# NEW DRIVERS: FIRST YEAR OF DRIVING EXPERIENCE AND THEIR CRASH RATES

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Article abstract

The main objective of this research is to characterize patterns of new drivers' crash rates per 30 day periods over one year after obtaining the first driving permit. The data set contains the individual records for all the new licensees from the province of Quebec who started the process of acquiring a license between March 1, 1989 and February 28, 1993, two years before and after the reform of March 1, 1991 which changed the rules of access to a first driving license. To have comparable groups, the candidates had to succeed in obtaining the license within 270 days of obtaining the learner's permit, and the driving record had to be available for a full year following licensing.

The accident distribution was modeled by a logistic regression since the monthly probability to be involved in more than one accident is very low. Men and women were analyzed separately as the average crash rate for women was about half the one for men. The models show that: 1) age affects significantly the crash rates for men and women; 2) experience reduces crash rates particularly over the first four months after licensing; 3) those who pass the theory exam in the first attempt (both genders) have lower crash rates; 4) but the reform had no direct effect on crash rates. New licensees constitute a heterogeneous group (age, sex) in terms of crash rates even though the law and the regulation were applied uniformly before the 1997 reform.

# NEW DRIVERS:
# FIRST YEAR OF DRIVING EXPERIENCE
# AND THEIR CRASH RATES

## by Claire Laberge-Nadeau, Urs Maag, Georges Dionne, Denise Desjardins and Stéphane Messier

**RÉSUMÉ**

Le principal objectif de cette recherche est d'analyser les taux d'accidents par périodes de 30 jours durant l'année qui suit l'obtention d'un premier permis de conduire. La base de données contient tous les dossiers des nouveaux conducteurs au Québec entre le 1ᵉʳ mars 1989 et le 28 juin 1993, soit deux ans avant et deux ans après la réforme du 1ᵉʳ mars 1991 qui a changé les règles d'accès à un premier permis de conduire. Pour obtenir des groupes comparables, les candidats devaient obtenir leur permis de conduire dans les 270 jours suivant l'obtention du permis d'apprenti et ils devaient avoir une expérience de conduite d'un an après l'obtention du permis.

La distribution des accidents a été modélisée comme étant logistique étant donné que la probabilité d'être impliqué dans plus d'un accident au cours d'une période de 30 jours est très faible. Les hommes et les femmes ont été analysés séparément étant donné que le taux moyen d'accidents des hommes était deux fois plus élevé que celui des femmes. Les modèles estimés montrent que: 1) l'âge des nouveaux conducteurs affecte significativement les taux d'accidents des hommes et des femmes; 2) l'expérience réduit significativement les taux

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d'accidents particulièrement durant les quatre premiers mois après l'obtention du permis; 3) les conducteurs qui ont réussi leur examen théorique à la première tentative ont moins d'accidents; 4) mais la réforme de 1991 n'a pas eu d'effet direct sur les taux d'accidents. En conclusion, les nouveaux conducteurs représentent un groupe hétérogène en terme d'accidents même si la loi et la réglementation étaient appliquées uniformément avant la réforme de 1997.

**ABSTRACT**

*The main objective of this research is to characterize patterns of new drivers' crash rates per 30 day periods over one year after obtaining the first driving permit. The data set contains the individual records for all the new licensees from the province of Quebec who started the process of acquiring a license between March 1, 1989 and February 28, 1993, two years before and after the reform of March 1, 1991 which changed the rules of access to a first driving license. To have comparable groups, the candidates had to succeed in obtaining the license within 270 days of obtaining the learner's permit, and the driving record had to be available for a full year following licensing.*

*The accident distribution was modeled by a logistic regression since the monthly probability to be involved in more than one accident is very low. Men and women were analyzed separately as the average crash rate for women was about half the one for men. The models show that: 1) age affects significantly the crash rates for men and women; 2) experience reduces crash rates particularly over the first four months after licensing; 3) those who pass the theory exam in the first attempt (both genders) have lower crash rates; 4) but the reform had no direct effect on crash rates. New licensees constitute a heterogeneous group (age, sex) in terms of crash rates even though the law and the regulations were applied uniformly before the 1997 reform.*

# ■ INTRODUCTION

Any learning task, particularly a complex one such as driving an automobile, needs time and experience to arrive at a good performance. New drivers have higher crash rates than experienced ones (Laberge-Nadeau et al., 1992) at any age.

Young drivers, 16-24 years old and particularly those 16-19, are overrepresented in road crashes. In Quebec in 1992, the young drivers licensees 16-24 y.o., were involved in 24% of injury car crashes although they represented only 13% of all licensees and 12% of the Quebec population (Letendre, 1995). The young men were at a 2.64 higher risk than the 25 y.o. and older.

In Canada the minimal licensing age is 16 except in New Foundland where it is 17 and in Alberta where it is 15 y.o.. In 1995, the vast majority (86.6%) of drivers in Quebec had acquired their first permit between the ages 16 and 24; in 1990, 57% of the population 16-17 y.o. had obtained their first driving license and even 65% of the 16-17 y.o. men. This is rather different from most European countries where the first license cannot be obtained

before reaching the age of 18. In Canada, since most new drivers are very young, regulators have been trying various methods to reduce the crash rates of young drivers by changing the rules for obtaining the first license. Various forms of graduated licensing have been introduced with mixed success.

On March 1, 1991, new rules came into effect which attempted to give new drivers more experience and better training before licensing. The theory exam had to be succeeded in order to obtain a learner's permit, and this permit had to be held for at least three months before the practical exam could be attempted. Each failure at an exam added at least another 28 days to the process. The number of compulsory driving lessons was increased from 8 sessions of one hour to 12 sessions of 55 minutes. In addition, a probationary license of two years duration was introduced as of November 14, 1991, with a maximum of 10 demerit points (15 for the regular license). The Société de l'assurance automobile du Québec (SAAQ), the provincial car insurer for bodily injuries, which has a major responsibility for road safety, wanted to know the effects of this change in access rules.

This article is part of an evaluation research aimed at measuring the effects on safety of the 1991 changes of regulations on access to the driving license. The objective is to characterize patterns of new drivers' crash rates per 30 days over a period of 360 days after they obtained their first driving permit. A comparison of the patterns between the pre and post reform will also be presented.

# ■ MATERIALS AND METHOD

This study is population based covering two periods, two years before and after the reform, concentrating particularly on the involvement in crashes of new licensees as drivers. Straightforward descriptive analysis will be followed by statistical models to evaluate the pre and post periods.

## ☐ Data source

A special file was created by Pichette and Bisson (1994) from the Société de l'assurance automobile du Québec (SAAQ) data. The SAAQ is a public corporation that insures all Quebecers for motor vehicle bodily injuries; it also regulates and manages the access to driving licenses. This special file contains all persons who started

the process of obtaining a learner's permit for class 5 (private car) of the Province of Quebec, a population of about 400 000 learners of all ages.

## □ Population studied

The population we have studied was limited to new licensees whose learning period was 270 days or less and for whom a full year of crash records was available after they obtained the driving license. We took the driver license holders who entered the system between March 1, 1989 and February 28th, 1993. The studied population of new licensees contains 110,352 men and 110,115 women for a total of 220,467 for whom individual records are available (Table 1).

**TABLE I**
**NEW LICENSEES WHOSE LEARNING PERIOD WAS 270 DAYS OR LESS WITH A FULL YEAR OF CRASH RECORDS AFTER OBTAINING THE LICENSE, BY ACCESS PERIOD AND GENDER, QUEBEC 1989-1993.**

| Period | Men | Women | Total |
|---|---|---|---|
| Pre reform 1989-1991 | 72,557 | 73,819 | 144,376 |
| Post reform 1991-1993 | 37,795 | 36,296 | 74,091 |
| Total | 110,352 | 110,115 | 220,467 |

## □ Variables studied

The dependent variables are the events (crash/no crash) in which the *i-th* licensee was involved coded as follows:

$Y_{ij} = 0$ if no crash in period $j$

$Y_{ij} = 1$ if at least one crash in period $j$

$j = 1, 2, ... 12$; with periods of 30 days.

In this way, the first 360 days following licensing are covered by 12 periods of equal length.

The explanatory variables comprise:

- the reform
- the year of entering the process (within the variable reform)
- the year of obtaining the license (within reform)

- the age in years at licensing (16,17,18-19, 20-24, 25+)

- the success in obtaining the theory exam at the first try (within reform)

- the success in obtaining the practical exam at the first try (within reform)

- the season of the crash (March 1 - May 31: spring, June 1 - August 31: summer, etc.)

- the driving experience since licensing at the time of the crash measured per 30 day periods

- the age specific jobless rate

- the quantity of regular unleaded gas (unit: $10^5$ m$^3$) sold in Quebec for the crash period.

The last two variables serve as economic indicators. We do not have the kilometer driven per driver which would have required a special survey that was beyond our limited research resources.

The dependent variable was modeled by a logistic regression:

$$\ln [E(Y_{ij}) / (1 - E(Y_{ij}))] = X_{ij} * b$$

where $X_{ij}$ is the dependent variable with $i$ as the index for the licensee, $j$ for the period, $X_y$ is the vector of explanatory variables and b the vector of the regression coefficients to be estimated. In order to adjust for possible within subject correlation, the generalized estimation equations (GEE: Liang & Zeger, 1986; Zeger et al., 1988) technique was applied when estimating the parameters of the logistic regression model. Men and women were treated separately.

# ■ RESULTS

## □ Descriptive analyses

Figure 1 shows the monthly crash rates per new driver for the first year following licensing. Since there were almost no drivers with more than one crash per period, we use crash rate for what is technically the event rate (at least one crash per period). We observe that men start with a high monthly record of an average of 15 crashes per thousand licensees (0.015) and reach 13 in the 5th month; they stay more or less at that level for the rest of the year. Women register an average of 8.6 (0.0086) crashes per thousand
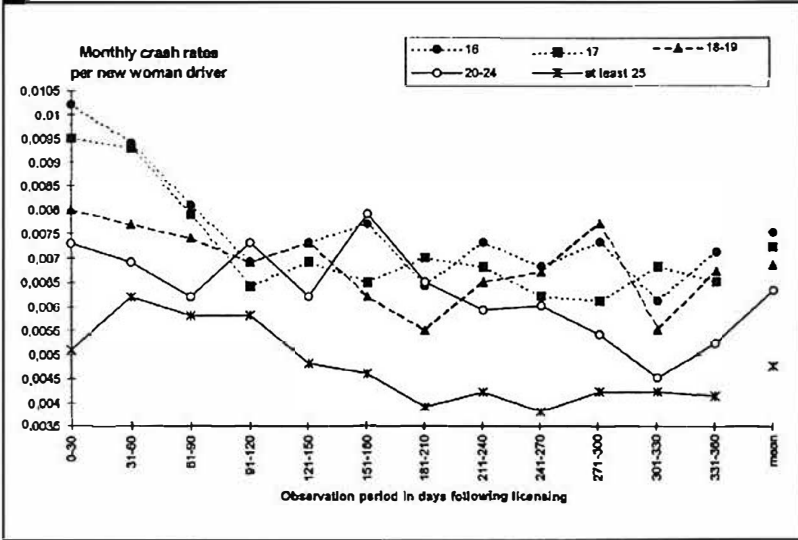
**FIGURE I**
**MONTHLY CRASH RATE PER NEW DRIVER WHO HAS 270 DAYS OR LESS WITH A LEARNER'S PERMIT AND 365 DAYS OF OBSERVATION OF THEIR INVOLVEMENT IN CRASHES FOLLOWING THE LICENSE DATE FOR WOMEN AND MEN.**
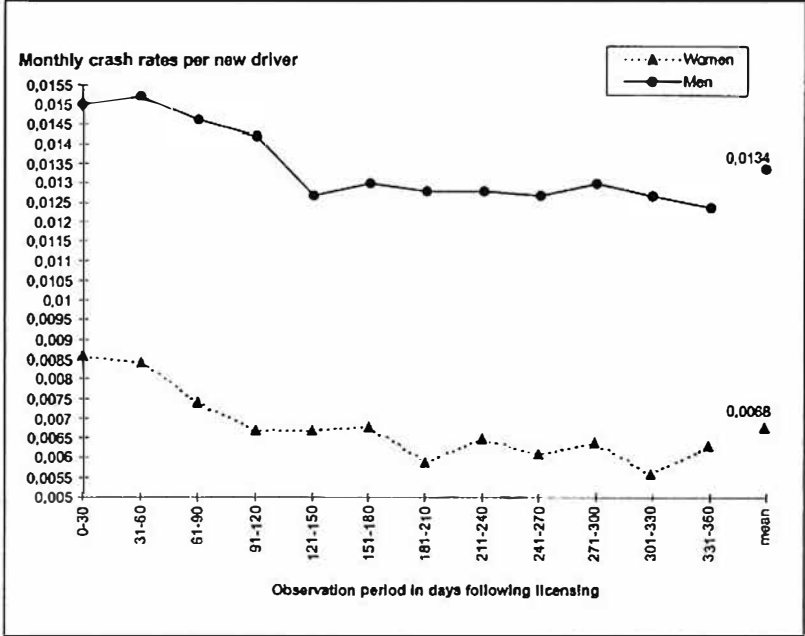
drivers in the first 30 days and drop to 6.7 in the 4th month and fluctuate around 6 thereafter. New men drivers register twice the crash rate of women. In this straightforward analysis, all ages were combined and cumulated for all years observed.

The monthly accident rates per driver by age group are shown in Figure 2 for women and in Figure 3 for men. We observe differences in crash rates between ages. For women drivers, aged 25 and up, the crash rates are much lower for each of the 12 periods, varying from 0.004 to 0.006; the 20-24 y.o. group shows lower rates than the younger groups for the first three and the last three months. The new young 16 y.o. women drivers have twice (0.01) the rate of the 25 y.o. and older ones (0.005) in their very first month of driving. For the men, the 25 y.o. and over register fewer crashes than the younger ones, their average being 11.5 accidents per thousand licensees; the 16 y.o. and 17 y.o. averages are respectively 13.7 and 14.5, i.e. 19% and 26% more crashes in the year following their licensing.

**FIGURE 2**
**CRASH RATES PER 30 DAY PERIODS FOR NEW WOMAN DRIVER BY AGE FOR THE FIRST YEAR FOLLOWING LICENSING.**



**FIGURE 3**
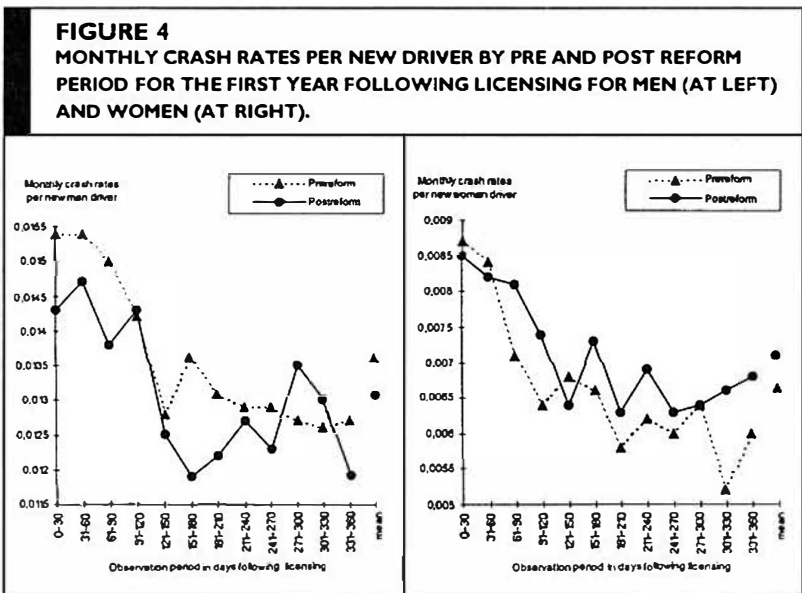**CRASH RATES PER 30 DAY PERIODS FOR NEW MAN DRIVER BY AGE FOR THE FIRST YEAR FOLLOWING LICENSING.**
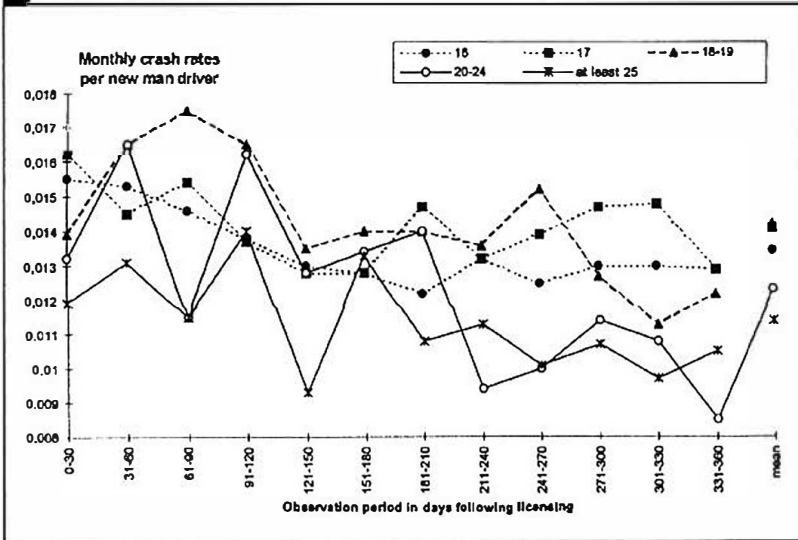
Table 2 shows the crash rates per 30 day periods per 1000 licensees. We notice that the accident rate for men in the post reform period has diminished from 13.4 to 13.0; for women it has increased from 6.6 crashes per thousand to 7.1. These differences are statistically significant ($p < .0001$). We observe also that the number of driving periods in the post reform period is about half of the pre reform period.

Figure 4 gives the monthly crash rates for the two periods (pre and post reform) separately for women and for men. Again, we

**TABLE 2**
**CRASH RATES PER 30 DAY PERIODS (RATES PER 1000 LICENSEES)**

| | MEN | | WOMEN | |
|---|---|---|---|---|
| | n | rate per 1,000 | n | rate per 1,000 |
| pre reform | 870,684 | 13.4 | 885,828 | 6.6 |
| post reform | 453,540 | 13.0 | 435,552 | 7.1 |
| total | 1,324,224 | 13.3 | 1,321,380 | 6.7 |

n: number of person-periods

**FIGURE 4**
**MONTHLY CRASH RATES PER NEW DRIVER BY PRE AND POST REFORM PERIOD FOR THE FIRST YEAR FOLLOWING LICENSING FOR MEN (AT LEFT) AND WOMEN (AT RIGHT).**

observe that for both groups and in both periods it takes about 5 months to stabilize at a lower crash rate.

Let us now examine the effect of the reform when taking into account all the explanatory variables. The models yield estimates for odd ratios with 95% confidence intervals (see Appendix). We shall extract subtables to highlight the principal results.

Table 3 shows results of the odd ratios when no explanatory variables were taken into account: .96 for men and 1.07 for women, the tendency expressed in Table 2. However, when all the explanatory variables available in our data source are taken into account, the apparent effect of the reform disappears since the confidence intervals contain the value 1.00; i.e. the reform had no effect on crash rates.

Table 4 shows a clear effect of age: comparing with crashes recorded by the 16 y.o., we observe that the odd ratios for new men drivers aged 17, 18-19 y.o. are similar, namely 1.03, 1.02 whereas they are lower for the 20-24 and the ≥ 25 y.o. group, they are respectively .86 and .74.

For women drivers, the age effect is substantial: from .93, .89 for the 17, 18-19 group, it drops to .59 for the 25 y.o. and up. There is a clear effect of age: older new licensees are at a lower risk than very young new licensees.

Table 5 shows the effect of experience. When using the model with the linear and the quadratic effect, the estimated probability of a crash in the 12th month period is 17% lower than in the 1st month for men and 28% lower for women. There is clearly a learning effect.

Among the explanatory variables we introduced, it is interesting to note that succeeding the theory exam at the first try,

| TABLE 3 |
| --- |
| THE EFFECT OF THE REFORM: ODD RATIOS (OR), POST VERSUS PRE REFORM, WITH 95% CONFIDENCE INTERVALS. |

| WITHOUT ANY EXPLANATORY VARIABLES | | | | | |
| --- | --- | --- | --- | --- | --- |
| | MEN | | | WOMEN | |
| | lower | OR | upper | lower | OR | upper |
| post reform | .93 | .96 | .99 | 1.02 | 1.07 | 1.12 |
| WITH ALL THE EXPLANATORY VARIABLES | | | | | |
| post reform | .81 | .91 | 1.03 | .83 | .97 | 1.14 |

**TABLE 4**
**THE AGE EFFECT: ODD RATIOS (OR) WITH 95% CONFIDENCE INTERVALS, ADJUSTED FOR ALL THE EXPLANATORY VARIABLES.**

| Age vs. 16 | MEN | | | WOMEN | | |
|---|---|---|---|---|---|---|
| | lower | OR | upper | lower | OR | upper |
| 17 | .98 | 1.03 | 1.07 | .87 | .93 | .99 |
| 18-19 | .97 | 1.02 | 1.08 | .83 | .89 | .95 |
| 20-24 | .80 | .86 | .93 | .74 | .81 | .88 |
| ≥ 25 | .68 | .74 | .81 | .54 | .59 | .65 |

**TABLE 5**
**THE EFFECT OF EXPERIENCE PER 30 DAY PERIOD: ODDS RATIOS PER UNIT INCREMENT WITH 95% CONFIDENCE INTERVALS, ADJUSTED FOR ALL THE EXPLANATORY VARIABLES.**

| | MEN | | | WOMEN | | |
|---|---|---|---|---|---|---|
| | lower | OR | upper | lower | OR | upper |
| linear effect | .95 | .97 | .99 | .91 | .93 | .95 |
| quadratic effect | .999 | 1.001 | 1.003 | 1.001 | 1.003 | 1.005 |

compared they need more than one try to success, leads to a substantial effect: those who succeeded at first try had a much lower crash rate than the ones who needed more than one. This result holds for the four groups: men and women, and in the pre and post reform period, the effect being stronger in the pre reform.

Two aggregate variables, unemployment and gasoline sold, were used in the model to control for economic factors. A higher jobless rate is associated with a lower crash rate for males but nor for females, and higher gasoline sales are associated with higher crash rates.

# ■ DISCUSSION AND CONCLUSION

Our analyses demonstrate very clearly that a simple comparison of the crash rates of new drivers before and after the reform is not sufficient; it may even lead to erroneous conclusions. For a

better comparison, other pertinent variables must be included in the models. Our study comprised the population of new drivers for a four year period, two years before and two after the reform. Limits on the learning period had to be imposed to arrive at comparable populations. Ideal variables of interest, namely the direct individual risk exposure in the form of distances driven during each period and the type of driving (night/day, highways/country, roads/city streets, etc.), were not available.

The results show that the reform had essentially no short-term effect (one year) on crash rates which is not so surprising since the reform introduced only modest changes. However, there are other interesting results. The population of new drivers is rather heterogeneous (gender, age) even though the laws and regulations treat everybody equally before the 1997 reform. Women have only half the crash rate of men. There is a considerable age effect with older new drivers being far less at risk than the very young new drivers. A considerable decrease of the crash rates, which we consider a learning effect, over the first year has been observed and quantified. The association between succeeding in the first attempt of the theory exam and lower crash rates, found in four different groups, was at first unexpected and constitutes a new finding. Several explanations seem possible: A lack of preparedness since it is no longer compulsory to have driving lessons on the theory part, a lack of comprehension due to language difficulties, a lack of sufficient education, or a noncaring attitude which could be the reflexion of a lack of readiness to be a responsible road user. We are presently carrying out further research on the relation between the performance on the theory test and the subsequent driving record.

Experience is clearly an important factor. As a consequence, many jurisdictions (Australia, France, New Zealand, several States in the U.S.A., some Canadian provinces) have been experimenting with various forms of graduated licensing. So far, no evaluation has shown substantial benefits for crash rates. Langley et al. (1996) studied hospital morbidity files for the years 1979 to 1992 to evaluate the New Zealand graduated driver licensing system. Even though a 23% reduction of car crash injuries occurred, they conclude: "An analysis of licensure data suggests that the reduction in crashes may, in large part, be attributable to an overall reduction in exposure". A personal communication from Perkins (1994) confirms "...that the effect of the New Zealand GDLS was based virtually entirely on persuading young people not to license", but no difference was found when collision rates per licensed drivers before and after graduated licensing were analyzed. In France, an

evaluation of the voluntary programme "L'apprentissage anticipé de la conduite" showed no improvement in crash rates attributable to this programme (Page 1995, Lassarre et Hoyau, 1997). However, in certain circles, graduated licensing is advocated almost as a panacea (IIHS, 1994, 1996; Mayhew and Simpson, 1990, 1996; Simpson, 1996, Williams et al., 1995). In our opinion, the age effect is neglected in these writings. Simard (1988) and Laberge-Nadeau et al. (1992) have shown that there is also an age effect, shown again in this article, which is distinct from the experience effect. Hence, putting more emphasis on the age effect, i.e. raising the licensing age, might well be a more effective way to decrease crashes among young new drivers.

The 1991 reform yielded a substantial indirect effect. In another study (Dionne et al., 1997), we examined the population of all new licensees in Quebec over an eleven year period. There was a substantial decrease of new licensees for 1991 and 1992 compared with the preceding years which can be attributed in part to the reform, but is also due to an economic recession which occurred at the same time. With fewer new licensees, fewer accidents resulted, as the crash rates per licensee remained the same. We estimate that 3,500 crashes per year were avoided comparing 1992-93 with 1989-90; thus a substantial benefit for public health and in social costs resulted.

Finally, another reform took effect in Quebec as of June 30, 1997, which prolongs the learning period to 12 months (8 if an approved driving course is taken) and imposes further restrictions on the probationary permit (maximum of 4 demerit points, no alcohol at all). We are looking forward to a new evaluation!

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# APPENDIX
## ODD RATIOS ( $e^{\hat\beta}$ ) WITH 95 % CONFIDENT INTERVALS

| Explanatory variables | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | $e^{\hat\beta - 1.96 s(\hat\beta)}$ | $e^{\hat\beta}$ | $e^{\hat\beta + 1.96 s(\hat\beta)}$ | $e^{\hat\beta - 1.96 s(\hat\beta)}$ | $e^{\hat\beta}$ | $e^{\hat\beta + 1.96 s(\hat\beta)}$ |
| Intercept | 0.0098 | 0.0135 | 0.0185 | 0.0061 | 0.0091 | 0.0136 |
| Reform: Post | 0.8090 | 0.9142 | 1.0332 | 0.8329 | 0.9727 | 1.1361 |
| **Entry date** | | | | | | |
| Pre : 1/3/89 - 28/2/90 | 1.0177 | 1.0899 | 1.1671 | 1.0549 | 1.1569 | 1.2688 |
| Post: 1/3/91 - 29/2/92 | 1.0230 | 1.1010 | 1.1849 | 1.0935 | 1.2040 | 1.3258 |
| **Year of permit** | | | | | | |
| 1st year Pre: 1989 | 0.9009 | 0.9532 | 1.0085 | 0.8244 | 0.8947 | 0.9710 |
| 2nd year Pre: 1990 | 0.8683 | 0.9212 | 0.9772 | 0.8484 | 0.9195 | 0.9966 |
| 1st year Post: 1991 | 0.9202 | 0.9885 | 1.0619 | 0.8202 | 0.9026 | 0.9933 |
| 2nd year Post: 1/1/92-15/9/92 | 0.9694 | 1.06 50 | 1.1701 | 0.9097 | 1.0327 | 1.1724 |
| **Age at which permit was given** | | | | | | |
| 17 y.o. | 0.9820 | 1.0266 | 1.0732 | 0.8731 | 0.9316 | 0.9940 |
| 18 - 19 y.o. | 0.9740 | 1.0249 | 1.0784 | 0.8299 | 0.8886 | 0.9516 |
| 20 - 24 y.o. | 0.8022 | 0.8622 | 0.9266 | 0.7438 | 0.8092 | 0.8804 |
| 25 y.o. + | 0.6761 | 0.7378 | 0.8052 | 0.5405 | 0.5924 | 0.6494 |
| **Season of accident** | | | | | | |
| Winter | 0.9345 | 0.9794 | 1.0265 | 0.8888 | 0.9470 | 1.0091 |
| Spring | 0.7979 | 0.8344 | 0.8726 | 0.8110 | 0.8628 | 0.9180 |
| Summer | 0.9804 | 1.0238 | 1.0691 | 0.9617 | 1.0244 | 1.0911 |
| **Theoretical exam** | | | | | | |
| Pre : one trial | 0.7216 | 0.7531 | 0.7859 | 0.7771 | 0.8254 | 0.8767 |
| Post : one trial | 0.7359 | 0.7805 | 0.8278 | 0.8075 | 0.8746 | 0.9473 |
| **Practical exam** | | | | | | |
| Pre : one trial | 1.0036 | 1.0556 | 1.1102 | 0.9211 | 0.9827 | 1.0483 |
| Post : one trial | 0.9448 | 1.0244 | 1.1107 | 0.8222 | 0.9080 | 1.0027 |
| Permit experience | 0.9514 | 0.9693 | 0.9874 | 0.9053 | 0.9293 | 0.9539 |
| Permit experience square | 0.9997 | 1.0011 | 1.0025 | 1.0013 | 1.0033 | 1.0053 |
| Unemployment rate | 0.9845 | 0.9905 | 0.9966 | 0.9878 | 0.9962 | 1.0047 |
| Gas sales | 1.0812 | 1.1484 | 1.2197 | 1.0087 | 1.0937 | 1.1858 |