE?* The conventional wisdom is that the RAE is due to the way the minor hockey system slots players into age categories. Minor hockey uses the calendar year to determine who plays with whom. For instance, at the AAA level in Canada, 11-year-old children born in January compete with 11-year-olds born in December to play on a Major Atom team. It is generally recognized that, on average, the older players within a calendar year have an advantage in physical maturation and, consequently, in relative hockey skill. At competitive levels below AAA, the inequity is even more pronounced. For instance, the Kingston Township Atom A team is drawn from players who are 10 and 11 years old and hence the age difference can be as high as two years. We term the system for slotting players based on the calendar year, the *Calendar Year System* (CYS). Based on an analysis of data from other professional sports, Daniel and Janssen (1987) dispute this conventional

wisdom and argue that it is not just the CYS but the CYS coupled with early streaming (players are selected from house league teams to play on "travel" or "rep" teams) that gives rise to the RAE. We believe that Daniel and Janssen are correct, albeit with a slightly different interpretation of their data.

*Given the RAE, are there alternatives to the CYS which reduce its inequity?* It has been our experience that most parents of minor hockey players are aware that the RAE exists (although they are cloudy on its details), and most are of the view that a one-time redefinition of the calendar year is what Hockey Canada has in mind as a way to fix the problem. They are also of the view that this one-time redefinition is not likely to work. We agree that such a change would not work. We propose a new system termed the Relative Age Fair Cycle System. We spell out its implementation details explicitly and we argue that it is more equitable than the CYS. We also argue that it is more equitable and practical than the *Novem System* proposed by Boucher and Halliwell (1991).[1]

*Is there a role for government intervention?* Hockey Canada governs all aspects of minor hockey in Canada. Hence, if there were going to be changes to the way minor hockey slots players, these changes would have to be championed and implemented by Hockey Canada. Hockey Canada is aware of the RAE but, to this point, has done nothing about it. In fact, their position is that there are more important issues to be tackled; and hence the RAE, and what to do about it, is not their priority. Given Hockey Canada's governance structure, it is unlikely that anything will be done in the near future. We will argue later in the paper that there may be a role for government intervention.

## The Relative Age Effect

Barnsley, Thompson and Barnsley (1985) first discussed the RAE based on 1982-83 NHL, Ontario Hockey League (OHL), and Western Hockey League (WHL)[2] data. Table 3 summarizes NHL data for 1961-62, 1972-73, 1982-83, as reported by Daniel and Janssen (1987) as well as our update based on player rosters for the 1996-97 season as published in the *Hockey News.*

TABLE 3
Breakdown of NHL Players by Birthquarter

| | *1961-62* | *1972-73* | *1982-83* | *1996-97* |
|---|---|---|---|---|
| Quarter 1 | 31 (0.30) | 81 (0.25) | 229 (0.32) | 349 (0.32) |
| Quarter 2 | 17 (0.17) | 77 (0.24) | 213 (0.30) | 315 (0.29) |
| Quarter 3 | 27 (0.26) | 72 (0.23) | 157 (0.22) | 225 (0.21) |
| Quarter 4 | 28 (0.27) | 88 (0.28) | 116 (0.16) | 202 (0.18) |

Note: The quantities in brackets are proportions. The data for 1961-62, 1972-73 and 1982-83 is taken from Daniel and Janssen (1987).

The first thing to note is the evidence for the RAE. In the years 1982-83 and 1996-97, the ratio of first-quarter births to fourth-quarter births is about 2:1. This stands in contrast to the uniform distribution of male births by quarter in Canada.[3]

One way to see that the 1996-97 data are not consistent with normal statistical variation is to first assume that players born in a particular quarter are no more likely to play in the NHL than players born in any other quarter, and then ask what the chance is that we would observe at least 349 of 1,091 players with birthdays in the first quarter playing in the NHL. The chances of this happening are approximately one in 10,000,000![4] Clearly, we need something other than chance to explain the distribution of NHL births.

The second thing to note is that the RAE is a relatively recent phenomenon since there is no evidence of it in the 1961-62 and 1972-73 NHL data. There have been a number of explanations for this. For instance, Daniel and Janssen argue that there was a fundamental change in the organization of minor hockey in the early 1970s:

> We might further venture the hypothesis that a key event in this transition was the international series with the Soviet Union in 1972. It was at that point that greater emphasis began to be placed on systematic methods of developing hockey talent and European methods were widely adopted. Streaming of players into various levels of proficiency at an early age became widespread.... By the early 1980's the products of the new system began reaching the NHL (Daniel and Janssen 1987, p. 23).

The RAE is also evident in our elite junior leagues. Table 4 shows data taken from the OHL.

TABLE 4
Birthmonth Data from Ontario Hockey League

| | *1982-83* | *1996-97* |
|---|---|---|
| Quarter 1 | 143 (0.41) | 153 (0.36) |
| Quarter 2 | 108 (0.31) | 121 (0.28) |
| Quarter 3 | 61 (0.17) | 100 (0.23) |
| Quarter 4 | 38 (0.11) | 53 (0.12) |

Note: The 1982-83 data is taken from Daniel and Janssen (1987).

The ratio of first-quarter to fourth-quarter births averages about 3:1. Data from the WHL (Daniel and Janssen and our update) give comparable results. If anything, the RAE is more pronounced in junior hockey than in the NHL.

Not surprisingly, the Canadian World Junior team has exhibited the RAE over the past decade. We examined the rosters for this team in the five years: 1992, 1994, 1996, 1998, 2000. Of the 110 players on these teams, 80 were born in the first half of the year and 30 were born in the second half. This is a ratio of 2.67:1 and is comparable to those of the OHL and WHL. Assuming uniform births, the chance of observing a ratio this high is less than one in 100,000. Again, this low probability suggests a systematic effect.

It does appear that the RAE dissipates as players get older in the system. Table 5 presents 1990s' estimates of the ratio of first-half births to second-half births at each level. Nonetheless, the ratio for the NHL is significantly greater than one.

TABLE 5
Ratio of First Half to Second-Half Births (1990s)

| | *Ratio* |
|---|---|
| Minor Hockey (Kingston, AAA) | 4.83 |
| Junior (OHL) | 1.78 |
| Professional (NHL) | 1.56 |

Based on this hockey data, it is clear that the RAE exists and has persisted into the 1990s. But what about other professional sports and their associated minor systems? What can we learn from them? Daniel and Janssen (1987) examined professional football, baseball, and basketball for evidence of the RAE. In what follows we summarize their data with slightly different interpretations of their findings.

Table 6 summarizes the Canadian Football League (CFL) and National Football League (NFL) data for the year 1984-85.

TABLE 6
Birthmonth Data for Professional Football

| | *CFL* | *NFL* | |
|---|---|---|---|
| | | *AFC* | *NFC* |
| Quarter 1 | 179 (0.23) | 209 (0.27) | 204 (0.27) |
| Quarter 2 | 200 (0.26) | 203 (0.26) | 174 (0.23) |
| Quarter 3 | 208 (0.27) | 198 (0.25) | 194 (0.26) |
| Quarter 4 | 191 (0.24) | 167 (0.21) | 177 (0.24) |

Source: Daniel and Janssen (1987).

Based on a chi-square test, these data are consistent with the hypothesis that birthdays are distributed uniformly across quarters. Hence, there does not appear to be evidence for the RAE in either league.

The same result appears to hold for the National Basketball Association (NBA). Table 7 summarizes NBA data for the year 1984-85.

TABLE 7
Birthmonth Data for Professional Basketball

| | |
|---|---|
| Quarter 1 | 78 |
| Quarter 2 | 66 |
| Quarter 3 | 83 |
| Quarter 4 | 70 |

Source: Daniel and Janssen (1987).

Again, a chi-square test confirms that this distribution is consistent with a uniform distribution across quarters.

Major league baseball is the interesting case. In the United States, streaming in minor basketball and football does not begin until high school. However, it begins earlier in baseball, although not quite as early as minor hockey in Canada. The cut-off date for the CYS which minor baseball uses in the United States is 1 August. Hence, if there were a RAE, it ought to show up in the quarter beginning in August. Table 8 shows the distribution of births of major league baseball players for the 1984-85 season.

TABLE 8
Birthmonth Data for Professional Baseball

| | | |
|---|---|---|
| Quarter 1 | (Aug., Sept., Oct.) | 195 |
| Quarter 2 | (Nov., Dec., Jan.) | 186 |
| Quarter 3 | (Feb., Mar., April) | 158 |
| Quarter 4 | (May, June, July) | 143 |

Source: Daniel and Janssen (1987).

The chi-square statistic is 10.28 and, with three degrees of freedom, there is about a 1.63 percent chance that we would observe a value this high. Another way to look at it is as follows: given that major League births are uniform across the calendar year, what is the probability that we would observe 195 or more birthdays in the first quarter (August, September, and October)? The answer is 0.0145; highly unlikely in our view. Hence, contrary to the findings of Daniel and Janssen, our assessment is that there is indeed evidence of the RAE in baseball. This conclusion is also reached by Thompson, Barnsley and Stebelsky (1991) using an expanded data set.

So what do we have? Both Daniel and Janssen (1987) and Barnsley, Thompson and Barnsley (1985) suggest that the RAE is the outcome of two necessary factors: the CYS of slotting players *and* early streaming. They have a point and the evidence is strong; there is no streaming in football or basketball until high school and we do not observe any evidence of RAE. On the other hand, baseball and hockey do have early streaming and we do observe the RAE. Therefore, a more complete explanation requires the CYS coupled with early streaming.

## EXISTING PROPOSALS TO ADDRESS THE ISSUE OF FAIRNESS

Given the RAE and the inequity of the CYS, the question is whether there are alternative slotting systems which are demonstrably more equitable and are likely to reduce the RAE. We discuss a few of the more popular proposals in this section.

### Change the Definition of the Calendar Year

In 1995, USA Hockey changed the age determination date from 31 December to 30 June. Montelpare *et al.* stated that the rationale for doing so was to ensure that "50% of the participants must be born within twelve weeks of the most important months of the hockey season" (1996, p. 37). Their basic

research had identified that 75 percent of their minor players (under 16 years of age) were born between January and April. As we stated earlier, it is unlikely that this change will have much effect. The evidence from baseball and hockey suggests that such a change will simply shift the advantage from January-April birthdays to July-December birthdays.

**Delayed Streaming**

The evidence suggests that early streaming and the CYS are required to get the RAE. In Canadian minor hockey, players are streamed very early. If this streaming was delayed until, say, age 13 or 14, the evidence from basketball and football suggests that we ought to observe a reduction, if not an elimination, of the RAE. But given the politics of Canadian minor hockey, this approach is not likely to be used.

**Smaller Age Groupings**

Another proposal is to make the range of age groupings smaller. In almost all Canadian minor hockey organizations there are two ranges in use. For organizations in smaller communities, the range tends to be two years. For instance, a Peewee team will be selected from players aged 12 and 13. At the AAA level, however, this period tends to be one year. Hence, for AAA, there would be a Minor Peewee team (age 12) and a Major Peewee team (age 13). The proposal is to form teams with a smaller range, say six months. In the case of six-month ranges at the AAA level, there would be a Minor "Minor Peewee" team (players turn 12 between 1 July and 31 December) and a Major "Minor Peewee" team (players turn 12 between 1 January and 30 June). It seems to us that this narrower range in age would reduce the RAE and therefore this proposal merits consideration. However, this proposal would likely result in more teams and, for most communities, that will put even more pressure on the limited ice available.

**Quotas**

Among others, Barnsley and Thompson (1988) have suggested quotas. For instance, suppose a coach is trying to select a Major Peewee team which, under the existing CYS, is drawn from players aged 13. A quota system would require the coach to select, say, at least eight of the 17 players (15 skaters and two goaltenders) from players with birthdays between 1 July and 31 December. It is not clear to us that such a quota system would work. To the extent that such quotas would lead to different teams, good players born in the early months of a year would have an even bigger advantage than they currently do under the CYS. Our view is that quotas would exacerbate the RAE.

**Teams Differentiated by Size**

Still another proposal is to form teams differentiated on physical size. It is certainly true that children mature at different rates. This is particularly true for children between the ages of 12 and 15. For instance, consider males aged 13. Lowery (1986) reports that the United States average population weight is 93 pounds, the 10 percent decile is 77.1 pounds (meaning that 10 percent of the population aged 13 have weights less than 77.1 pounds), and the 90 percent decile is 123.4 pounds (10 percent of the population aged 13 has a weight higher than 123.4 pounds). The difference between these deciles is almost 50 pounds which is substantial considering the average weight is only 93 pounds.

By way of example, the system might have a *Light* Minor Peewee team and a *Heavy* Minor Peewee team with a cut-off weight as at a particular date: those above the cut-off would play Heavy, and those below Light. There are some fairly clear implementation problems with such a system. Moreover, how many young hockey players, at the direction of their parents, would be running in sweat suits trying to "make" the Light weight? Nonetheless such a system would reduce the RAE since, generally, age is positively correlated with size.[5]

**Rotating Calendar Cut-Off Dates**

In the summer of 1999, the Canadian Hockey Association organized and sponsored a conference, the "Open Ice Hockey Summit," to examine the state of hockey in Canada. Participants included players, coaches, and managers from all levels of Canadian

TABLE 9
The RAF Cycle System

| | *Season* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Quarter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* |
| 1991 (1) | T2 | T3 | T4 | T5 | T6 | T7 | T8 | |
| 1991 (2) | T2 | T3 | T4 | T4 | T5 | T7 | T8 | |
| 1991 (3) | T2 | T3 | T3 | T4 | T5 | T6 | T8 | |
| 1991 (4) | T2 | T2 | T3 | T4 | T5 | T6 | T7 | |
| 1992 (1) | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 |
| 1992 (2) | T1 | T2 | T3 | T3 | T4 | T6 | T7 | T8 |
| 1992 (3) | T1 | T2 | T2 | T3 | T4 | T5 | T7 | T8 |
| 1992 (4) | T1 | T1 | T2 | T3 | T4 | T5 | T6 | T8 |
| 1993 (1) | | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
| 1993 (2) | | T1 | T2 | T2 | T3 | T5 | T6 | T7 |
| 1993 (3) | | T1 | T1 | T2 | T3 | T4 | T6 | T7 |
| 1993 (4) | | | T1 | T2 | T3 | T4 | T5 | T7 |
| 1994 (1) | | | T1 | T2 | T3 | T4 | T5 | T6 |
| 1994 (2) | | | T1 | T1 | T2 | T4 | T5 | T6 |
| 1994 (3) | | | | T1 | T2 | T3 | T5 | T6 |
| 1994 (4) | | | | T1 | T2 | T3 | T4 | T6 |
| 1995 (1) | | | | T1 | T2 | T3 | T4 | T5 |
| 1995 (2) | | | | | T1 | T3 | T4 | T5 |
| 1995 (3) | | | | | T1 | T2 | T4 | T5 |
| 1995 (4) | | | | | T1 | T2 | T3 | T5 |
| 1996 (1) | | | | | T1 | T2 | T3 | T4 |
| 1996 (2) | | | | | | T2 | T3 | T4 |
| 1996 (3) | | | | | | T1 | T3 | T4 |
| 1996 (4) | | | | | | T1 | T2 | T4 |
| 1997 (1) | | | | | | T1 | T2 | T3 |
| 1997 (2) | | | | | | T1 | T2 | T3 |
| 1997 (3) | | | | | | | T2 | T3 |
| 1997 (4) | | | | | | | T1 | T3 |
| 1998 (1) | | | | | | | T1 | T2 |
| 1998 (2) | | | | | | | T1 | T2 |
| 1998 (3) | | | | | | | T1 | T2 |
| 1998 (4) | | | | | | | | T2 |
| 1999 (1) | | | | | | | | T1 |
| 1999 (2) | | | | | | | | T1 |
| 1998 (3) | | | | | | | | T1 |
| 1999 (4) | | | | | | | | T1 |

hockey including the NHL. The conference produced 11 recommendations to improve hockey in Canada. Recommendation 3 is this:

> Examine the date of age determination. (The cut-off date is currently December 31st, but some thought has been given to rotating it throughout the calendar year. The objective is for a player to not always be the youngest or oldest in a given division.)[6]

The proposal implicit in this recommendation is to rotate the cut-off date throughout the year. However, it does not spell out the details of how such a system would work. We will have more to say about this kind of approach in the next section.

## A New System

We now tackle the problem of making the system fairer.[7] We begin by dividing a year into four quarters: Quarter 1 (January, February, and March), Quarter 2 (April, May, and June), Quarter 3 (July, August, and September), and Quarter 4 (October, November, and December). We use the notation year (quarter) to refer to those players born in a particular quarter of a given year. For example, 1992(3) refers to players born in 1992 sometime in the third quarter (i.e., sometime in the months July, August, or September). We assume that players born in the same quarter have the same hockey potential.

Suppose an organization fields eight teams each season. For convenience we label them T1, T2, T3, ..., T8 (rather than the usual names Minor Novice, Novice, Minor Atom, and so on). These teams are ordered on the basis of age, so, for instance, the players on the T2 team are younger than those on the T3 team. To make the example concrete, we assume that players born in 1992 begin play in the year 2000 season at age 8 on the T1 team. There is no compelling reason for choosing to begin in 2000 but, to make the example concrete, we need to start somewhere.

The new slotting system works on an eight-year cycle, and in Table 9 we present who plays with whom, assuming that the new system is implemented for the 2000 season. Examining the table, note that the seasons are specified horizontally across the top of the table beginning in the year 2000 and running to the year 2007. Birthquarters are shown vertically in the first column beginning with the 1991(1)s and running to the 1999(4)s.

First note that in the 2000 season the T1 team is selected from the 1992(1)s, the 1992(2)s, the 1992(3)s, and the 1992(4)s. In this same season (column), the T2 team is selected from the 1991(1)s, the 1991(2)s, the 1991(3)s, and the 1991(4)s. We have not shown the complete set of teams for the 2000 season, but it would be easy to extend the table upwards to specify them. In general, note that all teams are selected from four contiguous birthquarters. Hence, all teams are selected from a year's worth of players.

To see how our slotting system differs from the CYS, suppose we compare what happens to the 1992(1)s and the 1992(4)s. The career progression for each is highlighted in Table 9. Table 10 compares what happens to each birthquarter over their eight-year careers using a measure we term *Relative Age*.

Table 10
Comparison of Birthquarters for 1992(1) and 1992(4)

| | *1992(1)s* | | *1992(4)s* | |
|---|---|---|---|---|
| *Season* | *Team* | *Relative Age* | *Team* | *Relative Age* |
| 2000 | T1 | oldest | T1 | youngest |
| 2001 | T2 | 2nd oldest | T1 | oldest |
| 2002 | T3 | 3rd oldest | T2 | 2nd oldest |
| 2003 | T4 | youngest | T3 | 3rd oldest |
| 2004 | T5 | youngest | T4 | 3rd oldest |
| 2005 | T6 | 3rd oldest | T5 | 2nd oldest |
| 2006 | T7 | 2nd oldest | T6 | oldest |
| 2007 | T8 | oldest | T8 | youngest |

To explain what the Relative Age column means, consider first the 1992(1)s. In the 2000 season, the 1992(1)s are the oldest quarter on the T1 team. Hence we use the term *oldest* to describe their Relative Age. In the 2001 season, they play on the T2 team, and among the four quarters on this team, the 1992(1)s are the second oldest quarter. We refer to their Relative Age on this team with *2nd oldest*. We could continue the argument and justify every element in the column. However, suffice it to say that since there are four quarters on each team, there are four relative age categories: *oldest, 2nd oldest, 3rd oldest,* and *youngest.*

Now examine both Relative Age columns in the table. The key thing to note is that each of these birthquarters is oldest in two years, 2nd oldest in two years, 3rd oldest in two years, and youngest in two years. In fact, under this new system, we can show that this is true for every birthquarter. Thus, we say that this slotting system is Relative Age Fair. We term it the RAF Cycle System, and in addition to it being fair in the sense described above, it has some other interesting properties:

1. It is easy to implement. You only need to know a player's birthquarter to slot him or her onto a team.

2. Not all players start on the T1 team; some start on the T2 team. This is true for the 1996(2)s, the 1997(3)s, and the 1998(4)s. This does not make the system unfair for these groups. Quite the contrary, it is necessary to make the system fair for all birthquarters.

3. Some players repeat on a team and then skip a team. For example, the 1992(4)s repeat on the T1 team and skip the T7 team. And again, the fact that some birthquarters skip a team does not make the system unfair for those birthquarters.

4. Under the CYS, players in the same birthyear tend to play together their entire careers. Their coaches tend to be the same and their roles tend to be the same. This is not so under the RAF Cycle System. Under this new system a player would play with a more diverse set of players and coaches and, almost certainly, he or she would play a more diverse set of roles over a minor hockey career.

5. There is nothing special about choosing birthquarters as the basic time measure of analysis. Nor is it necessary to have an eight-year cycle. It is easy to construct Relative Age Fair cycles for different values of these variables. For instance, we could construct a Relative Age Fair cycle for a six-year period beginning in Minor Atom.

6. The RAF Cycle System is easily implemented in organizations that field teams selected from eight consecutive quarters (i.e., one Novice team, one Atom team, etc.). This system is also Relative Age Fair if the definition is changed to include eight relative ages (one for each of the eight birthquarters on a team).

7. The RAF Cycle System is different from the Novem System. We believe the RAF Cycle System is superior for two reasons. First, it is demonstrably more equitable. And second, it does not require a minor hockey organization to field additional teams to get the gain in equity. On this second point, suppose an organization wanted to give its players eight seasons of hockey. Under the RAF Cycle System it would simply field eight teams each year. However, under the Novem System, it would have to field nine teams. This is a serious drawback given the limited availability of ice in most communities.

8. We can show that the RAF Cycle System is equivalent to a calendar rotation system if the eight-year sequence of calendar year definitions as shown in Table 11 is used. This sequence has an eight-year cycle. The cut-off date goes back

by a quarter each year for three years beginning in year two, stays the same for a year, and then moves forward by a quarter in each of the last three years.

TABLE 11
Definition of Year

| *Year* | *Year Definition* |
|---|---|
| 1 | 1 Jan. 1 – 31 Dec. |
| 2 | 1 Oct. 1 – 30 Sept. |
| 3 | 1 July – 30 June |
| 4 | 1 April – 31 May |
| 5 | 1 April – 31 May |
| 6 | 1 July – 30 June |
| 7 | 1 Oct. – 30 Sept. |
| 8 | 1 Jan. – 31 Dec. |

We conclude this section with an interesting question. If hockey talent is born evenly throughout the year (there is no real reason to believe that it isn't), are we putting our best elite teams on the ice? Would something like the RAF Cycle System give us a better chance at, say, the World Junior Championship?

## The Rationale for Intervention

Any changes to the rules and regulations governing minor hockey in Canada must be approved by Hockey Canada, the umbrella organization for all the provincial hockey organizations. Our understanding of the process for a rule change is as follows: the Executive Committee of the Board of Hockey Canada meets in August and they make a proposal to the board for a change of regulations. This proposal is presented and discussed in January at the semi-annual meeting of the board, and is then voted on at the summer annual general meeting.

The issue of the RAE has been before the Hockey Canada board and executive committee on a number of occasions over the past ten years. Each time nothing has been done. Even after the Open Ice Summit recommended that this problem be dealt with, Hockey Canada has admitted that this issue is not a high priority. A part of Hockey Canada's difficulty is that there is no agreement within the organization on the best way to deal with the problem. Another difficulty is that any solution to the RAE, including the RAF Cycle System, is likely to be difficult to understand. This makes such proposals difficult to sell to the rank and file. For the RAF Cycle System or any similar system to have a chance at being implemented, it will have to be championed at the board or executive committee level.

This does present some interesting public policy implications. The current system is clearly discriminatory. Moreover, Hockey Canada has no intention of changing it in the immediate future. Such a change would require an internal champion or significant external pressure, neither of which appears imminent. Consequently we would argue that there is a rationale for some sort of federal government intervention.

## Summary

Among our great players, Wayne Gretzky has articulated the dream of every young Canadian hockey player: to play in the National Hockey League and lift the Stanley Cup overhead. However, not all young hockey players have the same access to this dream. The CYS discriminates against those born late in the year. This is not right and it should be fixed.

## Notes

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[1]The hallmark of the CYS is that minor hockey players born late in the year are disadvantaged every year. Players born in December are the youngest on their teams throughout their minor hockey career. The Novem System allows these disadvantaged players to sometimes be the

oldest players on their team. It essentially is a calendar rotation system for a limited number of age groupings. In the example that Boucher and Halliwell use, only the Atom and Peewee age groupings are affected, and even within these groupings, the system is not fair. Moreover, each team would be drawn from only three-quarters of a year of players. Hence, to implement this system, an organization would have to field an additional team.

[2]The OHL and WHL are two of the three Major Junior A leagues in Canada. Some players go from these leagues directly to the National Hockey League.

[3]The distribution of male births in Canada for the four quarters of 1968 are 24.4 percent, 25.6 percent, 26.1 percent, and 23.9 percent respectively (*Canadian Statistical Review*). This distribution is relatively uniform for each of the years. The slight variations from 25 percent in each quarter are, no doubt, due to normal statistical variation. Barnsley, Thompson and Barnsley (1985) report that these percentages have not fluctuated significantly from year to year.

[4]This probability is obtained using the binomial distribution with 1,091 trials and a probability of success equal to 0.25.

[5]A referee has suggested that size is another form of discrimination in minor hockey. We are inclined to agree.

[6]See the website <http://nt.canadianhockey.ca/openice/e/index/html>.

[7]In this section we only present our results. The underlying mathematics is presented in a more technical paper and is available from the authors upon request.

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