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The Role of Driver Education in the Licensing Process in Quebec

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Problem. *In many jurisdictions, driver education (DE) graduates, compared to non-graduates, are granted a time-discount that allows them to drive unsupervised several months earlier, despite little evidence of a safety benefit and consistent evidence of increased crash risk. Confounding factors may be threatening the validity of DE evaluations. A theoretical framework called the "licensing process" (LP) is proposed to identify and explore potential confounding factors in DE evaluations.*

Method. *Prospective study data on a cohort of 1804 novice drivers 16 to 19 years of age of both sexes are analyzed in relation to the LP framework. These data derive from two sources that were linked together: an extensive questionnaire on learning methods, risk-taking, and lifestyles, and government records on exam performance, violations, and crashes.*

Results. *Violation and crash records are not associated with DE attendance. DE attendance is associated with younger ages, greater financial support from family, and fewer hours of supervised driving practice with a learner's permit. For both sexes, more hours of supervised driving practice with a learner's permit is associated with increased crash risk. Most participants, particularly males under 19 years of age, attended DE partly or entirely to save time or money; these motivations are associated with higher violation and crash rates.*

Discussion. *DE evaluations need to identify and control for potential confounding factors. Research is needed to understand the associations between increased crash risk and potential confounding factors like motivation to attend DE and hours of supervised driving practice.*

Keywords Adolescent Drivers; Driver Education; Crash Risk; Motivation; Experience; GDL

The leading cause of adolescent death in high-income countries is road injury (World Health Organization, 1999). Driver education (DE) is a popular and controversial countermeasure. Authorities in 37 of the 62 North American licensing jurisdictions grant time-discounts to adolescents who attend DE, allowing them to license between three months and two years earlier than adolescents who do not attend DE (Mayhew, Simpson, & Singhal, 2005). The DE time-discount incentive is controversial because there is little or no evidence that DE improves adolescent driver safety (Achara, et al., 2001; Evans, 1991; Mayhew et al., 1998; Potvin, Champagne, & Laberge-Nadeau, 1988), and there is consistent evidence that adolescent crashes *increase* when DE courses speed up licensing (Ulmer, Preusser, Ferguson, & Williams, 1999). Compared with novice drivers who did not use the DE time-discount in the following Canadian provinces, novice drivers who used the time-discount had 45 percent more crashes in Ontario (Boase & Tasca, 1998), 27 percent more crashes in Nova Scotia (Mayhew et al., 2003), and 45 percent more crashes in British Columbia (Wiggins, 2004). Wiggins (2004) concluded, "The consistency of the results across jurisdictions suggests that something more than the form and the content of driver education may be at work."

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Evaluations of DE that show no effect or increased crash risk might be confounded by unmeasured factors; e.g., individual or family differences—lack of control for confounding factors is the most serious threat to the validity of road safety evaluations (Elvik, 2003). Therefore, in this article a conceptual framework is proposed for understanding how potential confounding factors interact with DE to produce different driving outcomes. This framework is referred to simply as the "licensing process" (LP) and it is defined broadly as all the factors that influence the acquisition and maintenance of driver's permits. In this article, the principle outcomes of interest in the LP model are performance on driver's permit exams, and violation and crash rates.

Three groups of questions are addressed. The first group focuses on differences between adolescents who do and do not attend DE and the associations between DE attendance and the principle outcomes of interest in the LP model; i.e., theory and road exam performances, violation and crash rates, and the associations between outcomes (i.e., between permit exam performance and violation and crashes, and between violations and crashes). A second group of questions focuses on what motivates

DE attendance and the association between DE motivations and violation and crash rates. Finally, the article investigates associations between the quality of DE courses and violation and crash rates. These three groups of questions attempt to describe the role that DE plays in the licensing process.

A prospective cohort study of 1,804 novice drivers aged 16 to 19 in Quebec was conducted to answer these and other questions. The study linked together on an individual basis data from two sources: an extensive questionnaire on learning methods, risk-taking, and lifestyles completed at the time of licensing; and government records of driver's permit exam performance and rates of violations and crashes for the first 450 days of unsupervised driving. Personal data were anonymized with a dummy number prior to analysis.

Section 2 presents the LP framework. Section 3 describes the research methods. Section 4 presents the results of the analyses according to each of the three groups of questions. In section 5, these results are discussed in relation to factors within the LP that potentially confound DE evaluations, and recommendations are made for future research.

THE LICENSING PROCESS (LP)

The LP refers to every factor that influences licensing, including maintaining a probationary driving permit record free of violations and crashes. The principal reason for suggesting the LP framework is that currently there are no conceptual frameworks for studying the development of driving behaviors and attitudes in direct relation to driver licensing. Theoretical and pedagogical models describe the ideal qualifications of a safe driver (see Gregersen & Bjurulf, 1996; Lonero et al., 1995; Hatakka et al., 1999)—however, these models do not specify practical methods or objective criteria for testing these qualifications during a driver's permit exam. Driver's permit exams are administered within regulatory licensing systems; e.g., GDL, based on criteria that have little if any relation to theoretical or pedagogical models or research-based criteria of safe driving. In addition, both the models and the licensing systems referred to above assume that the adolescent population is relatively homogeneous and that safe driving skills are universally achievable. In other words, the assumption exists that every adolescent of legal licensing age (ranging from 15 to 19 years around the world) can become safe enough to drive unsupervised on public roads by taking training courses and passing standardized government permit exams. This assumption is problematic because there is no scientific consensus concerning precise definitions of safe driving (see discussion in Hirsch, 2003), and there is little evidence to support the belief that every adolescent is capable of or interested in becoming a safe driver.

The LP framework improves upon the above approaches in several ways. One, it focuses directly on the relation between driver development; (e.g., traffic-related experience and confidence), and licensing requirements (e.g., the predictive validity of permit exam criteria). Two, it assumes that the adolescent population is heterogeneous, and that for various reasons, such as lack of maturity, some adolescents of legal licensing age may not be ready or willing to cope with the responsibilities attached to a driver's permit. Finally, the LP framework reflects an ecological approach that attempts to account for all potential influences on the safety of adolescent novice drivers, including motivations concerning DE, expectations about driving, quantity and quality of exposure, socio-economic status, and risk attitudes.

Figure 1 presents a version of the LP time-line divided into three distinct time-periods, along with one example of a potential interaction between factors. The first time-period covers all relevant factors before the learner's permit, including success on the learner's permit theory exam. The second time-period comprises all the factors beginning with the issuance of the learner's permit and ending with the successful completion of the road exam and issuance of the probationary driver's permit. The third time-period comprises events occurring with the probationary permit, such as driving exposure, violations, and crashes.

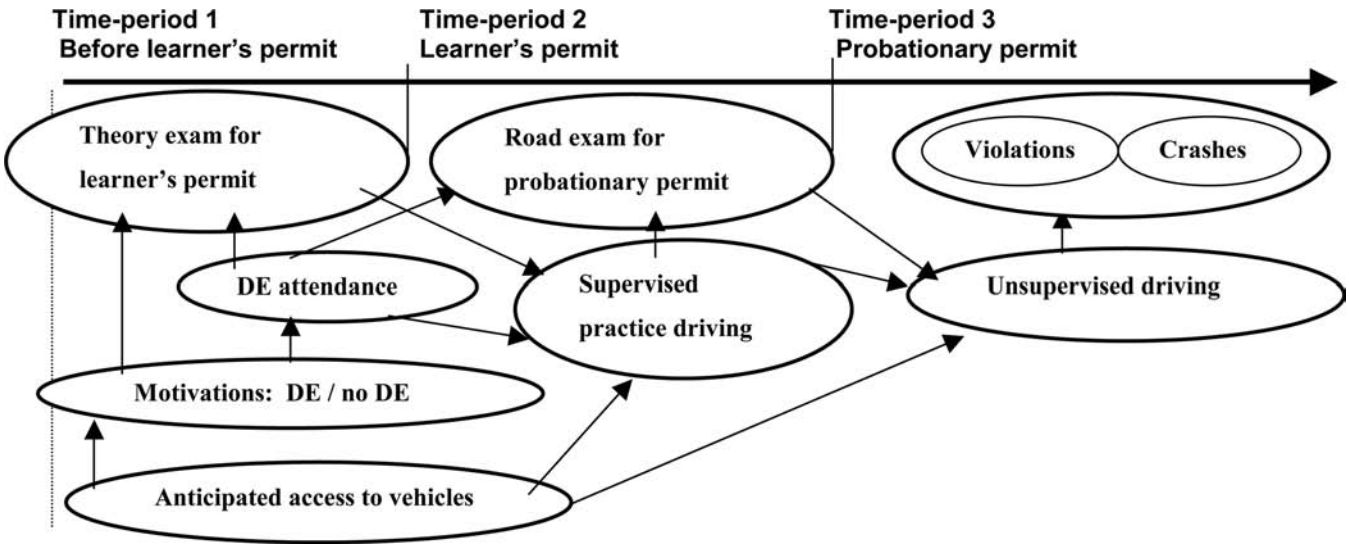

Figure 1 Time-line of licensing process and one possible interaction between factors.

The figure shows three factors that are components of driver's permit regulatory systems like GDL, DE attendance, the learner's permit theory exam, and the probationary permit road exam. Four other factors are included that have received little research attention: motivation to attend or not attend DE, anticipated access to vehicles, supervised driving practice with the learner's permit, and unsupervised driving with the probationary permit. The arrows describe relationships between factors that directly influence licensing and that may influence driving outcomes; i.e., violations and crashes. In most jurisdictions, violations lead to permit suspensions and revocations. In some jurisdictions, crashes can delay graduation to a full permit (Preusser & Leaf, 2003). Note that the regulatory system factors comprise only some of the factors within the LP framework.

The LP framework illustrates how the factors that are not directly addressed by regulatory systems like GDL potentially confound the evaluation of the safety effectiveness of DE and other GDL components. One potential confounder not shown in Figure 1 is family support for licensing, measurable in hours of supervised practice or in financial aid for DE tuition, licensing fees, and vehicle-related expenses. The factors that potentially influence the licensing process can be organized into four interrelated groups: individual differences, family backgrounds, business practices, and government licensing policies; DE incentives, age of access, permit exam criteria, and post-licensing sanctions. These groups merit lengthy discussions that exceed the scope of this article. The most salient points will be taken up in the discussion at the end of this article.

GDL IN QUEBEC

Table I presents the GDL system administered by the Societé de l'assurance automobile du Québec (SAAQ) during the time that the study presented in this article was conducted. Three types of driving permits are described: the learner's, the probationary, and the class 5. To qualify for a learner's permit, a candidate must be at least 16 years old, have parental consent if under 18 years old, pass a vision test, and succeed with 75 percent on each of three sections (laws, signs, specialization) of a theory exam.

The learner's permit allows driving practice on public roads under the supervision of a driver who has held a valid permit for at least two years. After 12 months with a learner's permit, the candidate may apply to take the probationary permit road test. However, the learner's permit holder qualifies for a time-discount allowing him to take the probationary permit road test after only eight months if he presents a certificate for 12 hours of driving lessons from an approved driving school.

The probationary permit allows the candidate to drive unsupervised any time, anywhere, and to carry passengers. Certain restrictions apply during the learner's and the probationary permit phases—zero alcohol tolerance and a limit of four demerit points that triggers a three-month permit suspension. After two years, or earlier if the candidate turns 25 years of age, the probationary permit is automatically upgraded without further testing to a class 5, or full permit. Class 5 permit holders have an alcohol limit of 0.08 BAC and 15 demerit points for a three-month permit revocation. Notice that DE comprises only one relatively brief and optional step towards full licensure.

METHOD

Design

A prospective cohort design was used to study differences in first year violation and crash rates between newly licensed Quebec drivers under 20 years of age who attended and who did not attend DE. From June to September 2000, a questionnaire, available in French and English, was distributed with the collaboration of the SAAQ at one of three permit exam centers in and around Montreal by trained, bilingual volunteers supervised by researchers from the Center for Research on Transportation (CRT) of the Université de Montréal. Probationary permit candidates who had just passed their road exams were asked to complete a lengthy questionnaire. An incentive was offered in the form of a lottery for one of 33 available $100 prizes. Each participant, and in the case of minors, a parent or guardian, signed

Table I The Quebec GDL system

	Permit type		
	Learner's	Probationary	Class 5
Requirements	- Minimum age 16 - Parental consent if below18 - Vision test - Three-part theory exam	- Completion of learner's permit stage - Parental consent if below 18 - Practical road exam	- Completion of probationary permit stage
Restrictions	- Supervision by permit holder with two years experience - Zero alcohol tolerance - Permit suspension with four demerit points	- Zero alcohol tolerance - Permit suspension with four demerit points	- .08 BAC - Permit revocation with 15 demerit points
Duration	- Minimum 12 months or eight months with a DE certificate for 12 hours of lessons	- Two years or 25th birthday	- Renewable every two years until 75th birthday

a consent form allowing researchers to access future driving records.

Participants

Of the initial 2,134 participants who completed a questionnaire, 1,804 (818 female) met the essential study criterion of providing signed legal consent allowing access to future driving records. Ten participants, four female, were coded as 19 year olds although they were between 11 days and five months past their 20th birthday. The mean age of the total sample for both females and males is 17.9. However, within the sample, the mean ages of probationary licensing vary according to DE attendance or non-attendance. Of the total study sample, 85 percent or 1,536 participants, 723 female, attended DE; DE attendance lowers the mean age of probationary licensing for females and males by approximately six months.

Data Sources

Between June 2000 and April 2003, data were collected from two principal sources: the questionnaire and SAAQ files. In September 2003, the SAAQ merged the data from both sources using a dummy number in order to exclude all identity markers other than age and sex before returning the complete file to the researchers for analysis.

The questionnaire contains 149 items organized into three sections. The first section collects information about the process of learning how to drive; e.g., experience before the learner's permit with non-motorized and motorized vehicles, DE or no DE, hours of supervised driving practice, self-rated learning and driving abilities. The second section consists of psychometric measures of risk taking associated with increased collision risk. The last section collects information about family backgrounds and lifestyles, i.e., residence, parental education and occupation, lifestyle habits, academic performance, expectations about car ownership, and driving patterns. The life style habits questionnaire was derived from the work of Shope et al. (2001). In relation to the LP framework (Figure 1), the questionnaire was distributed at the start of period 3, the probationary period, to collect retrospective data about the previous two periods in the licensing process; e.g., methods used to prepare for the SAAQ learner's and the probationary exams, as well as prospective data about anticipated driving exposure during the probationary permit period.

The second source of data is the drivers' records from the SAAQ files. The SAAQ is a crown corporation that insures all residents of Quebec for injuries sustained in collisions with a motor vehicle and has a mandate to improve road safety. The SAAQ administers driver licensing, motor vehicle registration, the demerit point system of violations and suspensions, and receives all police reports on collisions. A driver's record contains the dates and details about permit exam performances (theory and road), demerit point infractions, permit suspensions and revocations, and police-reported crashes. The records were obtained from the SAAQ for the entire study population until the end of December 2001. Minor-property-damage-only crashes that parties settle between themselves with the insurers' joint report are not recorded by the SAAQ.

Analyses

The longest observation period available for all the participants with their first probationary license is 450 days, and the violation rates and crash rates that serve as outcome measure of safety in this study are always based on that time period. Analyses were done separately by sex because the results of chi-square tests ($p < .001$) confirmed the well-established sex differential—the rates of violations per 100 female and male participants were 12.7 and 34.2 respectively, and the rates of crashes per 100 female and male participants were 5.7 and 12.9 respectively—and because proportionately more females than males attended DE ($p < .001$) and succeeded on the first attempt at the theory exam ($p < .01$). Age is generally analyzed according to two-year age groups, 16–17 vs. 18–19, for three reasons: one, statistically significant decreases in violation rates were observed for males as age increased; two, 16 and 17 year olds need parental consent to obtain any driving permit, and, three, the two age groupings are of approximately equal proportional size.

Explanatory factors from the four groups outlined in section 2 that were contained in the questionnaire were cross tabulated with outcomes of interest: DE attendance; performance on the theory exam; performance on the road exam, violations, and crashes. Discrepancies may appear when summing the counts for some factors because some participants did not answer every question. Factor analyses were performed for the psychometric scales and grouped into eight sets of variables (see Maag, Laberge-Nadeau, & Hirsch, 2004). Each set yielded one principal component: an overall index for risk taking was constructed by adding the eight principal components. Analyses of variance of these principal components using crashes (none, one, or more) and violations (none, one, two or more) as factors proved to be disappointing. For example, although the mean of the overall index for males with crashes is significantly higher than the mean for the ones without ($p < 0.005$), the fraction of variance that is accounted for is negligible (Eta squared < 0.02), principally because of the large variation within groups; i.e., the heterogeneity of the respondents.

Logistic regression models were constructed for the outcomes of interest mentioned above using all the available pertinent variables. The models always included the variables age, SAAQ exam preparation, and number of hours of supervised driving practice. Other variables in the final models were only included if they yielded a significant odds ratio for at least one sex. Variables that play a role in several of the outcomes emerge from these logistic regressions. Contingency tables are given for the most interesting associations. Unless otherwise indicated, all associations reported are statistically significant at 5 percent or less. Tables not presented here are available for consultation.

Limits and Strengths

Participants were recruited from three licensing centers where over a period of approximately four months research assistants

approached successful adolescent candidates for a probationary permit and requested that they complete the extensive questionnaire. For several reasons, it is difficult to determine the precise rate of participation in the study. Therefore, the potential exists for a selection bias that is inherent to all surveys. In general, however, participants who volunteer have characteristics that predispose them towards more socially acceptable behavior, so it is possible that any selection bias might exclude the riskier drivers from the study sample. One method for verifying this assumption is to compare the first year violation and crash rates of the sample, containing only first-year probationary permit holders, with the violation and crash rates for the same time period of all first-year probationary permit holders, matched for age and sex, in Quebec. Age- and sex-matched data on violations and crashes for the same time period in Quebec are available; however, the data combine all permit holders (learner's or probationary or class 5) and is not available only for first-year probationary permit holders. Nevertheless, comparisons of violation and crash rates from the study data were made with the available Quebec data. Rates for one or more violations for 360 days per 100 drivers for females and males respectively were 10.2 and 27.4 for the study population and 14.8 and 49.4 in Quebec (Tardiff, 2003); rates for one or more crashes for 360 days per 100 drivers for females and males respectively were 4.6 and 10.3 for the study population and 8.2 and 14.6 in Quebec (SAAQ, 2004). It might be possible, therefore, that any selection bias that might exist could be associated with an underestimation of the magnitude of some of the findings in the study related to risk taking and increased violation and crash risk. Due to budget limitations, direct measures of driving exposure could not be obtained.

This study has several strengths. First, the cohort design and extensive questionnaire allowed for the collection of retrospective data on driving-related experience prior to the start of unsupervised driving exposure as well as prospective data covering the first 450 days of unsupervised driving with a probationary permit. The inclusion of a signed consent form for access to driving records provided researchers with a full range of objective data about the participants including their performance on theory and road exams and all violations and police-reported crashes up to the first 450 days of unsupervised driving and prevented loss of data from participants who may have been reluctant to self-report violations and crashes after they occurred. The linkage between the questionnaire data and the anonymized driving records for each individual created a unique data base that allowed for a more detailed exploration of the learning and driving patterns of various adolescent driver subgroups.

RESULTS

Results are presented as follows. The first section explains the use of a proxy for driving exposure. The following sections examine the three groups of questions focusing on DE attendance, DE motivations, and the quality of DE courses, within in the LP model.

Driving-Exposure Proxy

Comparing violation and crash rates is more meaningful when there is some measure of driving exposure. Binary regression models performed on the study population found that, for both sexes, participants who anticipated access to driving with a probationary permit "often or always" compared to "sometimes or never" were more likely to report more than 50 hours of supervised driving practice with a learner's permit, after taking into account the influences of age, the number of cars at home, and car ownership (Hirsch, 2005). Therefore, the quantity of supervised driving practice hours with a learner's permit may also reflect the quantity of unsupervised driving exposure with a probationary permit.

DE Attendance and the LP Model

The first group of questions focus on differences between adolescents who do and do not attend DE and the associations between DE attendance and the principle outcomes of interest in the LP model; i.e., theory and road exam performances, violation and crash rates, as well as the associations between permit exam performance and violation and crashes, and between violations and crashes.

Differences Between Adolescents Who Do and Do Not Attend DE. In the study sample, more females (88.4 percent) than males (82.5 percent) attended DE. In Quebec, the DE program that leads to certificates valid for time- and insurance-discounts must include a minimum of 12 hours of practical lessons. Many driving schools also offer optional teacher-taught classroom theory as preparation for the learner's permit theory exam. More females (65.9 percent) than males (56.9 percent) chose the option of DE with theory classes. The sex difference remains significant after controlling for age. The distinction between DE with theory and driving and DE with driving only is made in relation to the remaining LP outcomes.

For both sexes, DE attendance was associated with being 16 to 17 years old, having fewer than 25 hours of supervised driving practice during the learner's permit period, and receiving full financial support from family for the purchase of a vehicle. Separate cross-tabulations showed that, for both sexes, families who pay the full cost for car purchases, compared to families who pay nothing or share costs with the participant, also tend to pay full costs for DE tuition, permit fees, and all vehicle-related expenses.

In addition, families who pay full costs also tend to have at least one university-educated parent. For females, DE non-attendance was associated with having between 25 and 50 hours of supervised practice and anticipating driving for errands on weekend evenings. For males, DE attendance was associated with anticipating driving for errands on weekend evenings, and DE non-attendance was associated with having unsupervised driving experience before the learner's permit, and working or seeking to work full time.

A report based on this research did not find any association, for either sex, between DE attendance and any of the psychometric scales on the questionnaire that measured risk perceptions

Table II Rates of combined first time exam performance by exam preparation method controlling for sex

Sex	Exam preparation method	n	Combined first time performances on permit exams: Passed both theory & road (% of exam method)	Passed theory not road (% of exam method)	Passed road not theory (% of exam method)	Failed both theory & road (% of exam method)
F[1]	No DE	95	33.7	18.9	38.9	8.4
	DE driving only	197	46.2	17.3	28.4	8.1
	DE theory & driving	526	61.6	15.4	17.5	5.5
M[1]	No DE	173	35.8	16.2	28.9	19.1
	DE driving only	273	44.0	11.7	37.7	6.6
	DE theory & driving	540	60.9	12.2	20.6	6.3

[1] χ^2 with 6 df, $p < .001$.

and attitudes (see Maag, Nadeau, & Hirsch, 2004). Further cross-tabulations did not find associations between DE attendance and academic performance (grades or time spent doing homework or academic ambition), or residence (city or suburbs), or family stability, as reflected by living with both parents compared to only one.

DE and Theory and Road Exam Performance. For both sexes, success on the first attempt on the theory exam was associated with attendance to DE courses that include theory. First time pass rates on the theory exam decrease as age at time of licensing increases for both sexes, probably due, in part, to the combined effects of higher rates of attendance in DE courses among younger candidates and the positive effect of DE attendance on exam pass rates. For males, road exam success was positively associated with attending DE only for driving lessons without theory.

Many DE students do not take exactly 12 hours of lessons—among females, 9.3 percent reported taking fewer than 12 hours and 15.3 percent reported taking more than 12 hours, and among males, 12.6 percent reported taking fewer than 12 hours and 12.9 percent reported taking more than 12 hours. The number of practical driving lessons taken is variably related to success on the first time on the road exam. Females who reported taking fewer than 12 hours of lessons had the highest first attempt pass rate of any group, 87.9 percent, followed by males with exactly 12 hours of lessons, 77.5 percent. The lowest first attempt pass rates on the road exam belong to females and males who reported taking more than 12 hours of lessons, 69.7 percent, and 72.1 percent, respectively.

Performances on the first attempts at the theory exam and the road exam are combined to create four distinct groups of permit exam performances: pass both theory and road; pass theory but not road; pass road but not theory, and pass neither theory nor road. Table II shows that DE is effective at improving combined performance on the permit exams. DE theory and driving courses had the highest success rate for both theory and road exams combined, 61.6 percent for females and 60.9 percent for males. The highest failure rate for both theory and road exams combined, 19.1 percent, more than twice the rate of any other subgroup, belongs to males who did not take DE at all.

Table III shows that the three different methods of preparation for the permit exams, no DE, DE with driving only, and DE with theory and driving, are differentially associated with the number of practice hours of supervised driving with someone other than the driving school teacher. Proportionately more participants of both sexes who did not attend DE had more than 50 hours of driving practice, 44.9 percent and 36.9 percent for females and males respectively, compared with participants who attended DE with driving only, 27.1 percent and 29.8 percent for females and males respectively, and with participants who attended DE with theory and driving, 17.8 percent and 24.4 percent for females and males, respectively. Proportionately fewer participants of both sexes who did not attend DE had less than 25 hours of driving practice, 14.6 percent and 25.5 percent for females and males respectively. Interestingly, no significant association was found when the variable for driving practice hours was added to a binary logistic regression model predicting road exam success (not shown).

Table III Hours of supervised driving practice with learner's permit by preparation method for permit exams controlling for sex

Sex	Preparation method for permit exams	n	Number of practice hours with someone other than the driving school teacher: <25 (% of prep. method)	25–50 (% of prep. method)	>50 (% of prep. method)
	No DE	89	14.6	40.4	44.9
F[2]	DE driving only	177	41.8	31.1	27.1
	DE driving & theory	499	46.7	35.5	17.8
	No DE	157	25.5	37.6	36.9
M[1]	DE driving only	242	36.8	33.5	29.8
	DE driving & theory	471	39.9	35.7	24.4

[1] χ^2 with 4 df. $p < .01$

[2] x^2 with 4 df. $p < .001$.

Table IV Estimation of the odds ratio (OR) and rates of having one or more violations during the first 450 days with a probationary permit per 100 adolescent novice drivers, controlling for sex, using a binary logistic regression model

	Females (n = 723)			Males (n = 832)		
Predictor variables	OR	95% CI	Violations per 100 drivers	OR	95% CI	Violations per 100 drivers
Age						
16–17	1.17	0.72–1.90	13.2	1.54[1]	1.11–2.12	38.0
18–19	Reference group		12.1	Reference group		29.3
SAAQ exam preparation method						
DE driving and theory	1.06	0.75–1.50	11.6	1.05	0.85–1.30	34.8
DE driving only	0.95	0.64–1.40	12.7	1.02	0.80–1.29	33.3
No. DE	Reference group		18.9	Reference group		33.5
Hours of supervised driving (learner's permit period)						
Less than 25	0.80[1]	0.38–0.98	11.3	0.71[2]	0.57–0.89	27.4
25 to 50	0.82	0.59–1.14	10.8	0.98	0.79–1.21	34.1
More than 50	Reference group		19.2	Reference group		43.7
Self-confidence cycling in traffic						
Very confident	0.98	0.60–1.62	13.1	1.69[1]	1.09–2.63	36.3
A little to not very	Reference group		11.6	Reference group		25.7
Self-rated facility learning to drive						
Very easy	1.54[3]	1.22–1.94	19.8	1.01	0.70–1.13	37.8
A little or not at all	Reference group		10.0	Reference group		30.7
Driving practice supervisors						
Mainly parents	0.78[1]	.61–0.99	9.8	0.97	0.83–1.14	34.1
Parents & friends	Reference group		14.9	Reference group		
34.2						
Owns or plans to own car						
Yes	1.43[2]	1.13–1.80	19.4	1.48[3]	1.27–1.73	43.2
No mention	Reference group		9.1	Reference group		25.3
Anticipates driving for work on weekdays						
Yes	1.38[2]	1.08–1.75	16.3	1.18[1]	1.01–1.38	37.5
No	Reference group		9.3	Reference group		30.0
1st time performance on theory and road exams						
Failed both	1.00	0.61–1.64	15.1	0.96	0.62–1.48	28.2
Passed road not theory	1.17	0.76–1.80	15.1	1.47[2]	1.01–1.95	40.5
Passed theory not road	0.95	0.48–1.87	12.8	0.62[1]	0.42–0.92	23.0
Passed both	Reference group		11.4	Reference group		34.6

[1]$p < .05$.
[2]$p < .01$.
[3]$p < .001$.

Permit Exam Performance, Violations, and Crashes. Table IV shows the binary regressions that measure the association between violations during the first 450 days of unsupervised driving and other variables such as sex, age, driving practice hours, and permit exam performance. A higher risk of violations was associated with, for both sexes, more than 50 hours of supervised driving during the learner's permit, already owning or planning to own a car, and anticipating to drive for work on weekdays. A higher risk of violations was associated with, for females, self-rating driving to be very easy to learn, and practicing driving with friends and parents compared with mainly parents. For males, higher violation risk was associated with being 16–17 years of age, having greater self-confidence cycling in traffic, and failing the theory test and passing the road test on the first attempts; lower violation risk was associated with passing the theory and failing the road tests on the first attempts.

Table V shows the binary regressions that measure the association between crashes during the first 450 days of unsupervised driving and other variables including sex, age, hours of driving practice, and permit exam performance. For both sexes, a higher risk of crashes was associated with more than 50 hours of supervised driving during the learner's permit and having two or more violations during the first 450 days of unsupervised driving. For females, a lower risk of crashes was associated with anticipating that one's family would pay all the vehicle repair costs. For males, higher crash risk was associated with having experience riding a moped or motorcycle in traffic before the learner's permit and failing the theory test but passing the road test on the first attempts.

Motivations to Attend DE and LP Outcomes

The second group of questions focuses on what motivates DE attendance and the association between DE motivations and violation and crash rates. Motivation was measured in the following manner. All the study participants were asked to check off a maximum of three reasons for why they did or did not attend DE courses (see appendix for the lists of reasons). Approximately

Table V Estimation of the odds ratio (OR) and rates of having one or more crashes during the first 450 days with a probationary permit per 100 adolescent novice drivers, controlling for sex, using a binary-logistic regression model

	Females (n = 723)			Males (n = 832)		
Predictor variables	OR	95% CI	Crashes per 100 drivers	OR	95% CI	Crashes per 100 drivers
Age						
16–17	1.29	0.92–1.80	7.2	0.95	0.76–1.19	12.2
18–19	Reference group		5.2	Reference group		12.7
SAAQ exam preparation method						
DE driving and theory	1.19	0.73–1.94	6.5	0.93	0.69–1.26	11.3
DE driving only	1.09	0.63–1.91	6.0	1.03	0.74–1.42	13.3
No DE	Reference group		6.0	Reference group		14.7
Hours of supervised driving (learner's permit period)						
Less than 25	0.61[1]	0.38–0.98	4.0	0.70[1]	0.51–0.98	8.5
25 to 50	1.08	0.70–1.70	6.2	1.19	0.89–1.59	14.0
More than 50	Reference group		10.3	Reference group		15.5
Moped/motorcycle experience in traffic (before learner's permit)						
Yes	0.88	0.57–1.38	6.3	1.43[2]	1.15–1.77	20.0
No	Reference group		6.3	Reference group		9.1
Vehicle repair costs paid by						
Family only	0.49[2]	0.32–0.77	2.3	0.87	0.67–1.12	20.0
Family and self	Reference group		8.5	Reference group 9.1		17.3
1st time performance on theory and road exams						
Failed both	1.18	0.51–2.75	8.7	0.91	0.50–1.68	28.2
Passed road not theory	1.02	0.57–1.80	7.4	1.50[1]	1.02–2.21	40.5
Passed theory not road	1.45	0.80–2.62	9.2	0.73	0.42–1.29	23.0
Passed both	Reference group		4.7	Reference group		34.6
Violations during first 450 days						
Zero	Reference group		5.1	Reference group		9.6
One	0.80	0.41–1.55	11.6			
Two or more	3.64[2]	1.42–9.32	36.4	0.89	0.64–1.24	14.0
				1.64[2]	1.14–2.36	25.8

[1] $p < .05$.
[2] $p < .01$.

84 percent from both DE and non-DE groups gave eligible responses. All but three of the participants who did not attend DE, 35 percent female, chose at least one of the following three motives: (a) a family member would teach them, (b) the time-discount was not a sufficient incentive, or (c) DE courses were perceived as too expensive. Approximately one third of the participants checked off all three motivations. The most popular combinations of choices were (b) and (c) together, 84 percent of the participants, followed by (a) and (c) together for 72 percent. These results require some interpretation.

Logically, the most critical factor of the three reasons for choosing not to attend DE is the possibility of learning to drive without a driving school, specifically, the availability of a vehicle and a licensed adult driver to provide instruction and supervision. Therefore, reasons (b) and (c) are by necessity secondary to condition (a). In support of this argument, cross-tabulations (not shown) show that proportionately more participants who did not attend DE, compared to those who did, had more hours of driving practice during the learner's permit period.

Participants who attended DE courses, 1,536 in total, 47 percent female, were organized into three mutually exclusive groups by type of motivation, learning, opportunity, or mixed, that account for 99.6 percent of the eligible responses. The learning motivation group reported that they attended DE either to learn to drive or to prepare for the SAAQ road test or both and for no other reason. The opportunity motivation group did not check off any learning reasons and reported that they attended DE either to save four months on the learner's permit period or to save money on insurance or both. The mixed motivation group reported at least one learning reason and one opportunity reason for attending DE. Over 36 percent of females attend DE for learning reasons, compared with only 14.7 percent of the males. Only 60 percent of females attend DE for mixed reasons, compared with nearly 79.0 percent of the males. Only seven females (1.1 percent) and 47 males (7.1 percent) reported attending DE exclusively for opportunity reasons. For analysis purposes, the opportunity group and the mixed group may be combined.

Table VI Motivation for attending DE by age controlling for sex

			Motivational for DE attendance	
Sex	Age	n	Learning (% of age)	Opportunity & mixed (% of age)
F	16–17	361	35.5	64.5
	18–19	262	43.1	56.9
M[1]	16–17	407	13.5	86.5
	18–19	259	20.8	79.2

[1] χ^2 with 2 df, $p < .05$.

Table VII DE motivations and driving records (violations and crash rates per 100 drivers) for first 450 days of probationary permit

DE motivations	n	Violation rates per 100 drivers[1]	Crash rates per 100 drivers[2]
Learning	350	14.0	5.7
Mixed	885	24.9	9.6
Opportunity	54	40.7	14.8
Total	1,289	22.6	8.8

[1] χ^2 with 2 df. $p < .05$.
[2] x^2 with 2df. $p < .001$

Table VI shows the results of cross tabulating DE motivation by age controlling for sex. For males, fewer than 14 percent at ages 16–17 and fewer than 21 percent at ages 18–19 attended DE for learning reasons. By comparison for females, more than 35 percent at ages 16–17 and more than 43 percent at ages 18–19 attended DE for learning reasons. Learning motivation increases with age of licensing and the highest proportion of males reporting learning motivation is lower than the lowest proportion of females reporting learning motivation.

Cross-tabulations (not shown) show that, relative to the other motivation groups, participants of both sexes who attended DE for learning reasons were more likely to: not own or in the near future plan to buy a vehicle, have only one or no vehicles at home, and anticipate having access to vehicles never to sometimes, compared with often to always. Probably related to this lack of access to vehicles, participants from the learning motivation group, relative to the other motivation groups, were more likely to: drive for the first time at driving school, report less facility in learning to drive, have fewer than 50 hours of supervised practice, and hold a learner's permit for longer than one year.

Finally, motivation for attending DE appears to be related to the outcomes of greatest interest, violations and crashes. Table VII shows that motivation to attend DE is associated with rates of violations and crashes (per 100 drivers). The learning motivation group had the lowest rates of violations and crashes, 14.0 and 5.7 respectively. The mixed motivation group has the next highest rates of violations and crashes, 24.9 and 9.6, respectively, and the opportunity motivation group has the highest rates of violations and crashes, 40.7 and 14.8, respectively.

Table VIII Comparison between the less-than-12 and the 12-or-more DE lesson groups in relation to violations and crashes during first 450 days with probationary permit

		Violation rates per 100 drivers[1]			Crash rates per 100 drivers[2]
Lesson groups	n	Zero violations	One or more violations	Two or more violations	One or more crashes
Less than 12	105	63.8	19.0	17.1	15.2
12 or more	1,699	76.3	17.3	6.4	9.3

[1] χ^2 with 2 df, $p < .001$.
[2] χ^2 with 1 df, $p < .10$.

Table IX Motivation for attending DE by lesson groups

		Motivations for DE attendance		
Lesson groups	n	Learning (% of lessons)	Mixed (% of lessons)	Opportunity (% of lessons)
Less than 12	84	10.7	77.4	11.9
12 or more	1,205	28.3	68.0	3.7

The Quality of DE Courses and Violation and Crash Rates

Finally, the article investigates associations between the quality of DE courses and violation and crash rates. DE quality is difficult to define and measure. However, one fairly unambiguous indicator of poor quality would be a lack of professional standards. Within the study sample, 74.9 percent of the DE students reported taking exactly the required 12 hours of lessons, 13.9 percent reported more than 12, and 11.1 percent, or 168, study participants of both sexes reported taking fewer than 12 hours of lessons. Among the last subgroup of 168 study participants, 105 passed the probationary permit exams, according to objective data from the SAAQ, before 12 months had expired on their learner's permits. Either this subgroup of 105 answered the questionnaire incorrectly or they made a false representation to the SAAQ. Assuming the latter, further investigations were made.

For convenience, the 105 study participants are called the "less-than-12" group because each participant took less than 12 lessons and less than 12 months to acquire a probationary permit. The remaining 1,699 study participants are called the "12-or-more" group because each participant either took a minimum of 12 lessons or took no lessons and waited the minimum of 12 months to obtain probationary permits. The two groups are compared, combining the sexes due to small numbers, in relation to their respective driving records.

Table VIII shows that, in relation to the 12-or-more subgroup, the less-than-12 subgroup had a higher rate of violations, and although the statistical association is marginally significant, a higher rate of crashes as well.

Table IX shows that the less-than-12 group, compared with the 12-or-more group, was less motivated to attent DE for learning reasons—this difference reaches statistical significance for both sexes when the comparison is made with the mixed and opportunity motivation groups combined.

DISCUSSION

As predicted by previous research, the study data show that attendance to DE driving courses, with or without theory, is not associated with fewer violations or crashes. However, because DE continues to be popular with North American public policy makers, this study explored the role of DE within the LP in order to identify factors that might confound evaluations of DE's safety benefit.

The study data indicate that adolescents who attend DE are different than those who do not. Three differences emerge that

might confound evaluations of DE's safety benefit: age, family support, and practice hours. The average age of participants who attended DE was five months younger than participants who did not attend DE, probably due, in part, to the time-discount. In this study, younger age for males was associated with increased risk of violations. The youngest novice drivers, males in particular, might be at increased crash risk due to a biologically driven sensation seeking, that peaks between 16 and 19 years of age (Zuckerman, 1994), and a normative underdeveloped self-regulatory competence (Steinberg, 2004). Research suggests that self-selection leads to more aggressive and riskier drivers licensing at younger ages (Williams, 1994). Cohort studies of adolescent novice drivers have found that for each annual increase in age at time of licensing, overall crash risk decreases by about 5 percent (Waller et al., 2001) or 6 percent (Maycock, Lockwood, & Lester, 1991). Other research has found that learning driving skills at younger ages is associated with riskier driving outcomes—compulsory skid control training has been associated with more crashes on ice for novice drivers 18 to 20 years of age and fewer crashes on ice for novice drivers 21 years and older (Katila, Keskinen, & Hatakka, 1996).

Family financial support for licensing and driving-related expenses differentiates participants who attend DE from those who do not. Participants of both sexes who attend DE, compared to those who do not, are more likely to report that their families are paying the full purchase costs for their vehicles, and males were less likely to report working full time for seeking full time work. Anticipated car ownership is associated, for both sexes, with higher violation rates. The data show that families that pay full purchase costs for vehicles are also more likely to pay full costs for DE tuition, permit fees, and all vehicle expenses, and to have at least one parent with a university education, an indicator of higher socioeconomic status (SES). Higher SES may be a protective factor in relation to violations and crashes: Laflamme and Engstrom (2002) found lower rates of unintentional injury among adolescents from families with higher SES, that compared to lower SES.

Driving practice hours with the learner's permit also differentiate the two groups. Participants who attended DE, compared with those who did not, were more likely to report having less than 25 hours, vs. more than 50 hours, of driving practice with a learner's permit. Even when practice hours are combined with the average 12 hours of driving lessons, the maximum of 37 hours for more of the participants who attended DE is less than the minimum 51 hours of practice reported by more of the participants who did not attend DE. This study found that, controlling for other risk factors—i.e., age, motorcycle experience, permit exam performance, and violation rates—an increase in practice hours from less than 25 to over 50 is associated with an increase in crash risk of 257 percent for females and 182 percent for males. Sagberg and Gregersen (unpublished manuscript) also found that novice drivers with more than 50 hours of practice had a higher crash risk than those with fewer practice hours. These results are consistent with the work of Forsyth (1992), who matched practice hours with driving records and found that males who had practiced more had an 18 percent higher crash risk: the author found it "difficult to believe that practice does not help to improve a driver's skills."

Two potential and complementary explanations for why more practice with a learner's permit is associated with greater crash risk with a probationary permit are increased exposure and over-confidence. The study data indicate that more practice hours may possibly be associated with more driving exposure after licensure. Over-confidence in driving skills may be defined as confidence in driving skills that are objectively below what is required to respond in a safe and timely manner to the full range of critical traffic situations drivers may encounter. Basic vehicle control skills can be learned relatively quickly and are usually sufficient to pass the permit exam, the requirements of which are "not extreme" (Mayhew & Simpson, 1990). Therefore, newly licensed drivers are initially exposed to complex, demanding traffic situations that may exceed their objective abilities and judgments. After sufficient driving experience, the objective skill levels for most new drivers should more closely match actual driving demands and over-confidence will decrease.

Precisely how much driving experience is sufficient to reduce over-confidence is not known. Gregersen et al., (2000) found that Swedish novice drivers between the ages of 16 and 18 with an average of 118.5 hours of supervised driving practice had safer driving records in their first two years than novices with only 40 to 48 hours of supervised practice. Based upon this finding and the assumption that hours of driving practice are linearly related to increased safety, the Insurance Institute of Highway Safety (2003) recommended a minimum of 30 to 50 hours of supervised practice for novice adolescent drivers, a recommendation that has been adopted as policy in 28 U.S. jurisdictions. However, data from this study and from a study by Sagberg and Gregersen (unpublished manuscript) demonstrate that crash risk increases for approximately the first 50 practice hours. To account for this apparent contradiction, Sagberg and Gregersen (unpublished manuscript) postulated an inverted U-shaped relationship between the number of driving practice hours and crash risk, implying that crash risk tends to increase with increased practice hours up to a certain level, after which crash risk begins to decrease. The proposed explanation for the inverted U-shaped relationship is that at the start of learning to drive, relatively low amounts of driving practice produce disproportionately large increases in self-confidence relative to objective abilities, and that eventually, with more experience, drivers begin to develop a more realistic assessment of their driving abilities relative to driving dangers.

The data also provide some evidence that DE attendance improves performance (measured as success on the first attempt) on the permit exams (theory and road). For both sexes, attending DE with theory classes and driving lessons improves performance on the theory exam, but did not appear to affect road exam performance. Males who attended DE with only driving lessons were less likely to pass the theory exam at the first attempt but more likely to pass the road exam at the first attempt, a pattern

of performance associated with increased risk of violations and crashes. Interestingly, the study data show that more driving lessons and more practice hours are not associated with better results on the road exam. Hypothetically, if driver's permit exam requirements were more demanding, more driving practice would be reflected in better performances and potentially also in safer driving records.

First time performance on permit exams (theory and road) is inconsistently related to safer driving record for males only—no associations were found for females. For males, decreased risk of violations is associated with passing the theory but failing the road exam on first attempts and increased risk of violations and crashes is associated with failing the theory exam on the first attempt and passing the road exam on the first attempt. This study corroborated the finding of previous research on another sample of over 100,000 Quebec drivers (Laberge-Nadeau et al., 1999) that males who fail the theory but pass the road exam on their first attempts are more likely to be involved in crashes. The finding in the present study is potentially more significant because it takes into account the influences of several other risk factors.

The study data also show that the motivations of adolescents who attend DE courses vary in ways that influence safety. Candidates who attended DE exclusively for learning motivations had the lowest rates of violations and crashes, candidates who attended DE exclusively for opportunity motivations had the highest rates of violations and crashes, and candidates with mixed motivations had violation and crash rates between the two extremes.

Motivation to attend DE potentially confounds DE evaluations in at least two ways. One, to the extent that permit candidates attend DE for opportunity reasons, the safety knowledge and skills taught in DE courses may have a reduced impact on their subsequent driving behavior. The second way that motivation to attend DE potentially confounds evaluations of DE effectiveness relates to the methodology used to quantify DE attendance. In large scale evaluations performed in Ontario by Boase and Tasca (1997) and in British Columbia by Wiggins (2004), DE attendance was classified by counting the DE certificates redeemed for a time-discount at license exam centers. Novice drivers who attended DE but licensed after the minimal waiting period did not need to redeem certificates and were therefore incorrectly excluded from the DE group. In this study, DE attendance was classified by self-reports. Almost 24 percent of the participants who reported attending DE did not redeem their DE certificates because they applied for their permits after the minimum 12-month learning period—nearly 40 percent of this subgroup attended DE exclusively for learning motivations. If the learning and licensing patterns of novice drivers in Ontario and British Columbia are similar to those in Quebec, the method of classifying DE attendance by counting DE certificates could bias evaluation results because it might systematically exclude a subgroup of novice drivers who attended DE for learning reasons only, the motivation that is associated with the safest driving records.

The quality of DE courses may also be associated with driving outcomes. DE quality is difficult to define and measure, however, an argument is made that a basic and indispensable measure of DE quality is respect for professional standards. The study data indicate that a subgroup of nearly 6 percent of the sample reported taking less than 12 hours of driving lessons but appeared to have obtained a DE certificate for 12 hours from a driving school. The driving records of this 6 percent subgroup are consistent with rule-breaking behavior—they recorded higher violation rates, and, at a weaker level of significance, higher crash rates as well. Given that the alleged cheating was self-reported while seated inside a government permit exam center, the 6 percent may be an underestimation. This alleged cheating should be viewed from the perspective of the LP framework, which is intended to increase awareness of potentially confounding variables by more accurately depicting the heterogeneity of the adolescent driver population in relation to the rules and regulations of licensing. This study has presented data indicating that even before their learner's permit, some adolescents report having driven cars without supervision, whereas other adolescents report driving for the first time at driving schools. The study data also indicate that relatively few hours of driving lessons or practice appear to be needed to prepare most candidates to successfully pass a driver's permit road exam on the first attempt. In this context, it is not surprising that fraudulent DE certificates might be attractive for some adolescents to purchase and some driving schools to sell.

In summary, the data indicate that the LP is complex and that factors that appear to influence driver safety pre-date by several years the onset of formal DE and permit evaluations. Evaluations of DE that do not control for the effects of potential confounding factors like driving experience before the learner's permit, age of licensing, motivations to attend DE, family support, and practice hours, may not accurately reflect the influence of DE on crash risk. Based on the study results, three recommendations are made. One, licensing authorities should consider discontinuing the time-discount incentive for DE attendance, as has been recommended by other researchers; i.e., Wiggins (2004), Mayhew et al. (2003). Two, following the recommendations of the Insurance Bureau of Canada (2002), research should aim at the development of driver's permit evaluations that have predictive validity for future driving safety. Finally, after the predictive driver's permit exams have been developed and validated, research should be done to develop the curricula and teaching methods that will effectively train all new driver's to meet the new evaluation criteria. This may include extra training or treatment for the subgroups that are at greater collision risk for their own unique reasons.

CONCLUSION

Ideally, the role of DE in the licensing process should be to assist in producing safer adolescent drivers. The reasons why decades of research have shown that DE is not achieving this goal may be partly due to the finding that those adolescents,

particularly males, who are most motivated to license at younger ages appear to be least motivated to attend DE for learning reasons. There is no research evidence and no theoretical reason to believe that DE incentives in the form of time-discounts would increase safety motivations. However, there is robust evidence that adolescents who use the DE time-discount have the highest crash rates. Hence, the DE time-discount should be abolished. Other measures to protect adolescents and the public are raising the driving age, increasing the predictive validity of the driver's permit exams, and ensuring that each novice driver has sufficient supervised experience before driving alone.

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APPENDIX

Reasons for attendance or non-attendance to DE

Why did you decide NOT to go to a driving school? The first reason being the most important (Maximum three reasons.)	1st	2nd	3rd
A family member or friend had already taught me or was willing to teach me how to drive.	○	○	○
The four-month time savings did not make any difference.	○	○	○
The insurance discount was not a sufficient incentive.	○	○	○
Driving courses are too expensive.	○	○	○
Driving courses are too inconvenient.	○	○	○
Driving courses are useless to me.	○	○	○
Other reason: Please specify_____	○	○	○

What were your reasons for deciding to go to a driving school? The first reason being the most important. (Maximum three reasons.)	1st	2nd	3rd
To learn how to drive.	○	○	○
To buy a car.	○	○	○
To be well prepared for the practical driver's license exam.	○	○	○
To save four-months on the learning period.	○	○	○
Due to lack of access to an automobile driver.	○	○	○
Due to lack of access to a driver to accompany me.	○	○	○
To save money on automobile insurance.	○	○	○
Because my parents wanted me to.	○	○	○
Other reason: Please specify_____	○	○	○