Université de Montréal

The Relationship Between Markers of Risk-Taking Tendencies and the First Year Driving Records of Young Drivers

par
Pierro Hirsch
Département de médecine sociale et préventive
Faculté de médecine

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The Relationship Between Markers of Risk-Taking Tendencies
and the First Year Driving Records of Young Drivers

présentée par:
Pierro Hirsch

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Présidente-rapporteur	Nicole Leduc
Directrice de recherche	Claire Laberge-Nadeau
Codirecteur	Urs Maag
Membre du jury	Robert Bourbeau
Examinateur externe	Brian Jonah
Représentante du doyen de la FES	

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SUMMARY

Adolescent driver overrepresentation in injury crashes has been documented since the 1940s and shows no sign of decreasing. In North America, the most effective safety interventions appear to work by reducing overall exposure, i.e. delaying licensure, or by restricting exposure to risky situations, i.e. curfews. Unsupervised, unrestricted adolescent drivers remain at high risk of crashing, presumably due to risk-taking tendencies.

This dissertation explores the adolescent driver risk-taking hypothesis by expanding the traditional focus on individuals to include markers of risk-taking tendencies in government policy, business practices, and families. New risk markers related to self-ratings of driving abilities and crash risk are explored and a new psychometric instrument is developed to measure crash beliefs related to perceptions of threat and confidence in preventive behaviors. A prospective cohort design was used to study associations between risk markers and the first year driving records of 1,804 newly licensed Quebec drivers less than 20 years of age recruited on a volunteer basis from driver's license exam centers in and around Montreal. Participants completed a 149-item questionnaire covering methods of learning to drive, risk-taking perceptions and attitudes, and family backgrounds and lifestyles. Complete driving records were supplied by the Societé d'assurance automobile du Québec including violation and crash records for the first 450 days with a probationary permit. All the data were anonymized and linked to individual records in one database for analysis.

The important results of the study are presented in two articles. The first article demonstrates that risk markers from all levels of the licensing process are related to increased violations and crashes: government policies that allow faster licensing for driver education (DE) graduates, permit exam criteria, insurance incentives, parental supervision of driving practice, motivation to attend DE, and the number of hours of driving practice are all markers of adolescent driver risk. The second article examines risk-taking attitudes, crash beliefs, lifestyles, and self-rated driving abilities. Less time spent doing homework was associated with riskier attitudes, lifestyles, and driving exposure patterns. The new subgroups that are formed when self-ratings for driving skill and safety are combined appear to be, for over half the male population, self-fulfilling prophesies of future crash risk. One promising result is that adolescent males who express greater confidence in the efficacy of preventive driving habits have fewer crashes, after controlling for exposure.

The thesis concludes with several recommendations. Government and insurance incentives to help adolescents license faster and at lower costs should be reconsidered. Preventive driving habits need to be scientifically validated and integrated into DE and license exams. More research is needed to understand how self-ratings develop and relate to risk taking and to determine the optimal quantity and quality of driving experience necessary to assure that adolescents will be safer when they drive without supervision or restrictions. In general, this thesis supports the argument that the population of adolescent drivers is too heterogeneous and the sources of risk taking are too diverse to be treated effectively by only population-based approaches such as traditional DE. The most promising strategies will need to combine high-risk subgroup and population approaches into comprehensive and coherent programs aimed at detecting and treating high-risk subgroups and improving social norms of driving behavior for all adolescent drivers.

Keywords: novice drivers, driver education, crash rates, motivation, driving experience, graduated driver licensing, self rating, risk perception, subgroups, lifestyles, risk taking

RÉSUMÉ

Le phénomène de la surreprésentation des conducteurs automobiles adolescents impliqués dans des accidents avec blessures est documenté depuis les années quarante et ne diminue pas. L'amélioration de la formation et de l'obtention du permis de conduire pour les nouveaux conducteurs adolescents n'a donc pas suivi l'amélioration de la sécurité en matière de technologie automobile et routière des dernières décennies. En Amérique du Nord, jusqu'à présent, les seules interventions efficaces pour réduire le risque de collisions impliquant des adolescents sont de restreindre le temps de conduite et de limiter l'exposition au risque : par exemple retarder l'obtention du permis de conduire, imposer un couvre-feu, limiter le nombre de passagers. Les adolescents sans supervision et ayant peu de restrictions en général sont hautement à risque, probablement dû à leur propension à prendre des risques. De manière hypothétique, pour réduire le risque d'accidents des adolescents, il faudra trouver des méthodes réduisant les risques que prennent les conducteurs adolescents.

Cette thèse explore l'hypothèse de prise de risques des adolescents en partant de l'individu et en y incluant les décisions de prises des risques aux niveaux des politiques gouvernementales, des pratiques commerciales et du contexte familial. On propose un modèle rationnel de catégories de risques afin de pouvoir organiser des marqueurs sélectionnés de risques et d'observer leurs associations avec d'autres marqueurs et avec les dossiers des conducteurs, c.-à.-d. les infractions et les collisions. On présente aussi un modèle du processus d'obtention du permis de conduire qui permet d'observer l'association entre des marqueurs de risques et les dossiers des conducteurs, toutes en relation avec la séquence d'événements étroitement liés aux examens et règlements. On explore de nouveaux marqueurs de risques provenant de l'auto-évaluation des adolescents de leurs habiletés de conduite ainsi que du risque futur de collision, et l'on met en place un nouvel instrument psychométrique afin de mesurer les croyances face au danger et quant à la confiance aux comportements de conduite préventive.

Une étude prospective a été utilisée afin de vérifier les associations entre les marqueurs de risques et les dossiers de la première année de conduite de 1804 nouveaux conducteurs ayant obtenu leur permis au Québec et ayant moins de vingt ans. Les participants ont été recrutés dans trois centres de service de la Société de l'assurance automobile du Québec (SAAQ) situés dans la région de Montréal - ils ont répondu à 149 questions réparties sur trois volets : les méthodes d'apprentissage de la conduite automobile, la propension à prendre des risques et des attitudes concernant la conduite, et le contexte familial et le style de vie. Un 2e questionnaire, envoyé par la poste, servait à obtenir des données sur la conduite sans supervision pendant la première année après l'obtention du permis. La SAAQ a fourni les dossiers de

conduite, et toutes les données ont été anonymisées et jumelées aux fins d'analyse. Toutes les variables ont été analysées par des recoupement dans des tableaux de contingence avec des tests du Chi-carré et les échelles psychométriques ont fait l'objet d' analyses factorielles. On a créé des modèles de régressions logistiques binaires afin d'étudier les variables-clés.

Les résultats importants de cette étude sont présentés dans deux articles. Le premier article démontre que les dossiers des participants sont directement liés aux marqueurs de risques à tous les niveaux du processus d'obtention du permis. Il y a deux politiques gouvernementales qui sont associées à une conduite plus à risques. La première est le raccourcissement du temps d'apprentissage pour ceux qui suivent un cours de conduite. Cette thèse reproduit les résultats d'évaluations effectuées dans trois autres provinces canadiennes : les adolescents qui obtiennent plus rapidement leur permis de conduire en présentant un certificat d'une école de conduite (EC) possèdent de pires dossiers de conduite. La deuxième politique gouvernementale qui représente un marqueur de risques provient des critères d'évaluation pour passer l'examen pratique. La thèse reprend des recherches antérieures indiquant que le fait de passer l'examen pratique à la première tentative n'implique pas nécessairement une conduite plus sécuritaire et peut être associée à une conduite à risques. Les commerces, tels que les compagnies d'assurance qui offrent des rabais pour les détenteurs de permis des EC ainsi que le manque de professionnalisme d'écoles de conduites qui vendent de manière frauduleuse des certificats d'EC constituent des marqueurs de risques. Les marqueurs de risques familiaux sont le consentement des parents à l'apprentissage de la conduite pour les jeunes de moins de 18 ans et d'utiliser un véhicule motorisé à deux roues, le manque de supervision parentale lors de la conduite, et l'implication de membres de la famille dans des collisions avec blessures. Grâce aux marqueurs individuels de risques, on a trouvé : d'une part, que les adolescents motivés à suivre des cours de conduite afin d'obtenir leur permis de conduire plus rapidement ou pour payer moins cher leur prime d'assurance ont de moins bons dossiers de conduite que les participants motivés à apprendre la conduite ou à être bien préparé pour l'examen de conduite pratique, et d'autre part, que les adolescents avec plus d'heures de pratique de conduite avec leur permis d'apprenti ont de pires dossiers de conduite.

Le deuxième article examine deux hypothèses ayant trait à l'auto-évaluation que les adolescents font de leur propre habileté de conduite et de leur sécurité. La première hypothèse attribue une plus grande prise de risques et un risque de collision à la surestimation de leur habileté de conduite. La seconde hypothèse affirme que les conducteurs ont une connaissance intime de leur propre sécurité même lorsqu'ils prennent des risques. Les données démontrent que même si les adolescents male les plus jeunes semblent surestimer leur habileté de conduite, la plupart des adolescents semblent avoir une

connaissance intime de leur propre sécurité routière. On associe de manière consistante, tel qu'anticipé, les différentes combinaisons des dossiers d'infractions et de collisions avec des sous-groupes définis par des combinaisons d'auto-évaluation. Ces sous-groupes sont également associés à des styles de vie distincte, un engagement académique, des perceptions et attitudes face aux risques ainsi que les expériences de conduite. Voici un nouveau résultat prometteur; les conducteurs adolescents masculins de tout âge qui ont le plus de confiance dans l'efficacité des habitudes préventive de conduite sont ceux qui ont tendance à avoir le moins d'accidents.

Nous concluons avec plusieurs recommandations visant à améliorer notre compréhension et à diminuer les conséquences dévastatrices de la propension à prendre des risques chez les adolescents. Il faudrait arrêter les politiques qui permettent aux adolescents d'obtenir plus rapidement leur permis de conduire jusqu'à ce que des méthodes efficaces soient mises en place pour accorder des permis à des adolescents plus prudents. Il faut valider par des recherches les habitudes de conduite préventive qui diminuent effectivement les risques de collisions et celles-ci doivent être ajoutées à l'éducation des apprenti-conducteurs et faire partie des critères d'évaluation de l'examen du permis de conduire. Il faut étudier de manière plus approfondie comment les auto-evaluations developent et comment ils se sont liés à la development physiologique, psychologique et sociale de l'adolescent. Il faut développer des méthodes de dépister et mieux éduquer les adolescents pour diminuer la prise de risque intentionnelle et non-intentionnelle. Quelques conclusions prometteuses de cette thèse demandent une attention particulière. Afin de comprendre comment les nouveaux conducteurs adolescents auto-évaluent leurs habiletés de conduite et le risque de collision, il faut faire des recherches plus approfondies et vérifier comment ces auto-évaluations sont associées aux tendances à prendre des risques, au style de vie et aux risques de collisions. Enfin, nous devons décider de la quantité et de la qualité de l'expérience de conduite nécessaire pour assurer une meilleure sécurité des jeunes nouveaux conducteurs quand ils conduisent sans supervision.

Mots-clefs : nouveaux conducteurs, éducation routière, taux de collisions, motivation, experience de conduite, accès graduel à la conduite, auto-évaluation, perception du risque, sous-populations, styles de vie, prise du risque

TABLE OF CONTENTS

LIST OF TABLES

Article 1

Article 2

LIST OF FIGURES

Chapter 1

Article 1

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LIST OF ABBREVIATIONS

APA	American Psychological Association
ADVS	Attitude towards driving violations scale
CBQ	Crash beliefs questionnaire
CRT	Centre for research on transportation
DALYs	Disability-adjusted life-years
DE	Driver education
DRQ-high	Driver risk-taking questionnaire – high risk scenarios
DRQ-normal	Driver risk-taking questionnaire – normal scenarios
DSM	Diagnostic and statistical manual
FRIV	Familiarity with road injury victims
GDL	Graduated driver licensing
GRQ	General risk-taking questionnaire
HPT	Hazard perception test
IBC	Insurance Bureau of Canada
IIHS	Insurance Institute of Highway Safety
INRETS	Institute national de recherche sur les transports et leur sécurité
MAO	Monoamine oxidase
MB	Mobility bias
MRI	Magnetic resonance imaging
NHTSA	National Highway Traffic Safety Administration
OECD	Organization of Economic Cooperation and Development
ONSER	Organisme national de sécurité en routière
RTI	Road traffic injury
SAAQ	Societé de l'assurance automobile du Québec
SMQ	Social motivation questionnaire
SS	Sensation seeking

CHAPTER 1

INTRODUCTION

Magnitude of adolescent driver involvement in injury crashes

Currently, in high-income countries, road traffic injuries (RTIs) are the leading cause of death and the third leading cause of burden of disease measured in lost disability-adjusted life years (DALYs) for persons aged 15-44 of both sexes (WHO, 1999). From the 1940s to the present, statistical analyses have consistently shown that adolescent drivers, 16- to 19-years old, are overrepresented in RTIs (Da Silva, 1942; Engstrom, Gregersen, Hernetkoski, Keskinen, & Nyberg, 2003; Goldstein, 1972; Mayhew & Simpson, 1990). Adolescent overrepresentation in RTIs exists internationally (Lonero et al., 1995) and it exists whether the crash rate is calculated per capita or on the basis of kilometers driven or number of licensed drivers (Ferguson, Leaf, Williams, & Preusser, 1996; Mayhew & Simpson, 1990). In 1995, 16- to 19-year old drivers in Québec were involved in 10% of the RTI crashes although they only represented 4% of all licensed drivers (Letendre, 1995). Adolescent driver overrepresentation can be expressed as a ratio of the percentage of RTI crashes (e.g. 10%) over the percentage of 16- to 19-year licensed drivers within the total population of licensed drivers (e.g. 4%). In 1995, the overrepresentation ratio in Québec was 2.5 to 1. Since 1995, the population of 16- to 19-year old drivers in Québec has decreased about 1% per year, and the overrepresentation ratio has increased slightly to 2.7 to 1 - between 1998 and 2003, 16- to 19-year old drivers were involved, on average, in 8.6% of the RTI crashes annually, and represented, on average, 3.2% of all licensed drivers (SAAQ, 2004). Williams and Shabanova (2003) analyzed crashes from 1996 to 2000 involving one or two vehicles only and found that in terms of responsibility for deaths per licensed driver, young drivers, especially males, had the highest rates and that the majority of deaths for which young drivers were responsible occurred to people other than themselves, especially passengers in their vehicles. Therefore, it is probable that many adolescent drivers are at increased risk of involving themselves and others in RTIs. These figures support the contention by Evans (1991) that adolescent driver overrepresentation in RTI crashes is so robust a phenomenon that it is "almost like a law of nature."

The nature of adolescent driver RTI prevention

The World Health Organization (WHO) declared that RTIs are predictable and preventable (WHO, 2003). Presently, this declaration appears to be more a prescriptive goal than the expression of a precise descriptive science for predicting and preventing all RTIs. Historically, RTI prevention efforts have pursued two distinct strategies. The first strategy, primary prevention, aims at by all injuries by preventing crashes from occurring. The second strategy, secondary prevention, focuses on preventing injury or reducing injury severity during a crash event. Primary prevention is largely dependent on driver behavior, e.g. correct and timely responses to ever-changing road and traffic conditions. Secondary

prevention requires engineering and passive restraints and a limited but critical set of driver behaviors, e.g. using the seatbelt. During a crash event, seat belts only protect those drivers and passengers who have used their seatbelts properly, and even then, the protection is not perfect (see discussion in Evans, 2002). During a crash, vehicle occupants, belted or not, and road users outside vehicles remain at risk of serious injury. Therefore, the main emphasis throughout this dissertation is on improving primary prevention of RTIs to all vehicle occupants and road users whenever adolescents are driving.

Reasons to take action

There are several reasons to exert efforts to reduce adolescent RTIs. The most obvious is the humanitarian motive proposed succinctly by Rose (1992) that "it is better to be healthy than ill or dead." A second reason is the economic argument that adolescents "have been expensive to rear and educate, and their death means a loss of many productive years" (Rose, 1992). Actuarial charts on lifetime earnings from 15- to 19-year-olds and the associated tax revenues would support the cost-benefit ratio of crash prevention efforts targeting adolescents (Robertson & Finnegan, 2003). A third reason for focusing primary prevention efforts on adolescent drivers is an argument, one that requires proper testing, about the potential long term benefits of effective driver training and license evaluations. The main premises of the argument are: (1) the majority of the population learns to drive and acquires licenses during adolescence; (2) driving, like all behaviors, becomes automatic or habitual; (3) driver behavior is a contributing factor in the majority of RTIs; (4) unsafe driving habits can persist for many years without negative consequences, and; (5) experience does not always improve safety, e.g. in Quebec, over 57% of RTI crashes involve drivers who have held their driving permits for over 11 years (SAAQ, 2004). Therefore, it is possible that the successful promotion of safer driving habits at the start of a driving career, with periodic "booster shot" reminders, may have long-term health benefits for the entire population.

A fourth reason for attempting to reduce the crash risk of adolescent novice drivers relates to the increasingly global nature of RTIs - in 1990, RTI was the 9th leading cause of DALYs worldwide and by the year 2020, RTI is expected to be the 3rd leading cause of DALYs worldwide (WHO, 1999). This projected increase in RTIs is expected to occur mainly in developing nations where motorization rates are increasing. In high-income nations, overall rates of RTI are expected to continue decreasing, although overrepresentation in RTIs by adolescent with full, unrestricted driver's permits appears to be holding constant. Overall decreases in RTIs in high income countries are associated with factors such as: demographic shifts, i.e. fewer adolescent drivers; more crashworthy vehicles, safer social norms regarding

seat belts and stricter alcohol laws, and; lower risk to pedestrians due to increased dependence on motor vehicles for transportation, e.g. relative to 10 years ago, today children rarely walk to school and are thus less exposed to traffic (McCarthy, 2003). However, in developing nations where RTIs are expected to increase dramatically, it is likely that the average motor vehicle will be relatively less expensive and possibly less crashworthy, and, due to the more varied traffic mix in these nations, e.g. motorcycles, bicycles, animal drawn vehicles, pedestrians, all sharing the same roadway, the role of driver behavior in preventing RTIs to unprotected road users will likely assume greater importance. Therefore, expertise in improving adolescent novice drivers' abilities to prevent crashes in high-income nations potentially could be transferred to developing nations to help reduce RTIs among their novice drivers.

Reasons for adolescent overrepresentation in RTIs

Gregersen (2003) notes that we still lack a "comprehensive understanding as to why adolescent drivers are overrepresented in road accidents" and that although many of the contributory reasons are known, many problems remain unsolved. "Comprehensive understanding" may be taken to denote knowledge of all or most of the causes of and the appropriate interventions against adolescent driver overrepresentation in RTIs. For the moment, risk taking is defined as behavior that increases the probability that an RTI will occur. Three factors contribute to adolescent driver risk taking: biopsychosocial immaturity, sex , and driver inexperience (Ferguson, 2003; Mayhew & Simpson, 1990). The association between sex and adolescent crash risk is well known, with males, compared to females, typically being involved in RTIs more frequently and with greater severity (Laberge-Nadeau, Maag, & Bourbeau, 1992). Therefore, most of the data analysis in this thesis was conducted separately for each sex. Explanations for the sex difference in RTIs include the contributing influences of testosterone (Evans, 1991), differences in driving exposure, and cultural determination (Farrow & Brissing, 1990), i.e. males more than females utilize mastery of the automobile as a measure of the transition between childhood and adulthood. Because the sex difference in RTI rates tends to decrease when exposure is accounted for, there is reason to believe that biological and cultural influences, while present, may be exaggerated as explanations for risk taking. The question becomes how well do the other two factors, age-related immaturity and driver inexperience, explain adolescent driver risk-taking behavior? Each of these potential explanations for adolescent driver risk taking is evaluated in relation to on an extensive literature review.

Age-related factors and adolescent driver risk taking

In the context of road safety research, "age" may have one or more of the following meanings:

1) Chronological age as a study variable;
2) Legal licensing age;
3) Age as a surrogate for "maturity", and;
4) Licensing age as a marker of differential crash risk.

1) Chronological age: The first and most obvious significance of age is its role, along with gender, as one of only two easily accessible study variables. This is problematic for several reasons. One, it has produced an abundance of correlation studies of age and crash data that demonstrate but do not explain the high frequency of crashes among adolescent drivers. Peck (1985) observed that demonstrating that age is associated with crash risk does not support any inference that "age is a good predictor of an individual's accident propensity." Two, the usual age groupings, 16 to 19 and 20 to 24, used in data presentations "may be obscuring important differences between individual age groups" (Pelz 1968 in Goldstein, 1972). Harrington (1970 in Goldstein, 1972) observed that the "need to study the records and behaviors of youthful drivers within 1-yr. groupings seems highly evident." Three, as a result of the focus on chronological age, less accessible variables with potentially more influence on RTI occurrence have received less attention (Evans, 1987). For example, parental models of driving behavior appear to influence adolescent driver risk taking behavior (Bianchi & Summala, 2004) and socioeconomic factors appear to influence the types of crashes in which adolescents are involved (Hasselberg & Laflamme, 2001) - these other influences have received far less research attention than they probably deserve.

2) Legal Driving Age: The legal driving age around the world ranges from 15- to 19-years of age. Authoritative guidelines for determining the optimal licensing age for novice drivers do not exist (Mayhew, Fields, & Simpson, 2000). Summala (1987) examined the adolescent influences of sensation seeking, extra-motives, and the general lack of responsibility for one's own life and concluded that delaying licensing until age 20 might be the only way to achieve real reductions in RTIs. Cooper, Pinili, and Chen (1995) concluded "postponing licensure for 16- or 17-year-olds for anything less than four years will not make them better first year drivers." Saarinen (1984 in Summula, 1987) suggested that increasing the driving age to 36 might be the only guarantee against reckless driving.

3) Age as a surrogate for "maturity": Ferdun, Peck, and Coppin, (1965) noted that advocates of raising the driving age to 18 assumed that the average 16-year old is not sufficiently mature to drive an automobile. A report on adolescent driver crashes observed that "the maturing process of the adolescent is, generally speaking, far from complete at the age of 18 years" (Organization for Economic Co-operation and Development, 1975). These observations accumulate more support as researchers learn more about human development. Park (2004) reports that neurologists using MRI technology have determined that during adolescence the prefrontal cortex of the brain may not be sufficiently developed to function reliably – that is, to set priorities, organize thoughts, suppress impulses, and weigh the consequences of one's actions – and quotes Dr. Jay Giedd's estimate that the brain is not truly mature until age 25. Steinberg (2003) recommends researching the neurobiological and neurophysiological underpinnings of phenomena associated with increased risk taking during adolescence such as susceptibility to peer pressure, inhibitory control, and future orientation. Zuckerman (1994) believes that sensation seeking is a genetically determined need, regulated by the monoamine oxidase (MAO) enzyme, to experience varied, novel, and complex sensations and to take physical and social risks that reaches its peak between the ages of 16 and 19, and then diminishes. Lerman, Patterson, and Shields (2003) report that several converging lines of evidence suggest that high sensation seekers have a greater risk of substance abuse. Steinberg (2004) believes that self-regulatory competence does not fully develop until early adulthood and that the biologically driven and normative disjunction between sensation seeking and underdeveloped self-regulatory competence is "unlikely to be remedied through educational interventions designed to change adolescents' perception, appraisal, or understanding of risk."

4) Licensing age as a marker of differential crash risk: Waller, Elliot, Shope, Raghunathan, and Little (2001) propose that in this society, adolescents who do not license as soon as they become 16 and who wait one, two, or three years may be different on other important dimensions than age, e.g. socioeconomic status (SES), cultural norms, or individual abilities. Williams (1994) also suggested that the 16-year olds who license, compared to those individuals who wait until they are older, may be more aggressive or have more motivation or opportunity to drive. In a study of the abilities of professional driving teachers to detect high-risk young drivers, 16-year old driving students were generally rated by their teachers as more competent than driving students who were one or two years older (Hirsch, 1997). This data can be interpreted as evidence of a self-selection bias. If the adolescents who self-select to license at the youngest ages have more competence or aggression or opportunity to drive, then the association between younger ages and higher crash risk may be, in part, a statistical artifact of the tendency for a subgroup of adolescent drivers with above average risk-taking tendencies or exposure to have greater proportional representation among the youngest driver's permit holders.

Experience-related factors and adolescent driver risk taking

The second variable that is traditionally associated with increased crash risk and risk taking among adolescent drivers is lack of driving experience. The experience variable is problematic for several reasons:

1) Experience is difficult to measure and compare;
2) Experience is difficult to disentangle from other variables;
3) Experience does not necessarily increase safety, and;
4) The quantity and quality of driving experience needed to increase safety is unknown.

1) *Driving experience is difficult to measure and compare*: Experience is usually measured by years of licensure or kilometers driven. Years of licensure is a reliable variable available from government records and useful when studying large populations, but it is also potentially misleading because comparing years of licensure with crash records implies an accumulation of an identical quantity and quality of exposure to risky driving situations (Assailly, 1997). Indeed, higher rates of kilometers may actually imply more driving in environments of lower risk per kilometer traveled, e.g. expressways, which can give misleading results when compared with lower rates of kilometers accumulated in denser urban areas with greater exposure to traffic conflicts. Also, when comparing years of licensure or kilometers driven, researchers are rarely able to control for other variables that potentially influence crash risk, such as self-selected exposure (Brown, 1982), the presence of passengers, motivations for driving, and especially among the novice drivers, traffic-related experience (with or without an appropriate permit) with non-motorized or motorized vehicles.

2) Driving experience is difficult to disentangle from other variables: Mayhew and Simpson (1995) conducted an exhaustive literature review on studies of experience-related factors and crash risk and found a "paucity of scientific evidence that has relevance to the issue of driver experience [most of which] suffers from serious methodological and interpretive limitations" - one of the most important limitations is the failure "to control for the possible confounding effects of factors associated with experience and those associated with age." The finding that crash rates decrease with increased experience can be accounted for by a variety of factors related to increases in age, e.g. increased responsibility in work and family life, and accompanying lifestyle changes, safer patterns of driving exposure etc...

3) Driving experience does not necessarily increase adolescent driver safety: The safety benefit of experience derives from accurate and timely feedback that strengthens the associations between a driver's actions and their consequences. There are two sources of feedback. One is the driving environment,

including vehicle and road characteristics and the actions of other road users. At all times while driving, feedback is provided by the traffic environment. Kuiken (1995) remarked that the driving environment is not a reliable source of clear corrective feedback for driver errors. The other source of feedback is the specific commentary of vehicle passengers. Prior to licensing, while novice drivers are in the official learning period, feedback is often provided by adult passengers acting in their roles as instructors or supervisors. There is no guarantee that these adult passengers are providing novice drivers with correct feedback. Also, due to the potential influence of learning motivations, expectations, and individual traits there is no guarantee that these the novice drivers are interpreting feedback correctly or that they can or will follow the proper advice without supervision.. As a result of these uncertainties, there is no theoretical or empirical reason to suggest that all adolescent drivers will necessarily become safer with experience. Waller et al. (2001) studied the violations and crashes of 13,809 young adult drivers for an average of seven years after their original license date and concluded that "there is only modest evidence of young driver learning from specific incidents." Fuller (1988) observes that deliberate risk taking is reinforced every time it is repeated without an undesirable consequence. Summala (1987) remarked that even the expert driver can be lulled into a false sense of security by the combined effects of the rare nature of car crashes, automated driving patterns, and a feeling of control. Duncan (1990) found that experienced drivers maintained shorter following distances, a habit correlated with higher crash rates.

The above observations raise several questions about the effectiveness of experience alone in reducing risk taking among novice adolescent drivers. What is the optimal quantity and quality of experience needed to develop safe driving behaviors that will be maintained after licensing? How effective is feedback during the official learning period, when many students are focused on passing the government permit exam? Sagberg and Gregersen (unpublished manuscript) have suggested that feedback might potentially be more efficient, if perhaps a little more risky to acquire, after a full unrestricted license has been granted. How do individual differences in learning abilities and motivations for driving interact with experience? Is it realistic to believe that all adolescents can become safe and skillful after the same minimum number of hours? Will there be different minimums for different types of learners? How can we identify which adolescents need more hours than others? In fact, we do not yet know the optimal number of hours of driving practice that is necessary for any adolescent driver to achieve safe and consistent driving behaviors (Williams & Ferguson, 2004).

4) Adolescent driver safety and quantity and quality of driving experience: Summala (1987) suggested that 50,000 kilometers of driving was necessary before an adolescent could outgrow the influence of

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4) Adolescent driver safety and quantity and quality of driving experience: Summala (1987) suggested that 50,000 kilometers of driving was necessary before an adolescent could outgrow the influence of

"extra motives" and begin to drive "as rationally as older drivers." Michiels and Schneider (1984) found that crash frequency, driving infractions, and risk behavior diminished after four to five years. According to l'organisme national de sécurité routière (ONSER) (1974) (now called INRETS in France, l'Institut national de recherche en transport et leur sécurité), 3,000 kilometers of driving is necessary before a novice begins to benefit from the experience. The Select Committee on Highway Safety (1977 in Wilde, 1994) noted that in their first year of driving, male drivers who obtained their license when they were 30 or older had the same crash rate per 1,000 drivers as the average of all male drivers in the population - by contrast, males who had acquired their licenses when they were 16 incurred crashes during their fourth year of driving at a rate 40% higher than all male drivers in the population. The safety enhancing value of driving experience does not appear to be effective for some drivers, males in particular, until after adolescence.

Adolescent driver risk taking

In the preceding sections, findings were presented that indicate that the precise contributions of age- and experience-related factors to adolescent driver risk taking are not clear. Assuming that risk-taking behavior plays a dominant role in adolescent driver crash risk, developing a clearer understanding of the sources of risk taking behavior should be a research priority. Lam (2003) observed, "Risky driving behaviors, including speeding and risk-taking, have shown to be a risk factor of crash injury disregarding ages and skills of drivers." Turner, McClure, and Pirozzo (2004) systematically reviewed the safety literature and found that risk-taking behavior, however it is measured, is associated with an increased chance of sustaining an injury. Jonah (1986) concludes that risky driving habits may be a more significant cause of traffic crashes than lack of driving experience or exposure. Evans (1993) advocated "substantially greater focus on the ways and means to reduce harm from traffic crashes by more frontally and vigorously addressing driver risk-taking in traffic." The question remains, what exactly is driver risk taking?

A review of the research literature did not produce a single consensually accepted definition of driver risk taking. Some argue that because no human behavior can guarantee total certainty of outcome, all behavior may be viewed as risk taking (Simonet & Wilde, 1997; Trimpop, 1994). Evans (1993) attests that "it is essentially impossible to conjure up any crash scenario in which the crash could not have been avoided if the drivers had behaved differently." Because licensing and driving are self-selected activities, individuals appear to control their own level of crash risk by choosing when and how they drive. These logical arguments are supported by empirical findings from detailed crash investigations that confirm driver behavior as the sole or contributory factor in about 80% of traffic crashes according to some

estimates (Sabey & Taylor, 1979; Streff, 1991) and between 94% and 99% according to others (Rumar 1985 in Evans, 1985).

Scientific rigor demands close scrutiny of the above definitions of driver risk taking and the empirical basis for conclusions about the dominant role of driver behavior in motor vehicle crashes. First, the definition of driver risk taking as any and all driver behavior is unacceptable because it violates a basic rule of definition by being too broad (Conway & Munson, 1997); if all driver behavior is risk taking then driving and risk taking become synonymous. In any case, not all behaviors would carry equal risk, so some gradation or typology should still be possible. Second, all the empirical studies mentioned above were retrospective in design and did not have control groups. Therefore, it is impossible to conclude with certainty that a specified driver error, e.g. driving too fast for conditions, was the sole or contributory factor in a crash event. Only seconds before the crash event in question, other drivers might have traveled at equal or greater speeds over the same section of road without incident. Despite the lack of a precise operational definition to risk taking, it is difficult to imagine that driver behavior does not play a contributory role in crashes or crash prevention. Therefore, following the suggestion by McKenna (1983), four psychological processes that describe the driver's contribution to crash events, what can be called the sources of risk-taking behavior, are outlined below.

Four sources of driver risk taking

Researchers have identified four distinct sources of driver risk-taking. The first two are identified by Evans (1993) and Simpson (1995) as miscalculation of risks and intentional risk taking for its own sake. Evans (1993) adds a third source for intentional self-destructive acts or suicide. A fourth source of risk-taking behavior is unintentional in the sense that the behavior or its significance is momentarily outside the driver's direct awareness or control. For discussion purposes only, each source is examined separately.

The claim that a crash results from a driver's miscalculation of risk assumes that the driver is competent, that is, that the driver possesses the necessary knowledge and ability to avoid traffic crashes. This claim is problematic because, at present, methods for evaluating a driver's crash avoidance ability are poorly developed. Explanations for inter- and intra-individual differences in abilities to cope with the driving task are provided by theories such as information processing, behavior feedback, and decision-making that accounts for both (Comsis Corporation, 1995). The results of studies that compare crash risk to measures from instruments based on these theories are mixed. Higher crash risk is associated with

information processing deficits such as slower hazard detection (Rumar, 1990), slower reaction times (Fergensen, 1971), and poor selective attention (Arthur & Doverspike, 1992). Cognitive ability, as reflected by higher academic achievement, correlates with lower crash risk (Harrington, 1972; Murray, 1998). Driving competence, as measured by performance on a practical road exam, appears to interact with sex in relation to crash risk - increased competence is associated with increased crash risk for males and decreased crash risk for females (Laberge-Nadeau et al., 1999). Poor decision-making skills correlate with higher rates of specific types of crash involvement for female drivers only (French, West, Elander, & Wilding, 1993). Competence, as measured by advanced driving skills, appears to interact with drivers' age in relation to crash risk. New drivers below the age of 21 years with skid training had more crashes on icy roads than age group matched drivers without the training – drivers 21 years and older with skid training had fewer crashes on icy roads than age group matched drivers without the training (Katila, Keskinen & Hatakka, 1996). Overall, these findings indicate that driving skills are associated with crash risk but that the direction of the association is influenced by interactions with driver age or sex or both; these interactions may reflect differences in motivation, quantity and quality of driving exposure, and intention to take risks.

The second source of risk taking is driver intention. Attempts to explain intentional risk taking are found in such theories as reasoned action (Fishbein & Azjen, 1975), risk homeostasis (Wilde, 1982), planned behavior (Ajzen, 1991), and problem behavior (Jessor, 1987). These theories share the assumption that drivers' intentions and beliefs, as determined by a complex interaction of different factors, can predict drivers' behavior. Weak to moderate empirical support for the claim that crashes result from intentional risk taking is provided by prospective research questionnaires that measure drivers' intentions and beliefs and that have predicted crashes, sometimes several years in advance (Maycock, 1995; Rutter & Quine, 1996; West, Elander, & French, 1993; West & Hall, 1997). In all these studies, the drivers' intentional risk taking was most often related to their disregard for legal driving rules, i.e. speed limits. Therefore, it is critical to question exactly what these adolescent drivers are intentionally risking. Are they intentionally risking legal sanctions or injury or both? This distinction is important because it might signal a lack of comprehension on the part of adolescents about the relationship between driving behaviors and driving outcomes.

In the third source of risk taking, suicidal intent, the drivers' comprehension of the relationship between specific driver behaviors and their expected driving outcomes is assumed to be unambiguous. Evans (2002) cites several studies that estimate suicide may account for as much as 5% of driver

fatalities. Theories that might explain driver risk taking with suicidal intent are beyond the scope of this dissertation.

The fourth source is unintentional risk taking - risk-taking behavior that is outside the driver's direct awareness or intentional control. Unintentional risk taking is explained within various theories. Ajzen (1991) expanded his original theory of reasoned action by adding the concept of perceived behavioral control to allow for the possibility that individual beliefs about behavior are influenced not only by direct experience but also by subjective and social norms, i.e. the experiences of acquaintances and friends, and by other factors that increase or reduce the perceived difficulty of performing the behavior in question. It is possible, therefore, that even if an adolescent driver is taught a certain safety rule at driving school, e.g. to maintain a 2- to 3-second gap when following other vehicles on expressways, he may not actually practice this behavior if influential adults and peers in his immediate social group demonstrate through their own behavior that the safety rule is unnecessary and impractical. The influence of family and community norms may be one of the mechanisms that potentially explains the finding from the postal questionnaire survey of over 10,000 drivers conducted by Peck and Kuan (1983) that the territory where the driver lives, defined by the ZIP code, is weakly predictive of crash involvement.

Other forms of unintentional risk taking are explained by person-centered traits. Elander, West, and French (1993) consider that some drivers more than others are prone to errors or lapses in their cognitive functioning. Cognitive psychology proposes that well-practiced behaviors, like driving, become habitual or automatic (Ranney, 1994). Therefore, given the random nature of crash events and the uncertainty of safe behaviors, it is possible that some drivers develop risky driving habits unintentionally. During adolescence in particular, one or more traits, e.g. impulsiveness, sensation seeking, emotional instability, may interact with lifestyle influences. The tendency to violate traffic laws related to sensations (i.e. speed and alcohol) may result directly from certain traits over which some adolescents may have not yet developed sufficient self-awareness or self-control. Some researchers claim that, compared with adults, many adolescents who are experiencing personal problems or who are sensation-seekers or both are not necessarily capable of understanding and directing their own risk-taking behavior (Irwin & Millstein, 1986; Jessor, 1987; McKnight, 1999).

To summarize, the sources of risk-taking behavior are diverse. Understanding how these sources contribute to adolescent driver risk taking is complicated by at least five factors. One, the potential loss or losses from a particular risk-taking behavior, e.g. speeding, may not be understood clearly or equally by

all adolescents. Two, at any given moment or during successive moments, two or more different sources of risk taking may influence driver behavior, e.g. alcohol impaired judgment and sensation seeking. Three, risk-taking tendencies can serve positive developmental needs, and perhaps cannot or should not be completely controlled. Tulloch and Lupton (2003) point out that "risk-taking ... is far more complex than is suggested in most writings on risk" - for some individuals, risk is associated with "uncertainty, insecurity and loss of control over the future", and for others, risk is "adventure, excitement, elation, and the opportunity to engage in self-actualization and self-improvement." Four, society presents adolescents with mixed signals about risk-taking behavior. Consider that speed, the pathogen of RTI, is labeled as risk taking. Yet speeding is: (1) widely practiced by adults; (2) tolerated by authorities, e.g. limited use of photo radar; (3) supported by industry through the legal sales of motor vehicles easily capable of doubling the legal speed limit and through the advertised sale of speed radar detectors to help consumers violate the law and keep their driving privileges; (4) glamorized by the media, and; (5) admired by peers. Therefore, adolescent novice drivers have several convincing reasons for believing that speeding is acceptable and relatively safe with only a slight risk of being penalized. Finally, adolescent driver risk-taking behaviors cannot manifest themselves without opportunity, i.e. access to a driver' permit and a motor vehicle. The opportunity to drive is controlled and even encouraged by adults, e.g. "among the affluent, a car has become a popular sixteenth birthday present" (Winslade, 1998). These complications in risk-taking research are exemplified in the following analytic description of a typical adolescent driver crash.

Analysis of risk taking in an adolescent driver crash

After midnight on a weekend, John, a 17-year old male with a full, unrestricted driver's permit gets into his 1992 Ford Mustang, a graduation gift from his grandmother, and begins to drive himself and two peer-aged passengers home. Only John attaches his seat belt. Urged on by one passenger, John accelerates to 160 kilometers per hour on a long, straight section of the road. Several times before, John has attained this speed on this section of road because of its configuration and lack of police presence. Distracted by a remark from one passenger, John does not slow down sufficiently before entering the next curve in the road - he loses control of his vehicle and drives off the road into a tree at the speed of 90 kilometers per hour. John and the passenger in the back seat sustain serious injury and the front seat passenger dies en route to hospital. The scientific question, not to be confused with legal or moral questions, is: who is the risk taker in this crash scenario?

Is John the risk taker? Did he simply miscalculate the time needed to slow down before the curve? Was he intentionally risking only a legal sanction, aware of the low probability of police

enforcement? Was he intentionally risking injury to himself and his passengers, fully aware that the consequences of crashing his vehicle into a tree at 90 kilometers per hour are roughly equivalent to the consequences of hitting the ground after falling from the roof of a twelve-story building? Was he worried that driving at the legal speed entailed the risk of a loss of self-esteem or status among his passengers for failure to meet the challenge of high speed driving? Was John under the influence of strong emotions, positive or negative, due to some recent event, e.g. an athletic success or a romantic disappointment? Was John self-aware and in control of his behavior or was he reacting impulsively, under the influence of biologically based sensation seeking, or alcohol, or recreational drugs, or fatigue, or some combination of the above factors?

Were the passengers risk takers for requesting or accepting a ride in John's vehicle, for not using their seat belts, and for inciting John to drive faster? Was John's grandmother a risk taker for buying him a Ford Mustang? Were John's parents risk takers for allowing him to drive a Ford Mustang? Were John's parents risk takers for sending John to a short driver education (DE) program, even after decades of research have been unable show that traditional DE has any safety benefit for adolescents? Were John's parents risk takers for accepting that the brief government driver's permit road evaluation was an adequate assessment of their son's driving competence? Were John's parents risk takers for not supervising their son's driving over many weeks and months before allowing him unrestricted access to his Ford Mustang? Were the parents of the passengers risk takers for not arranging transportation for their children? Were the adult hosts of the social event risk takers for not carefully monitoring the availability of alcohol and drugs and the after-party transportation of their guests?

Was John's driving school instructor a risk taker when he gave John a passing grade, even though he felt strongly that John's judgments regarding speed choice were often inappropriate? Research indicates that driving instructors could be accurate judges of their students' risk-taking tendencies (Hirsch, 1997) and may even be able to predict their future crashes (West & Hall, 1997). Was the insurance company a risk taker when it insured John to drive his Mustang? Automobile insurance is the largest single class of property and casualty insurance in Canada – total premiums for automobiles exceed those for all other classes combined (Insurance Bureau of Canada, 1994). John paid a high premium due to the insurance company's well-developed actuarial knowledge of their own high risk of financial loss when adolescent male clients drive sports cars. Were the Ford Company, their designers, engineers, marketing department and salesmen risk takers? Ford Mustang vehicles registered between 1990 and 1994 in the US were involved in nearly 2.5 times the average number of fatal crashes for all vehicles registered in the US during this period and over 10 times the number of fatal crashes as the Volkswagen

Passat (Status Reports, 1995). During this period, according to anecdotal evidence, crash-involved Mustangs were towed back to dealership garages so frequently that some Ford salesmen began to refer to Mustangs as "organ donors."

Was the government a risk taker by not installing guardrails at the curve? Were the policymakers and administrators of driver permits risk takers for granting a full, unrestricted permit to a 17-year old novice adolescent male after conducting only one cursory evaluation of minimal driving skills? Were policymakers risk takers for not increasing the driving age, enforcing speed laws, zero alcohol tolerance, night curfews, passenger restrictions, or power-to-weight ratio restrictions on vehicles for novice adolescent drivers?

A strong argument can be made that the crash scenario described above is the culmination of many acts of commission and omission by many individuals, both close to and far removed from the actual crash event. All the behaviors of each of these individuals were normal, that is, within the norms of either adult or adolescent society. Therefore, a comprehensive understanding of why adolescent drivers are overrepresented in road accidents should attempt to account for the contributions of normal adolescent risk-taking tendencies and the normal risk-taking actions of every adult who enables adolescents to have the opportunity to legally drive and insure motor vehicles. The model presented below facilitates the observation and analysis of all these contributing factors.

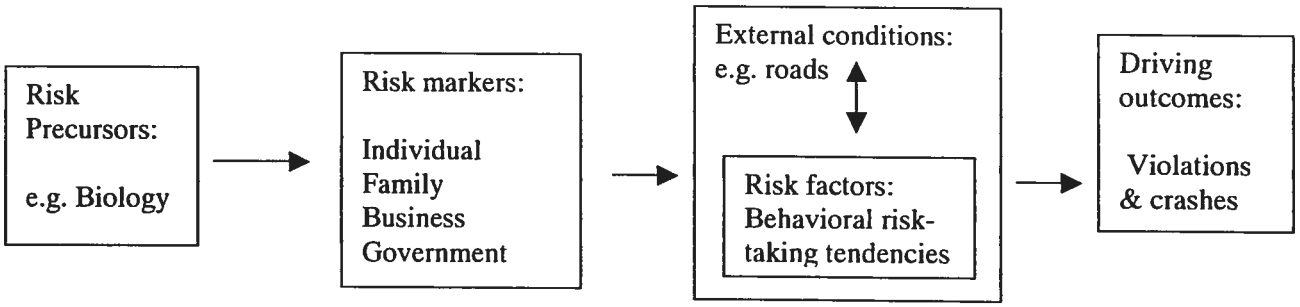
A rational model of crash risk categories

Grundy (1973) proposed three risk categories for the analysis of individual health risks: 1) precursors; 2) risk markers, and; 3) risk factors. In Figure 1, these categories are adapted to the study of adolescent crash risk and the scope of risk markers is expanded to include family, business, and government policy. Crash risk precursors are detectable biological and physiological characteristics, such as perceptual and cognitive abilities, which directly influence an individual's risk of crash involvement. Risk markers are those relatively stable characteristics of individuals, family, business, and government which have been most frequently associated with the presence of risk factors for negative health outcomes. Individual risk markers include sex, age, socio-economic status, personality, beliefs and values, lifestyles, academic records, and driving records. Family risk markers include parental driving records, support for adolescent licensing, and quantity and quality of involvement in driver training. Business risk markers include driving school evaluation practices and insurance company policies. Government risk

markers include laws like licensing age and government permit test standards. Precursors and risk markers are either uncontrollable or can be controlled with varying degrees of difficulty.

Risk factors are the behaviors, intentional or unintentional, by any person(s) that increases the probability of exposure to harmful quantities of kinetic energy from motor vehicles to any person(s), at any moment, anywhere on or near the road system. In reference to the example of the injuries and death that resulted from the adolescent driver crashing his Ford Mustang into a tree, every individual associated with that crash event, from the government policymakers and road exam evaluators who granted his driver's license to the parents who gave him the car, shares in the construction of that crash event. Therefore, every individual's behavior was risk taking. The effect of risk-taking behaviors on the probability and severity of an injury crash is proportional to the intensity and duration of exposure to the interaction between speed and external conditions such as road configuration, traction conditions, visibility, and traffic. Specific risk-taking behaviors that are repeated frequently are called risk-taking tendencies. One example of a risk-taking tendency is the habit of driving at speeds that exceed the limits of available traction or the safety margins between vehicles and other road users or the crashworthiness of the vehicle. Another example of a risk-taking tendency is any government policy that enables or tolerates driver risk taking.

Figure 1.
Rational Model of Crash Risk Categories Adapted for the Study of Adolescent Crash Risk from Grundy (1973)



Three assumptions underlie the rational model of risk categories. One, a single traffic crash is a multifactorial event that cannot be predicted with certainty by any precursor, risk marker or risk factor, alone or in combination. An adolescent, male driver who drinks and drives often does arrive home safely despite the precursor of alcohol-impairment, the risk markers of age, sex, and inexperience, and the risk factor of excessive speed. Farrow (1987) reports that adolescent drivers are commonly involved in dangerous drinking-driving situations without significant consequences. This basic appreciation of

driving reality justifies the description of the highway system as a "forgiving" environment (Shinar, 1993).

Two, no external conditions, i.e. icy roads, reduced visibility at night, risky actions of other drivers, alone or in combination, can predict a single traffic crash with absolute certainty. Janssen (1990) assumes that crash risk is under each driver's voluntary control. Brown (1982) declares that a crash can occur only when the driver's capabilities, including his or her judgment regarding vehicle performance, fail to meet the current demands of the traffic system. These statements directly support the potential validity of the WHO definition of an RTI as a predictable and preventable event, which implies that the individual driver controls at least some of the risk in any injury crash.

Three, risk categories have temporal and interactive dimensions. Precursors, risk markers and risk factors can be either temporary states or relatively stable traits. Perceptual problems, for example, can be related to the temporary effects of fatigue or to a relatively stable innate characteristic like a sleeping disorder, e.g. apnea. Aggressive behavior can be related to the combined effects of gender and age-related hormonal precursors interacting with emotions and temporary alcohol effects facilitated by the risk markers of membership in a delinquent sub-population. Risk factors range from relatively stable behaviors like habitually failing to make complete stops at stop signs, to temporary ones like running red lights unintentionally under the influence of stress or fatigue or intentionally when driving a sick child to the hospital.

The fact that the prediction of single crashes is not possible, even with knowledge of all the risk categories, i.e. precursors, markers and factors, and knowledge of the external conditions, is normal and inescapable. However, the unpredictability of a single crash event need not limit prevention efforts – the calculation of the relative risk of crash events based on knowledge of the risk categories is possible. Of all the risk categories, risk markers have the virtue of being both relatively stable and accessible. BY combining knowledge about various risk markers, the relative risk of RTI for different subgroups of individual adolescent drivers can be calculated. For example, by combining only four risk markers, sex, age, duration of learner's permit, and performance on the learner's permit theory exam, Hirsch and Maag (2001) calculated a relative risk of 1.9 for RTI crash involvement during the first year of unsupervised driving for a subgroup of adolescent novice drivers, (17-year old males who failed their theory exam on the first attempt and licensed in the shortest time delay), compared to the entire population of novice drivers. In theory, the RTI risk of this and other subgroups of adolescent drivers can be reduced with a better understanding of how combinations of risk markers are associated with crash events, presumably

mediated by the risk-taking tendencies of individual drivers. However, much research is needed to understand how markers are associated with risk factors and risk-taking tendencies.

The goal and objectives of the dissertation

The overall goal of the dissertation is to develop new concepts and to uncover new findings to aid in the development of interventions to prevent RTIs to all vehicle occupants and road users whenever adolescents are driving. The several objectives around this goal are to:

(1) identify risk markers at each of four levels, individual, family, business, and government, and to measure their associations with driving outcomes, i.e. violations and crashes, during the first 450 days of unsupervised driving;
(2) explore risk markers related to self-ratings of driving abilities and crash risks, in relation to driving outcomes, i.e. violations and crashes, during the first 450 days of unsupervised driving;
(3) explore beliefs about crash events, e.g. perceived threat and efficacy of preventive behavior, in relation to driving outcomes, i.e. violations and crashes, and;
(4) develop new conceptual models for organizing risk markers and measuring their influence upon driving outcomes, i.e. violations and crashes.

Organization of the thesis

After the preceding review of the literature on the problem of adolescent driver risk and crashes, the remainder of the thesis is organized as follows. Chapter two discusses the cultural and scientific context of the adolescent RTI problem and the potential existence of a mobility bias in policy making for adolescent drivers. It also reviews three novice driver crash risk countermeasures in light of the mobility bias: (1) DE; (2) driver's permit exams, and; (3) graduated driver licensing (GDL) programs.

The two following articles are based on an extensive analysis of the data that is represented in the final research report entitled, *Étude comparative des nouveaux conducteurs selon qu'ils ont suivi ou pas un cours de conduite et ce, en accordant un attention particulière à la propension à prendre des risques*, (Appendix 10). The final report contains all the analyses of each of the three data sources that comprise the data set: the first questionnaire, the follow-up questionnaire, and the SAAQ files containing details of performance on the permit exams, demerit point violations, and police-reported crashes. The method of data collection and analysis is explained thoroughly in each of the following articles.

The first article, *The Role of Driver Education in the Licensing Process in Quebec*, defines the licensing process and examines risk markers within that process and their relationship with driving records. This article corresponds to objective 1 and objective 4 of the thesis and is the subject of Chapter three. The second article, *Self-rated driving abilities, risk-taking attitudes, and first year driving records of adolescents,* examines the risk markers of adolescent self-ratings of their own driving abilities in relation to their risk-taking tendencies and driving records. This article corresponds to objective 2 and objective 3 of the thesis and is the subject of Chapter four.

There are several documents in appendices. Appendix 1 contains a copy of the article, *Driver education and adolescent risk taking: Evidence of a mobility bias in public policy making*, of which I am the sole author, published in the Journal of Safety Research in 2003. Appendices 2 through 5 contain the French and English versions of the first questionnaire, explanation letters, and consent forms. Appendices 6 through 9 contain the French and English versions of the follow-up questionnaire and explanation letters. Appendix 10 is the final report, containing the analysis of the data set for this study, entitled, *Étude comparative des nouveaux conducteurs selon qu'ils ont suivi ou pas un cours de conduite et ce, en accordant un attention particulière à la propension à prendre des risques*. Appendix 11 contains a review of literature on the relationship between driver's permit exam performance and crash rates entitled, *Le lien entre la performance aux examens (théorique et pratique) pour l'obtention d'un permis de conduire et le taux d'implication dans les accident. Annexe au rapport final. Recension des écrits,* published at the Laboratoire sur la sécurité des transports du centre de recherché sur les transports, Université de Montréal, (July, 1999), of which I am the first author.

Originality and contribution to health promotion in public health

This thesis makes several original contributions to health promotion solutions to the adolescent crash risk problem. One, it created an original and extensive data set on a cohort of 1,804 novice adolescent drivers that links anonymized data from two sources to individual participants. The first source is a detailed three-part questionnaire covering methods for learning how to drive, including experience and confidence levels before the learner's permit with traffic- and driving-related, psychometric measures of risk taking, and lifestyles including family background and academic performance. The second source is government records of permit exam performance, number of attempts for each of the three sections of the theory exam, and the road exam, and complete records of demerit points and police-reported crashes ending after the first 450 days of unsupervised driving with a probationary permit. The data base covers a span of two to three years in the lives of the participants in the study cohort and allows for the analysis of

violation and crash rates, while controlling for exposure, in relation to a wide range of diverse variables related to adolescent driver safety.

Another original aspect of this work relates to methodology. A test called the Crash Beliefs Questionnaire (CBQ) was created for inclusion in the psychometric risk-taking section of the questionnaire. The results of the CBQ are novel and potentially open a new direction in adolescent crash risk research. Another methodological contribution of this thesis is a novel application of the technique of combining answers and creating paired subgroups from different self-ratings of driving abilities. This method avoids statistically manipulating the data and allows for the emergence of incongruities in self-ratings that appear to be a normal part of adolescent development. To the best of my knowledge, this approach to studying self-rated driving abilities has never been reported in the literature. The self-rating subgroups identified with this approach are associated with specific lifestyle patterns and driving outcomes.

Finally, this thesis adds new concepts and models to the public health approach to reducing adolescent crash risk. First, this thesis proposes the Rational Model of Crash Risk Categories in which risk taking is operationally defined as any behavior(s) by any individual(s), adolescents and adults included, which increases exposure to harmful amounts of kinetic energy to any road user. Because these behaviors are difficult to observe, the Rational Model offers another analytic category, risk markers, which can be observed and measured in relation to driving outcomes. The study of risk markers allows for a more effective identification of subgroups of adolescent drivers with different crash risks. The identification of subgroup-specific risk taking allows for a more effective targeting of critical areas, e.g. public policy, that can potentially be modified to positively influence the practice of safer social norms of driving behavior for the entire population.

In general, population-based interventions have the greatest potential for prevention because they influence the greatest number of individuals. However, population-based approaches for novice adolescent drivers, e.g. mandatory or high school DE or GDL, have had limited success influencing the crash risk of unsupervised adolescent drivers. The limited success of these population-based interventions to reduce adolescent RTIs may be related to the diverse co varying sources of adolescent driver risk taking and the lack of effective control over fully licensed drivers, adults and adolescents alike. Studying high-risk subgroups, through the use of risk markers, can produce knowledge that may: 1) improve population-based interventions; 2) suggest approaches for targeting and treating specific high risk subgroups, and; 3) facilitate the combination of both approaches into one strategy. The successful combination of both population approaches and high-risk subgroup into a single prevention strategy is

common (WHO, 2002). Frank, Bouman, Cain, and Watts (1992) recommend blending population and high-risk subgroup approaches to identify subgroups of adolescents and young adults with unique psychological and behavioral dispositions regarding injury. Among the most critical, promising, and under developed areas for the study of risk markers are DE and driver licensing. To help organize the study of markers of high-risk subgroups, the Licensing Process Model, is proposed – this model is fully explained in the Chapter 3. The next chapter discusses the cultural and scientific background of the adolescent overrepresentation in RTIs and highlights some government risk markers related to this background.

CHAPTER 2

CULTURAL AND SCIENTIFIC CONTEXT OF ROAD SAFETY IN NORTH AMERICA - EVIDENCE OF A MOBILITY BIAS

Cultural and scientific context of road safety in North America - Evidence of a mobility bias

Every public health problem develops within specific cultural and scientific contexts. A fundamental argument in this thesis is that certain values or biases within the cultural and scientific context of the adolescent driving are intrinsic to the origin and the perpetuation of the RTI problem. In the article entitled, *Driver education and adolescent risk taking: Evidence of a mobility bias*, of which I am the sole author, published in the Journal of Safety Research in 2003 (Appendix 1), evidence is presented to support the contention that public policy regarding adolescent drivers is biased in favor of increasing mobility by allowing relatively fast and inexpensive access to a driver's permit rather than increasing the safety of adolescent drivers by investing time and money in driver training and permit evaluations.

Each of the four objectives of this thesis explores markers of risk-taking tendencies that are potentially influenced by the mobility bias within the cultural and scientific context of the adolescent RTI problem. The first objective is to identify risk markers at four different levels, i.e. individual, family, business, and government, and to study their associations with driving outcomes, i.e. violations and crashes. These risk markers are related to licensing decisions and are, therefore, potentially biased towards mobility at the expense of safety. The second objective is to explore self-ratings of driving abilities and crash risks in relation to driving outcomes, i.e. violations and crashes, during the period of unsupervised driving. Self-ratings of driving abilities are necessarily influenced by cultural and scientific definitions of precisely what behaviors constitute safe and skillful driving, and these definitions are potentially influenced by the mobility bias. The third objective of this thesis explores particular aspects of drivers' beliefs about crash events, e.g. perceived threat and efficacy of preventive behavior, in relation to driving outcomes, i.e. violations and crashes. Beliefs about crash events reflect personal experiences that are also influenced by the social and scientific values concerning crashes. For example, a potential influence of the mobility bias is to accept that RTIs are a normal and inevitable cost for the benefits of automobile transportation. To the extent that this is true, the mobility bias may be undermining efforts to reduce RTIs through the promotion of safer norms of driving behavior. The fourth objective is to develop new conceptual models for organizing risk markers and measuring their influence upon driving outcomes, i.e. violations and crashes. These new models are based on an appreciation of the wider context in which the RTI problem occurs. This chapter examines the cultural and scientific context of road safety in North America, using some European examples for contrast, from the perspective of a potential mobility bias.

From 1925 to 1966, RTI fatalities in the US increased 242%, from 21,900 to 53,041 respectively, and the death rate per 100,000 population increased 42%, from 19.1 in 1925 to 27.1 in 1966 (Dellinger,

Branche, & Jones, 2001). Initially, reactions from researchers to the rising toll of death and injury ranged widely. At one extreme, Rosen (1958) implied in his classic work, *A History of Public Health*, that the magnitude of the RTI problem was exaggerated, "accidents involving motor vehicles tend to attract and monopolize public attention. Although, accidents in the home outnumber those involving automobiles." This is a remarkably misleading comparison given the stature of the author and the difference in severity between road traffic injuries and home injuries. At the other extreme, Rapoport (1961 in Klein, 1968) implied that American society's response to RTIs was terribly inadequate when he provocatively asked whether we really wanted to reduce accidents, or "do accidents serve the same purpose that human sacrifice, gladiatorial contests, bear-baiting, and other forms of socially legitimized blood-letting served in other centuries in other cultures?" The above two quotations exemplify an ambivalence towards defining the problem and finding acceptable solutions to RTIs that persists to some degree today. It is reasonable to assume that this ambivalence is partly rooted in the prominence that motor vehicles have increasingly assumed in daily life. One way of capturing this prominence is with the label "car culture."

> Car culture, briefly defined, is the cluster of beliefs, attitudes, symbols, values, behavior and institutions which have grown up around the manufacture and use of automobiles. Its economic base is an enormous, many-faceted industry that leads the business cycle and has profound implications for domestic and foreign policy... As an 'American way of life', it invests a machine with values transcending in importance that of efficient, economical transportation...The most important puberty rite in the United States occurs when a young man or woman passes the driving examination, presses down the accelerator, and feels an answering surge of power, as if - some highway poet has written – 'wolves howled from extinct caves in the bloodstream.' (Sandford in Orme, 1985, p. 286)

Underlying this rhapsodic description of car culture are the irrefutable and interrelated realities of the predominance of the automobile and subsidiary industries in the global economy, the legally and socially sanctioned granting of driving privileges to adolescents as young as 15, a growing dependence on motor vehicles for almost all our transportation needs, and a psychological relationship with the automobile that has often been described as a passionate love affair.

Perhaps the most insidious of car culture values and a potential marker of increased crash risk is the common perception that RTIs are a normal price to pay for the benefits of driving. Fischhoff, Furby, and Gregory (1987) observe that individuals can easily be led to believe that the risk of injury is a

necessary cost attached to the benefits of technologies like motor vehicle transportation, i.e. "whiplash [results] because they want to get someplace with *reasonable* speed" (italics added). In relation to adolescent RTIs, Mayhew, Warren, Simpson, and Haas (1981) point out that "a *reasonably* large number of deaths and injuries are virtually accepted as *inevitable* each year" (italics added). The words necessary, reasonable, and inevitable are emphasized in the preceding sentences because these words reflect the perception that, within car culture values, RTI occurrence is acceptable and normal.

If the perception that RTIs are normal and acceptable develops into a stable belief, it may be used to justify risk taking in the form of reduced efforts to prevent RTIs. For example, US automobile seat belts were not standard equipment on motor vehicles until government legislation compelled all car manufacturers to do so (Nader, 1991). The lack of safety standards of motor vehicles prior to legislative changes were partially justified by a stable belief that the unsafe driver, disparagingly referred to as "the nut behind the wheel," was the incorrigible source of the RTI problem. The lack of factory-installed seatbelts in vehicles could be considered a risk marker for RTIs. Even today, many adolescents (and adults) resist using seat belts and their risk taking is tolerated in many US jurisdictions with secondary seat belt laws that only allow police to penalize a non-wearer of seat belts if he has first committed another traffic violation. McCartt and Northrup (2004) found that one of the strongest predictors of higher seat belt use was the existence of primary seat belt laws that allow police to stop and penalize a driver only for not wearing a seat belt. Therefore, according to the definition of risk taking proposed in this thesis, in jurisdictions with secondary seat belt laws, adolescents who do not wear seat belts and legislators who do not vote for a change to primary seat belt laws are risk takers, and the existence of secondary seat belt laws is a risk marker for RTIs to all occupants of vehicles, particularly adolescents, in those jurisdictions.

In an article that was published by the Journal of Safety Research, entitled *Adolescent driver risk taking and driver education: evidence of a mobility bias in public policymaking*, (see Appendix 1), mobility is defined as relatively unrestricted access to and usage of motor vehicles, and I coin the term "mobility bias" (MB) to describe the non-random selection of transportation policies that promote mobility over safer, but more restricted access and usage of motor vehicles, and over safer alternative modes of transport. I began to suspect the existence of the MB over several years of reading road safety discussions in which the word "transportation", which should properly denote all ground vehicles including bicycles, buses, and trains, had been replaced by the word "mobility", which appeared to refer almost exclusively to motor vehicles and driver licensing. My suspicions were strengthened by qualitative

research findings - Køltzow (1993) interviewed transportation policymakers and concluded that when mobility conflicts with safety they give primary consideration to the "freedom of the car."

The main justification in a democratic society for public policies that increase or do not decrease risk for individual citizens is popular and informed consent, i.e. social values. Several researchers have attributed the reduced efforts to legislate safety by transportation policymakers to social values. Dussault (1994) observes, "The demand for safety turns out to be a by-product of the demand for mobility" and concludes "mobility has won out and will always win out over safety." Mayhew and Simpson (1990) acknowledge the safety value of increasing the driving age in North America but speculate that this policy "may be politically and socially unacceptable." Simpson (1995) claims that parents "are well aware of the dangers young people face on the road...but are often prepared to accept these risks in exchange for the convenience that accrues from licensing young people." Drummond (1994) observes that "a reduction in the number of young driver crashes does not necessarily indicate the best outcome from a community perspective...an effective and equitable balance must be reached between a range of competing objectives." This last statement was singled out for praise in a review in the journal *Accident Analysis and Prevention* as an example of a "thoughtful and comprehensive discussion of the road use (including safety) characteristics of under 25s" (Review, 1996). Obviously, none of the researchers cited above would agree that adolescent RTIs are a social good. However, they all appear to believe that voters, and parents in particular, have given policymakers their informed consent to trade adolescent RTIs for the benefits of adolescent mobility. These researchers do not produce any evidence for their beliefs – none of their statements are supported by results from public surveys, or interviews, or records of failed attempts to legislate safety.

A contrary perspective emerges when researchers scientifically test the assumption that the public, and parents in particular, prefer adolescent driver mobility to adolescent safety. Williams et al. (1996) found that most parents preferred tougher driving restrictions, despite the explicit recognition that they and their children would be inconvenienced to some extent; in a Connecticut survey, 82% of the parents of 15 year olds were in favor of a night driving curfew for newly licensed drivers that the legislators rejected. In California, 79% of a sample of parents of adolescents in a GDL program strongly endorsed the new system of driving restrictions and longer learning periods (Williams, Nelson, & Leaf, 2002). Ferguson, Williams, Leaf, Preusser, and Farmer (2001) also found that relatively few parents in Florida reported that GDL requirements inconvenienced them. There is even some evidence of public support for the most mobility reducing and safety-enhancing intervention of all, raising the driving age ("Raise the driving age", 1989; Williams & Ferguson, 2002). Therefore, it appears possible that public

policy decision making that is biased for mobility when it conflicts with safety may not always be an expression of the informed consent of the majority of voters. The importance for public health of a possible MB in policymaking is its potential for increasing the risk of RTI for adolescent drivers, their passengers, and other road users. The MB could potentially increase RTI risk through its influence in three closely interrelated areas: (1) RTI prevention research; (2) driver licensing, and; (3) road safety interventions.

RTI prevention research

In RTI prevention research, the MB may be associated with three phenomena that exert a potentially negative effect: under-funding of research; divergent priorities between the sciences of public health and traffic safety, and; a gap in road safety theory. In terms of under-funding, Bonnie, Fulco, and Liverman (1999) report that although injury (unintentional and intentional) account for more years of productive life lost than heart disease, stroke, and cancer combined, the US federal research investment in injury prevention is less than one-third the investment in heart disease and stroke, and less than 15% of the investment in cancer. Road injury is the single largest category of unintentional injury. In addition, the comparatively low amount of funding, e.g. 379.7 million for injury compared to 2,570.6 million for cancer, is divided between unintentional injury, homicide, and suicide. In Canada, about 9% of the burden of illness has been attributed to injury, but less than 1% of health research funds are known to be directed to injuries (Insurance Bureau of Canada, 2002). The MB might be associated with the under funding of RTI research because improved road safety frequently involves some form of restricted access and usage of motor vehicles, e.g. raising the driving age, enforcing speed or alcohol laws.

Another potentially harmful influence of the MB on RTI prevention research manifests itself in the slightly divergent priorities of public health and traffic safety. Mayhew and Simpson (1990) assert that these disciplines "do not necessarily yield the same priorities" and that this divergence represents "perhaps the greatest obstacle and certainly the most frustrating one" in the field of RTI prevention. According to the authors, public health sets priorities on the basis of the various causes of death and injury to a target group and tries to reduce deaths from those causes in absolute numbers. Public health generally measures the RTI problem in road deaths per population. Traffic safety sets priorities on the basis of the relative contribution of each target group to the total of road deaths and injury and generally measures the RTI problem in road deaths per kilometer traveled. Mayhew and Simpson (1990) provide the example of children below five years of age as a case where traffic safety measures do not adequately reflect the public interest. RTI is a major cause of death for children below five years of age, but as the

authors report, children in this age group do not contribute a large percentage to the total of road deaths and injuries so they are not considered a traffic safety priority.

Another critique of the traffic safety approach is raised by Richter, Barach, Ben-Michael, and Berman (2001) who assert that the traffic safety measure of road deaths per kilometer traveled implicitly endorses "an ethically problematic paradigm" that weighs the benefits of mobility against road death and injuries and they question whether "the safety of individuals should be sacrificed for the collective benefits of mobility." The authors recommend that reducing road deaths in absolute numbers should be society's goal. In direct response to the ideas proposed by Richter et al. (2001), Dellinger et al. (2001) defend the use of the traffic safety criterion of road deaths per kilometer traveled and argue, "Simply trading in absolute numbers of motor vehicle related deaths would not be good science."

As in all worthwhile debates, both sides have valid points. The use of the public health measure of deaths per population does not fully account for the risk of exposure to transportation injury, and given that transportation is necessary and beneficial, risk of injury due to exposure to transportation needs to be measured. Traffic safety science partially fulfills that need by measuring the risk of exposure to motor vehicles in fatalities per kilometer traveled. However, traffic safety does not usually offer comparisons between the risks of exposure to alternative modes of transportation, e.g. motor vehicles vs. trains. This regular omission partially justifies the description by Richter et al. (2001) of the traffic safety measure of fatalities per kilometer traveled as ethically problematic. The question may not be, as Dellinger et al. (2001) imply, which rate qualifies as "good science." Rather, the more important question may be which goal promises greater overall health benefits for society, maximum reduction of RTIs per population, or maximum reductions of RTIs per kilometer traveled in privately owned and operated motor vehicles.

In 1997, the Swedish parliament answered the more important question by officially adopting a Vision Zero policy with the goal of achieving the maximum decrease in absolute numbers of RTIs for the Swedish population. Within this public health oriented vision, decreasing the fatality rate per population clearly becomes more important than decreasing the fatality rate per kilometer traveled in motor vehicles. Hatakka, Keskinen, Gregersen, Glad, and Hernetkoski (2002) report that the recent "radical decrease" in the licensing of young people in Sweden is a safety-positive trend associated with less driving exposure, greater use of public transportation, and decreased crashes in absolute numbers. The authors suggest that driver training should include transportation education aimed at encouraging adolescents to favor modes of transportation that have significantly lower fatality rates per kilometer traveled, e.g. trains. With the

Swedish example in mind, one can argue that traffic safety science, relative to public health science, has a built-in MB.

Another potentially harmful influence of the MB on RTI prevention research is related to what can be called a scientific "theory gap." Researchers have not been able to specify precisely and exhaustively which driving behaviors qualify as risky (Simpson, 1995) or as safe (Evans, 1991; Mayhew and Simpson, 1990). Nor have researchers yet developed a single, widely accepted, authoritative theory or model to explain how motor vehicle crashes occur (McKenna, 1983; Ranney, 1994). There are many valid reasons for this theory gap: the complexity, variability, and rarity of the road crashes for individuals; the difficulty of measuring driver behavior immediately before rare events like road crashes (Rothengater, 1997), and; inter- and intra-individual differences in driving abilities and risk perceptions. Taylor (1976) was aware of the problem of the subjectivity of risk perceptions and noted, "few drivers are found who will admit that they cannot justify their conduct, however outrageous it has been." Precisely because of this subjectivity, Taylor believed that safe driving behavior could best be improved with normative rules based on research; however, he noticed that scientists were "unable or unwilling to consider normative rules, because they are not causal laws" and reasoned that even "if it should seem inappropriate to declaim rules of conduct from the laboratory, scientists should be able at least to state the possible constituents of each rule; attaching some order of importance to the item." Taylor's suggestions have not been enacted. Scientists have not specified safe driving rules, and the theory gap persists. As a direct result of the theory gap, Gregersen and Bjurulf (1996) are able to observe "most of us want to drive safely" but we lack a definition of "what this implies in actual behavior."

The existence of the theory gap could arguably be attributed to a MB that influences research agendas and financing away from projects that might decrease mobility. To be effective, new standards of driver performance and behavior, e.g. maintaining adequate safety margins, would need to be thoroughly evaluated at the time of licensing and enforced at all times for the entire driving population. In other words, safety rules, especially those supported by research, tend to restrict mobility, and legislators, particularly in North America, tend to resist imposing restrictions on mobility. Consider alcohol and driving. "Per se" laws predetermine unacceptable blood alcohol concentrations (BAC). Such laws greatly facilitate the apprehension and prosecution of drinking drivers and vary around the world from .02 to .15 BAC (Mann, Macdonald, Stoduto, Bondy, Jonah, & Shaikh, 2001). Borkenstein, Crowther, Shumate, Zeil, & Zylman (1964) demonstrated that the risk of a traffic crash in which the driver is responsible climbed exponentially after .04 BAC – for BAC levels between .04 and .08 the odds ratio was 1.7 for at-fault crash involvement. There is some evidence that this relative risk could be nearly twice as great in

today's more complex traffic environments (Kruger & Vollrath, 2004). Yet, today in North America fully licensed adolescent drivers a young as 18 have a legal limit of .08 BAC.

The theory gap has repercussions on many levels. Lack of scientific clarity about safe driving behavior translates into a lack of objective criteria for safe driving. A lack of objective safe driving criteria allows every driver to interpret safety subjectively, without fear of authoritative contradiction. This may partially explain why drivers may overrate their driving abilities - two decades worth of studies in 18 countries found that the majority of drivers claimed they are better than the average driver (Sivak, 2002). Without objective criteria for safe driving, there is no basis for correcting what must be, in many cases, a dangerous level of driver overconfidence.

The theory gap pertains as well to the lack of clarity about how crashes occur and what action drivers can take to prevent their occurrence. McKenna (1993) found that individuals appear to believe that motor vehicle crashes are influenced more by factors outside their control, e.g. the environment, other drivers. Smith, Sullivan, Bauman, Powell-Davies, and Mitchell (1999) found that the majority of respondents did not believe serious road injury was "all or mostly preventable" because "one's level of risk is partially determined by the behavior of others." Even the experience of being involved in an injury crash as a driver does not necessarily teach clear lessons about crash prevention behaviors to all or most crash involved drivers. Rothe (1987) conducted in-depth interviews with a group of 130 adolescent drivers who had been involved in injury crashes and found that over two-thirds of the drivers said that they were proceeding with normal caution prior to the crash and that the other driver was to blame - one quarter of the adolescents said that if they were involved in similar circumstances in the future there is either nothing that they would do, or that they could do. Similar findings were reported by Kidd (1993), who interviewed 21 drivers injured in crashes, most of whom did not perceive that the occurrence of the crash can be controlled and did not identify any self-protective behaviors that were specific to driving. A stable belief that self-protective behaviors do not exist for or are ineffective against traffic crashes might potentially be a marker of increased crash risk.

The subjective perceptions of drivers, even after they have become injury crash victims, do not correspond well with the WHO definition of RTIs as predictable and preventable events. Nor do these subjective perceptions correspond well with the definition of risk taking presented in this thesis that posits that every individual involved in an RTI crash had a share in the construction of that event, and therefore, might have been able to prevent the crash or lessen its severity if he or she had behaved differently. It is fair to speculate that drivers of all ages might perceive more clearly how they could prevent crashes if the

theory gap did not exist and clear rules for safe driving and crash prevention were authoritatively established and consistently promoted throughout the motor vehicle transportation system.

In summary, there are several reasons to suspect that a MB is influencing RTI prevention research by contributing to under funding, divergent priorities between public health and traffic safety research, and the theory gap in road safety science. These phenomena, in turn, appear to exert an influence on driver licensing exams and road safety interventions. Next, the potential influence of the MB on driver licensing, i.e. age of access and exam criteria, is examined.

Driver licensing

Without a driver's license, an individual's access to employment, recreation, medical help, everyday sustenance, and social events is limited. In 1979, the U.S. Supreme court ruled that there is a substantial property interest in a driver's license that cannot easily be infringed (Jacobs, 1989). Gregersen and Bjurulf (1996) observe that in many countries "a driving license is regarded as a necessity for transport needs and a citizen's right." Waller, Li, Hall, and Stutts (1978) affirm, "Both the economy and our way of life rest on the supposition that a large portion of the adult population will be able to drive." Williams (1997) believes that raising the driving age to 17 or 18 as in Western Europe would "be perceived in the United States as an infringement of personal liberties." These car culture values find concise expression in the statement by McKnight (1984), "Any group of people that drive will have accidents. By agreeing to license them, society accepts that risk." The above statements raise several critical questions about driver's license exams. What is the minimum age when adolescents can be relied upon to behave with adult responsibility and competence? What are the criteria for evaluating the competence of driver's license candidates and do these exam criteria test the candidates' ability to prevent crashes? Who calculates how much risk society is willing to accept? How are these calculations determined? Finally, is it possible that a MB is influencing driver's license exam criteria?

Legal minimum driving ages have ranged from 15 years in some North American jurisdictions to 18 years of age in most of Europe (Lynam & Twisk, 1995). Ferdun et al. (1965) reports that in the 1960's in California, applicants for a driver's license needed parental consent until the age of 21, unless they were 18 and married, and that over the years in California, a number of attempts had been made to raise the minimum driving age. A report to the US congress ranked second the strategy of raising the driving age to 17, based on estimated cost-benefit ratios of interventions to reduce injury and injury severity (Rice et al. 1989 in Laberge-Nadeau, Maag, & Bourbeau, 1992). Laberge-Nadeau et al. (1992) found that first year

crash rates were highest for 16-year old novice drivers, lower for 17-year olds, higher for 18-year olds and declined gradually thereafter, and recommended that the licensing age should be raised to 18 as in most European countries. Other researchers from around the world have also recommended raising the driving age as an effective countermeasure for adolescent driver crashes (Bjornstig, Bylund, Lekander, & Brorsson, 1985; Ebacher & Montreuil, 1984; Insurance Institute for Highway Safety, 1994; Levy, 1990; O'Connor 1986 in Mayhew & Simpson, 1990; Preusser, 1988; Williams, 1987). Laberge-Nadeau et al. (1992) cites a formal recommendation made in 1989 by the National Committee for Injury Prevention and Control stating that the intervention of increasing the licensing age has not been considered sufficiently. Mayhew and Simpson (1990) conclude an exhaustive review of the research literature on adolescent driver crashes by stating, "The only effective countermeasure to date has been raising the driving age." Williams et al. (1983) evaluated adolescent driving records in New Jersey and neighboring states after New Jersey raised the legal driving age from 16 to 17 and concluded that 65 to 85 per cent reductions in 16-year old driver fatal crash involvement can be expected if the licensing age is increased from 16 to 17, without increasing fatal crash rates in older drivers. Preusser, Williams, and Lund (1985) found that raising the licensing age would not, for the most part, change the lifestyle of 16- year olds. For Winsdale (1997), it seems so logical that raising the driving age to 18 would save both lives and money he considers "that it's almost unbelievable that there are no pressure groups introducing such measures." I suggest that a MB in policymaking may be influencing the common perception that current legal driving age is inviolable.

Another area where the MB and the theory gap appear to have influence is in the criteria for driver permit exams. Townsend, Engel, Andersen, and Clifford (1993) claim that the purpose of a permit exam is to ensure that the license candidate has the minimum knowledge and skills required for competent practice and that competent practice implies that the licensing exam should measure knowledge and skills that are required for public protection. Most researchers agree that driver's permit exams only test the minimal knowledge and skill necessary to drive a car (MacDonald, 1987; Mayhew & Simpson, 1990; Waller, 1975). Mayhew (2003) observes that few jurisdictions have considered the adequacy of their basic on-road test to ensure that learner's are ready to drive without supervision. One critical question that has not yet been answered is whether driver's permit exams are valid assessments of adolescent driver safety?

Questions concerning driver permit exam validity are complex. At least four forms of validity apply to driver's permit exams: construct, content, concurrent, and predictive validity. Construct validity relates to how accurately a test measures a particular attribute or psychological construct. As noted above,

compared to no formal training at all. This criticism misunderstands that the purpose of the 1986 Danish DE program evaluation was not to demonstrate the effectiveness of DE but rather to measure the effectiveness of modifications to an existing mandatory DE program. The results of that evaluation showed significant reductions in multi-vehicle crashes, after controlling for age, sex, experience, and exposure, during the first one and a half years of driving for novice drivers who followed the modified DE curriculum implemented in 1986 compared to novice drivers who followed the DE curriculum in effect before 1986 (Carstensen, 2002). The 1986 Danish DE program was not effective in reducing single-vehicle crashes. Single-vehicle crashes appear to be associated more with deliberate risk taking, whereas multi-vehicle crashes appear to be associated more with lack of experience and awareness in traffic. The partial but substantial crash reductions from the 1986 Danish DE program can be attributed, in part, to the quality control on the curriculum made possible by Danish laws that only allow professional instructors to teach novice drivers and prohibit driving practice with family and friends. One other reason for the success of the 1986 Danish DE program is the curriculum content and design, which is discussed below in reference to the potential reasons why every other evaluation of traditional DE outside Denmark has shown few, if any, positive safety benefits.

Mayhew and Simpson (1996) suggest several reasons why traditional DE may not be effective at reducing adolescent driver crash risk. First, the authors suggest that the DE course may lack safe driving content validity or that the delivery of the course may be inadequate or both. The major deficits of traditional DE programs can be illustrated in relation to the improved safe driving content and delivery of the DE program started in Denmark in 1986. Before 1986, DE programs in Denmark were similar to traditional DE programs – the curriculum only specified a few general rules for course content: e.g. technical knowledge of the vehicle and traffic laws; some driving in the city, in the country, during daylight and at dusk, and the only specification for program delivery was that a minimum skill level should be achieved before driving in heavy traffic. In 1986, the following major changes were made to both the content and the delivery of DE in Denmark (Carstensen, 2002): (1) all Danish driving instructors teach according to detailed lesson plans listing objectives of maneuvers and skills to be learned; (2) theory and practice are closely connected - students learn a topic in theory before trying it in practice on the road, and lessons were structured to progress from easy to difficult tasks; (3) practical training starts in a closed circuit where the learner drove alone in a car at low speeds to become familiar with basic maneuvers before entering calm traffic; (4) the program emphasizes topics relating to defensive driving, i.e. perceiving hazards and learning how to react to them, and; (5) the defensive driving topics are included in the theoretical and practical driver's permit test. To the best of my knowledge there is no North American DE program that can match the safe driving content and delivery of the 1986 Danish DE program. One

key point that has been and continues to be overlooked in North America is that government driver's permit tests in Denmark are designed to measure the crash prevention knowledge and skills taught in the DE program.

In the evaluation of the Danish DE program, Carstensen (2002) does not mention the cost of this DE program, but it must be substantial if only because every hour of driving practice must be taken with a professional instructor. The 1986 Danish DE program represents a high level of commitment by the government and its' citizens to ensuring that Danish adolescents have a comprehensive education in safe driving before licensing. It is difficult to imagine how this safety-biased approach could be easily replicated in most North American jurisdictions, as illustrated by the other reasons suggested for the ineffectiveness of DE.

The second reason suggested by Mayhew and Simpson (1996) why DE may not work is that it does not motivate drivers to learn or to apply safety skills. Williams, Paek, and Lund (1995) investigated what does motivate safe driving. Based on the analysis of 543 telephone interviews with randomly selected drivers (weighted to represent 154,000,000 US households), the authors found that DE "was not generally thought to increase one's concern for safe driving" – what does encourage safe driving, in the minds of drivers, is the possibility of negative consequences: crash involvement, a fine, a permit suspension, or higher insurance costs. Conspicuously absent from the list of possible negative consequences reported in the telephone interviews is the possibility of failing the driver's permit exam. Researchers recognize the intrinsic link between permit exam criteria and DE when they declare that the criteria of the driver's permit exam effectively determine the standards for DE (MacDonald, 1987; Waller, 1978). Therefore, if safety skills are not tested on the driver's permit exam (contrary to the situation in Denmark), then there is little incentive for adolescents to learn them. The authors of a report to the US Congress, known as the DE evaluation programs (DEEP) study, implicitly recognized the safety deficit in government driver's permit exams when they wrote

> To the extent that instruction and licensing share the same goal - which is, to make sure that prospective drivers are able to operate a vehicle safely - it behooves the driving instructor to prepare his student for the license exam. However, the instructor should recognize that the goal of his instructional program is safe driving, not simply preparing the students to pass the examination, and he should attempt to see to it that the students accept this goal. (National Highway Traffic Safety Administration, 1975, p I-7)

This recommendation is naïve. DE instructors in a highly competitive, private-enterprise market have insufficient authority to demand that their students invest time and money to learn driving skills that are not specifically tested on driver's permit exams. An adolescent DE student who does not wish to comply with a demanding DE teacher can easily attend another driving school or learn to drive with family or friends. (In Denmark, all driving schools teach to the higher standard of a more safety-oriented permit exam and the option to learn to drive with non-professional teachers is not available.) After licensing, novice drivers in almost all jurisdictions may become involved in crashes without any adverse effect on their driving privileges. How can DE teachers motivate adolescent novice drivers to learn and apply safety skills that are not evaluated on government driver's permit exams?

A third reason why Mayhew and Simpson suggest that traditional DE may not improve safety is that the course may not address lifestyles related to adolescence and risky driving. However, Gregersen (1996) advises that even if an adolescent is defined as a high-risk driver through lifestyle-related factors, it is probably not advisable to try and change lifestyles for several reasons; among these are ethical concerns and insufficient knowledge of the nature of the relationship between lifestyle and crash risk. For example, in some cases, reckless driving behavior that may appear to be related to lifestyle influences may in fact be, according to the Diagnostic and Statistical Manual of Mental Disorders (Fourth edition, revised: DSM-IV-R), a sign of an antisocial personality disorder (American Psychiatric Association, 2000). DE instructors lack the professional qualifications and the authority to invade their students' privacy and to intervene in lifestyle-related issues, and the diagnosis and treatment of personality disorders is definitely not in their job description.

A final reason suggested by Mayhew and Simpson for DE's apparent ineffectiveness is that the course content might not be flexible and specific enough to meet the needs of different students in a heterogeneous population. There is some evidence that DE course material that is tailored for specific groups can produce safety benefits. McKnight and Edwards (1982) conducted a two-year prospective study to determine whether designing special manuals and theory exams to accommodate drivers with certain characteristics, specifically new applicants, renewal applicants and older applicants, would improve driving safety. When the authors tested the results of this approach on crash risk they found that the treatment groups of new drivers had significantly fewer collisions with convictions than the control group who received the regular driver's manual and theory exam. A key point, however, is that government examiners administered different final tests to each group corresponding to their different training material. There is no evidence that a tailored approach would be effective if all candidates passed the same standardized minimal government exam. Eventually, as in all learning situations with desirable

goals, i.e. a driver's permit, tailored training would most likely evolve into standardized preparation for a standardized exam. Smith and Kirkham (1982) observe that individual differences have not been systematically taken into account in designing DE programs and "consequently, all learner drivers tend to receive a standard course, which has as its goal the obtaining of a license rather than the prevention of accidents." In short, a strong argument can be made that traditional DE is now and will remain ineffective as a safety intervention as long as its chief role is to prepare novice drivers to pass the current standardized driver's permit exams that appear to be designed primarily to facilitate access to motor vehicles and not necessarily to produce safer drivers.

As demonstrated by the failure of the 1986 Danish DE program to reduce single-vehicle crashes, there appears to be a type of intentional risk taking that is prevalent among some subgroups of adolescent drivers and that is not easily reduced through education (Williams, 1987; Wurst, 2002). On the contrary, the behavioral tendency to take risks within these subgroups may even increase with improved driving skills. This hypothesis is supported by evaluation studies that found that adolescent drivers with advanced training in skid control had more crashes on icy road surfaces than adolescent drivers without the advanced training (Keskinen, Hatakka, Katila, & Laapotti, 1992). The evaluation of the DeKalb DE study recognized the challenge of intentional risk taking in one of it's final recommendations that called for the development of an interim measure of personality/emotional/attitudinal factors predictive of collision and violation occurrence (Stock et al., 1983). Presumably, this interim measure would serve as a diagnostic/screening test and permit targeted interventions prior to granting a full license – a form of testing that has been recommended by the Insurance Bureau of Canada (1995). There is little evidence that any scientific progress has been made in this direction, possibly due, in part, to what Mayhew and Simpson (1990) describe as the concerns of driver licensing authorities about "invasion of personal privacy, discriminatory and unfair practices." It is fair to ask whether transportation policymakers would allow these issues to automatically and absolutely outweigh the potential health benefits of a screening program if it were not for the influence of a MB.

Graduated Driver Licensing (GDL)

In the 1980's, a program called graduated driver licensing was introduced based on a 1971 North Carolina study that identified the overrepresentation of adolescent drivers in crashes at night and when another adolescent was the right front passenger (Waller, 2003). Following educational principles of distributed learning (i.e., over time) and progressing from simple to complex skills, GDL proposed that novice adolescents should: (1) acquire initial driving experience under low risk conditions, e.g. no night

driving; (2) have extended supervised practice; (3) move gradually to more complex conditions, and; (4) receive harsher penalties for deliberate risk taking. The first jurisdiction to formally adopt a program called GDL was New Zealand, in 1984. Since then, GDL programs of varying formats have been adopted by increasing numbers of jurisdictions around the world, and overall, evaluations of the safety benefits have been positive (Shope & Molnar, 2003). However, positive results still require scientific explanations. The GDL programs appear to influence adolescent driver crash risk in two ways related to exposure reduction. One, overall exposure to unsupervised driving is reduced by the GDL delays and conditions that prolong the supervised learning period for individual drivers and that may also decrease the total number of new drivers. Two, when unsupervised driving is permitted, exposure to risky conditions is reduced by GDL restrictions, e.g. curfews, passenger restrictions, zero alcohol tolerance. First, the overall exposure reduction effect of GDL is examined.

Reductions in overall driving exposure are achieved by extending the period of supervised practice several months, effectively raising the age when adolescents drive unsupervised. The well-known safety benefits of increasing the driving age were described earlier in this chapter. Safety benefits also follow from an inadvertent reduction to overall exposure associated with a reduction in the number of new drivers - in some jurisdictions the implementation of GDL was followed by a decrease in the licensing rate of the youngest adolescents (Keegan, 1994; McKnight & Peck, 2002). Langley, Wagenaar, and Begg (1996) analyzed the licensure data and concluded that the reduction in crashes following implementation of GDL in New Zealand might be attributable, in large part, to an overall reduction in exposure. The decreased licensing rate among the youngest adolescents may be due to a transitional inflation in licensing prior to the implementation of GDL restrictions, and to delays in licensing after the restrictions come into effect (McKnight & Peck, 2002) - this fluctuation in licensing rates may also reflect the decreased attractiveness of a driver's permit that carries GDL restrictions.

Reductions in driving under risky conditions are achieved through restrictions to: night driving, i.e. curfews; dangerous distractions, i.e. adolescent passengers; impairment, i.e. zero alcohol tolerance, and; access to high-speed roads. Night curfews have been in effect in some jurisdictions for many years and have well documented safety benefits (Preusser, Williams, Lund, & Zador, 1990). Studies have documented that the risk of adolescent drivers crashing is directly associated with increases in the number of adolescent passengers (Lin & Fearn, 2003) – therefore, it was not surprising when Masten and Hagge (2004) found evidence that passenger restrictions are associated with decreased crash risk. The safety benefits of restricted access to high-speed roads have not yet, to the best of my knowledge, been

demonstrated. Overall, it is not surprising that exposure reduction policies have shown positive effects in evaluations of GDL by Foss and Evenson (1999) and by Shope and Molnar (2003).

However, exposure reduction is only one aspect of the promised safety benefits of GDL. The other aspect is greater safety through increases in supervised experience before full licensure. Increases in experience for novice drivers are expected by extending the learner's permit period and allowing more time to practice; Many North American jurisdictions have even legislated a minimum number of hours of supervised practice. To date, there is no evidence that North American attempts to increase the number of hours of supervised driving experience under low risk conditions has decreased the crash risk of adolescent drivers after they are unsupervised and relatively unrestricted. Hedlund and Compton (2004) reviewed all five published evaluation studies of GDL in North America and concluded "GDL programs to date appear to have little or no carryover effect after full licensure." There are several potential reasons for this lack of safety benefit. One, in many jurisdictions, the GDL program contains a component known as a "time-discount" that allows adolescents to shorten by several months their period of supervised practice if they present a certificate of completion from a DE program to the licensing authorities. As discussed earlier in the section on DE, there is no theoretical or empirical evidence that traditional DE increases safety, therefore, there is no theoretical or empirical justification for implementing the DE time-discount. Many jurisdictions have implemented the DE time-discount, or made DE mandatory for under 18-year old driver's permit candidates, despite the lack of evidence that DE graduates are safer drivers. Moreover, three Canadian provinces have maintained their DE time-discounts despite evaluations that confirm that novice adolescent drivers who use the time-discount have higher crash rates than novice adolescent drivers who wait longer to license (Boase & Tasca, 1998; Mayhew, Simpson, Williams, & Desmond, 2002; Wiggins, 2003). The policy decision to allow the youngest and most at-risk adolescents to license earlier as a result of DE attendance supports the contention that licensing policies are designed to increase mobility rather than to increase the safety of licensed drivers (see Appendix 1 for a full discussion of the MB and the DE time-discount). Another reason why adolescent drivers who have passed through a GDL program, compared with adolescents who have not passed through the GDL program, are not necessarily safer when driving without supervision is that GDL "is not designed to address deliberate risk taking behavior" (Waller, 2003). The challenge of the hard-core subgroup of intentional risk takers may require a more comprehensive countermeasure than any currently in existence.

Finally, GDL was designed to increase supervised experience prior to unsupervised driving under the assumption that increased experience decreases crash risk. However, as discussed in Chapter 1, the precise quantity and quality of supervised driving experience that is required to improve unsupervised

driver safety is not known. One research study in Sweden indicated that increases in supervised experience have a positive safety effect on unsupervised driving (Gregersen et al., 2000). The Swedish study analyzed aggregate data from different sources to conclude that novice drivers with an average of 118 hours of supervised driving practice between the ages of 16 and 18 had safer driving records in their first two years than novices with only 40 to 48 hours of supervised practice. Largely on the basis of the Swedish finding, a minimum of 30 to 50 hours of supervised practice during the learner stage was recommended by the IIHS and legislated in 28 US states (IIHS, 2003). However, even if there was full compliance with the recommendation in these US states, 30 to 50 hours of practice need not have resulted in safer unsupervised adolescent drivers because the relationship between practice hours and safer outcomes is not necessarily linear. Sagberg and Gregersen (unpublished manuscript) found that below a certain number of hours, more supervised driving practice was associated with increased crash risk. Sagberg and Gregersen postulated an inverted U-shaped relationship between the number of pre-license driving practice hours and post-license crash risk - this implies that crash risk increases with increased practice hours up to a certain level, after which it 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-rated driving abilities - eventually, with additional hours of practice, drivers begin to develop a more realistic assessment of their own abilities.

While promising, the results from Sweden may not be generalizable to the North American context. Adolescents in Sweden may only license fully at age 18, compared to age 16 in the US. Other factors may also play a role. For example, according to Spangenberg et al. (2003), compared to Denmark, socialization of children in Sweden discourages risk taking. No comparisons have been made, to the best of my knowledge, between Swedish and American socialization of risk taking in children. However, a cross cultural study of driver risk perceptions found that US drivers perceived the least amount of risk in traffic situations when compared with Spanish, West German, and Brazilian drivers (Sivak, Soler, Trankle, & Spagnhol, 1989). Therefore, it is possible that policies that are effective in Sweden may not be equally effective in North America.

One final aspect of GDL in North America deserves mention. Contrary to the expectations of many researchers, the mobility reducing restrictions of GDL policies have been quite popular with parents despite the inconveniences they have caused – some parents even express a desire for further restrictions (Ferguson et al., 2001). Waller (2003) states that she is unclear why now there is so much support for the GDL system when 20 to 30 years ago there so much reluctance to accept it. Waller lists seven obstacles

encountered in the early 1970s to acceptance of a proposal for a GDL system. Four of the seven obstacles specifically mention government legislators as the source of the objections. Two of the remaining three obstacles mention parents as the source of objections; one referred to the perception that parents "are usually eager to give up chauffeuring" and the other concerned the potential "that parents would lie about the amount of supervised practice" that GDL imposed. Klein (1976) observed that the during the 1970s, the status quo belief was that "the privately owned and operated conventional vehicle should continue as the major means of transportation" and that "often the grounds for opposition to a countermeasure are taken for granted rather than investigated." As discussed at the start of this chapter, recent survey results show that perceptions and concerns about parental objections to GDL appear to be exaggerated. One can only speculate whether 20 to 30 years ago parents were fundamentally different than parents today. The seventh and last obstacle listed by Waller is a general objection to penalizing "all young drivers when only some of them will have crashes." This last objection raises the issues of whether driving is a privilege or a right and to what extent is the government responsible for protecting its citizens from known risks.

Summary of Chapter 2

Chapter 2 presents evidence for the argument that drivers, particularly in North America, are influenced by car culture values that lead to the acceptance of RTIs as normal events. An argument was made that the perception of RTIs as normal events supports, and is supported by, a MB in RTI prevention research, driver licensing, and road safety interventions. RTI prevention research reflects the MB in the under funding of injury research, the divergence between public health and traffic safety priorities, and a conspicuous theory gap in road safety science. Driver licensing reflects the MB in the minimal standards for permit exam criteria and the perverse effects whereby many of the candidates with the highest success rates on the practical road exams also appear to have the highest crash rates. Partially due to the MB, success on a road exam may be a marker of increased crash risk. Road safety interventions against adolescent driver RTI risk also appear to reflect a MB. By contrast, North American DE programs appear ineffective compared to a more coherent and consistent approach exemplified by the Danish DE model, which respects basic learning theory by specifying crash prevention knowledge and skills as learning objectives and testing crash prevention on the theory and practical government driver's permit exams. North American transportation policymakers appear to use DE to facilitate and to accelerate licensing, despite consistent evidence of no safety benefit to DE graduates. The fact that DE time-discounts have been maintained even after several evaluations have shown a negative safety effect is arguably more

evidence of a MB among transportation policymakers. Government support for the DE-time discount is a risk marker for adolescent crashes. GDL, once described as a "palatable alternative over the inevitable safety gains of raising the driving age" (Mayhew & Simpson, 1990), has been successful in reducing adolescent crash risk to the extent that it has limited driving exposure and exposure to risky driving situations. In addition, the early resistance to GDL in the 1970s can arguably be attributed to a MB that seems to have decreased slightly over the years but may still be interfering with the further development and implementation of more effective adolescent driver RTI interventions.

The literature review that is reflected in the preceding two chapters has inspired the research that is discussed in the remainder of the thesis. The extensive three-part questionnaire and the shorter follow-up survey that are used in the study protocol were adapted from several existing questionnaires and sometimes only single items from other research studies that had successfully discriminated between low- and high-risk drivers. The goal in constructing the questionnaires was not merely to replicate other research and validate concepts but rather to explore unresolved and underdeveloped issues and to develop models that would provide a better fit for the abundant and diverse data that road safety studies have generated. A new psychometric instrument called a Crash Belief Questionnaire (CBQ) was developed specifically to explore the relatively under researched area of adolescent driver beliefs about crashes and crash prevention. Chapter 3 develops the Licensing Process (LP) model as a way of incorporating into the explanation of DE ineffectiveness factors that have received little attention or have been regarded as confounders instead of being recognized and addressed directly by DE programs and licensing criteria. Chapter 4 discusses the findings on driver self-rated abilities in relation to methods of learning to drive, exposure, measures of driver risk taking including crash beliefs, and lifestyle.

CHAPTER 3

ARTICLE 1:

THE ROLE OF DRIVER EDUCATION IN THE LICENSING PROCESS IN QUEBEC

Pierro Hirsch, Urs Maag, and Claire Laberge Nadeau

Université de Montréal

ABSTRACT

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 1,804 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, time discount.

The leading cause of adolescent death in high-income countries is road injury (WHO, 1999). Driver education (DE) is a traditional countermeasure that is popular with North American public policy makers. Currently, 38 of the 51 licensing jurisdictions in the US provide incentives to adolescents with DE certificates in the form of permission to license up to two years earlier or to waive night restrictions or requirements for 30 to 50 hours of supervised driving - an additional two jurisdictions impose mandatory DE for all new drivers (IIHS, 2003). In Canada, six of eleven provinces grant "time-discounts" that allow DE certificate holders to drive unsupervised several months earlier than permit candidates without DE certificates (IIHS, 2003). In total, 46 of the 62 licensing jurisdictions in North America provide adolescent driver's permit candidates with incentives or obligations to attend DE.

From a public health perspective, government incentives to attend DE are problematic – not only is there little or no evidence that DE courses improve adolescent driver safety (Achara, et al., 2001; Evans, 1991; Mayhew, Simpson, William, & Ferguson, 1998; Potvin, Champagne, & Laberge-Nadeau, 1988), but research indicates that adolescent crashes *increase* when DE courses expedite licensing (Ulmer, Preusser, Ferguson, & Williams, 1999). Hirsch and Nadeau (1995) predicted that adolescents who licensed earlier, e.g. by using a time-discount, might comprise "a smaller cohort of new young drivers with a higher collision rate." Subsequent evaluations of the time-discount policy confirmed that, compared with novice drivers who did not present DE certificates to license earlier, novice drivers who licensed earlier using DE certificates had 45% more crashes in Ontario (Boase & Tasca, 1998), 27% more crashes in Nova Scotia (Mayhew, Simpson, Williams, & Desmond, 2003), and 45% more crashes in British Columbia (Wiggins, 2004). Wiggins (2004) concludes, "The consistency of the results across jurisdictions suggests that *something more* than the form and the content of driver education may be at work" (italics added). Given the strong government support for DE, it is important to understand what this "something more" might be.

Elvik (2003) states that the most serious threat to the validity of road safety evaluations is lack of control for confounding factors. Evaluations of the DE time-discount that show increased crash risk might be confounded by unmeasured factors, e.g. individual differences in risk taking, motivation, or family backgrounds. Therefore, in this article a conceptual framework is proposed for understanding how potential confounding factors interact with DE and other elements of licensing systems 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 permits, ranging from parental support for licensing to government evaluation criteria for permit exams and rules for permit revocations. Ideally, the goal of the LP is to produce safer drivers and the role of DE within the LP is to increase the likelihood of achieving that goal.

Using the LP model to control for confounding factors, this article investigates six inter-related hypotheses associated with LP events and outcomes, i.e. preparation methods for permit exams (DE or no DE), permit exam performance (theory and road), violations and crashes. Each hypothesis is based on an extensive review of previous research and on reasonable expectations. Hypothesis 1: Adolescents who attend DE are different than those who do not. Hypothesis 2: DE attendance improves performance on the driver's permit exams (theory and road). Hypothesis 3: Good performance on permit exams (theory and road) is inconsistently related to safer driving records. Hypothesis 4: Overall, DE attendance is not associated with safer driving. Hypothesis 5: The motivations of adolescents who attend DE courses vary in ways that are associated with safer outcomes. Hypothesis 6: The quality of DE courses varies in ways that are associated with safer outcomes. Cumulatively, these six hypotheses are intended to highlight different aspects of the LP and to discover potential confounding factors that might help explain the apparent lack of effectiveness of DE courses.

To test these six hypotheses, a prospective cohort study of 1,804 novice drivers aged 16 to 19 in Quebec was conducted that linked together individual 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 was anonymized with a dummy number prior to analysis. This article is organized as follows. 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 six hypotheses. 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 this framework is that currently there are no conceptual frameworks for studying the development of driving behaviors and attitudes in direct relation to driver licensing. There are theoretical models, e.g. Gregersen and Bjurulf, (1996), and pedagogical models, e.g. Novice Driver Education Model Curriculum Outline (Lonero et al., 1995) and GADGET (Hatakka, Keskinen, Hernetkoski, Glad, & Gregersen, 1999), and there are regulatory licensing systems like GDL. However, these are unsatisfactory for three reasons. One, the theoretical and pedagogical models describe the ideal qualifications of a safe novice driver but they do not specify the practical methods for testing these qualifications during a driver's permit exam. Two,

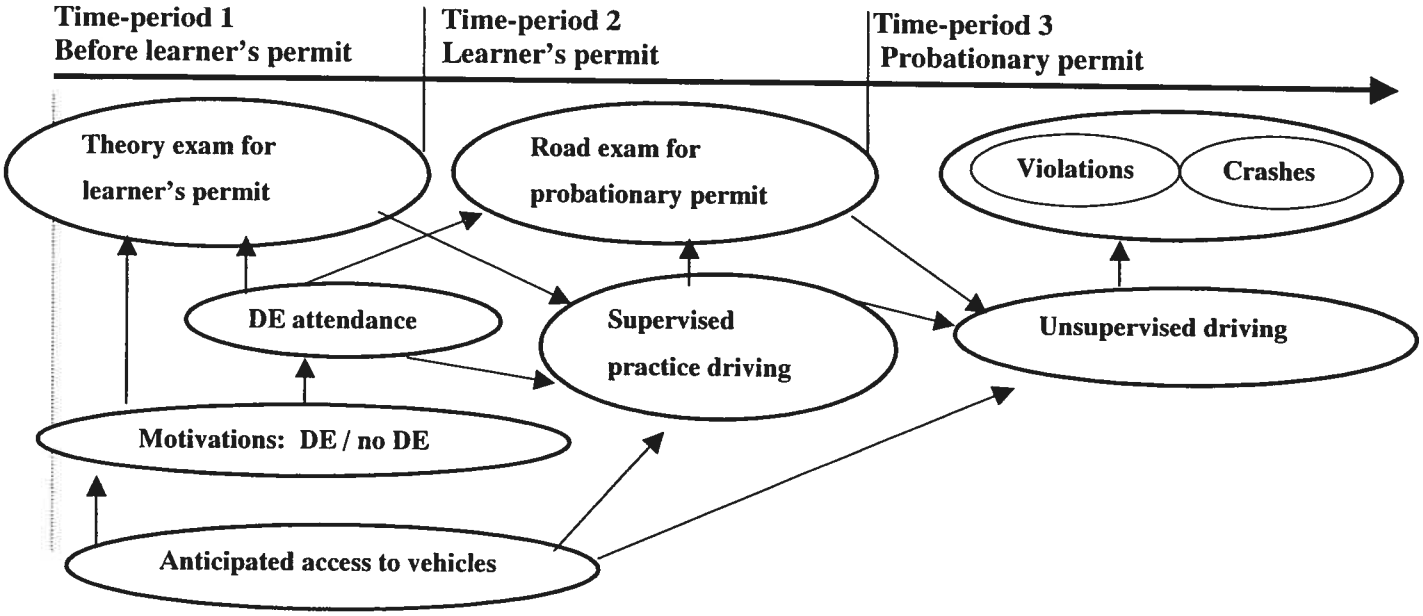
licensing systems administer driver's permit exams that have little if any relation to theoretical or pedagogical models or research-based criteria of safe driving. Finally, both the models and the licensing systems assume that adolescents are sufficiently homogeneous that everyone will become a qualified, safe driver by progressing through similar training or developmental stages. This last 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, e.g. 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 a global approach that attempts to account for all potential influences on the safety of adolescent novice drivers, e.g. motivations concerning DE, expectations about driving, quantity and quality of exposure, socio-economic status, risk attitudes, etc.

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. Some of these factors, e.g. motivations for attending or not attending DE, have received little research attention. 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, e.g. driving exposure, violations, and crashes.

Below the time-line, 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. Below the regulatory factors are four other factors: 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.

Figure 1
Time-line of licensing process and possible interactions between factors



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. For instance, anticipated access to vehicles may increase motivation to license sooner, thereby increasing the attractiveness of the DE time-discount, where it is available, and accelerating the onset of unsupervised driving. Another potential confounder not shown in the Figure is the degree of 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 inter-related groups: individual differences; family backgrounds; business practices, and; government licensing policies, i.e. DE incentives, age of access, permit exam criteria, post-licensing sanctions. These groups merit lengthy discussions that exceed the scope of this article. Therefore, only some of the more salient points are mentioned.

Adolescents differ in numerous ways that influence how and when they license and how safely they drive, i.e. motivation, psychomotor ability, available time and opportunity for driving instruction and practice, and ability to pay costs related to licensing and driving. Some research indicates that the majority of adolescents, males more than females, are eager to become licensed (Ferguson, Leaf, Williams, & Preusser, 1996; Stoddard, 1991). Other research indicates that changes in regulatory and social environments may alter the attractiveness of a driver's permit (Hatakka, Keskinen, Gregersen, Glad, & Hernetkoski, 2002; Keegan, 1994).

Family factors may have a distal influence on licensing and driving behavior - Bianchi and Summala (2004) cite several references indicating the existence of genetic dispositions for sensation seeking, aggressiveness, or even cognitive style and attention. Family factors may also have a more proximal influence on licensing and driving behavior through: lifelong exposure to parental driving models (Carlson & Klein, 1970; Ferguson, Williams, Chapline, Reinfurt, & De Leonardis, 2001; Levelt, 1994); lifestyles related to socio economic status (SES) and occupation (Engstrom, Diderichsen, & Laflamme, 2002), and; the gate-keeping function of parents who allow adolescents access to cars and can, at least in theory, determine when, where, why, and how often they drive (Beck, Hartos & Simons-Morton, 2002).

Business practices and government policies also influence licensing and driving behavior. Many insurance companies provide discounts to DE graduates (Picard, 2004). Lower insurance costs and the time-discount might increase the attractiveness of DE courses and potentially increase the number of driving schools as well. Market forces in the relatively unregulated and competitive driving school industry would lower tuition, which would discourage curriculum development and the employment of better-educated teachers with higher salary expectations. Because driver permit road exams only test minimal skills (Hirsch et al., 1999), low quality DE may go unnoticed. Therefore, basic economic principles allow us to deduce that the combination of current business practices and government policies is likely to have a positive effect on licensing rates and a potentially negative effect on the quality of DE. In summary, factors from each the four sets described above, independently or combined, may affect when adolescents license, and how frequently, under what conditions, and in what manner they choose to drive.

GDL in Quebec

Table 1 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% on each of three sections, (laws, signs, specialization), of a theory exam.

Table 1.
The Quebec GDL system

	Permit type		
	Learner's	Probationary	Class 5
Requirements	- Minimum age 16 - Parental consent if below 18 - 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

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 twelve 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 twelve 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 .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 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 eleven 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. Table 2 shows that 85% of the total sample, or 1,536 study participants, 723 female, attended DE and that DE attendance lowers the mean age of probationary licensing for females and males by approximately six months.

Table 2
Sample size and mean age of study population according to DE attendance controlling for sex

DE attendance	n	Females		Males	
		Mean age	n	Mean age	n
Yes	1,536	17.95	723	17.83	813
No	268	18.46	95	18.31	173
Total	1,804	18.01	818	17.91	986

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 first 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, and expectations about car ownership and driving patterns. The life style habits questionnaire was derived from the work of Shope, Waller, Raghunathan, and Patil (2001). In relation to the LP framework (Fig. 1), the first 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 data from the SAAQ were obtained for the entire study population until the end of December 2001 and included the participants' complete history to the end of the first 450 days of holding a probationary permit. 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 ($p<.01$). Because applicants below 18-years of age require the signature of a parent or legal guardian to obtain a learner's and a probationary permit, age is generally analyzed according to two-year age groups, 16-17 vs. 18-19.

Explanatory factors from the four groups outlined in section 2 that were contained in the questionnaire were cross tabulated with each of the five 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 (see Appendix 10) were performed for the psychometric scales (see section 2 of questionnaire, Appendix 4) and grouped into eight sets of variables. Each set yielded one principal component that was also added to construct an overall index for risk taking. 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, 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 (Beta 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 five 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% 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 combines 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 10.32 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

Hypotheses 1, 2, 3, and 4

The first four hypotheses concern the entire sample of novice drivers and five events or outcomes from the LP framework (Fig. 1). Hypothesis 1 concerns differences in the populations who do and do not attend DE. Hypothesis 2 concerns the effect of DE attendance on driver's permit exam performance. Hypothesis 3 concerns the effect of permit exam performance on violations and crashes. Hypothesis 4 concerns the effect of DE attendance on violations and crashes. Variables with significant associations with each LP event or outcome were entered into five binary regression models performed separately for each sex, yielding five pairs of binary regressions. Table 3 summarizes these five pairs of models by listing the odds ratios and the corresponding significance level. Initial models included simultaneously all the appropriate explanatory variables listed in the left hand column. Final regression models presented in Table 3 always include age, SAAQ exam preparation, and the number of supervised hours of driving practice. Other variables are only shown if there is a significant odds ratio for at least one sex. Table 3 should be read in two ways: (i) by column – each model shows the variables with a significant association

with the event; differences emerge between the models for females and males; (ii) by row – variables emerge that are pertinent for several outcomes.

H1: Adolescents who attend DE are different than those who do not

In the study sample, more females (88.4%) than males (82.5%) attended DE. In Quebec, DE is defined as 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%) than males (56.9 %) 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 events and 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.

Table 3
Estimation of the odds ratio, (OR), of the occurrence of various licensing process events and outcomes, controlling for sex, derived from five separate binary-logistic regression models (blank fields indicate non-inclusion in respective models)

Explanatory variables		Licensing process events and outcomes									
		DE attendance		Theory exam (1st time success) for learner's permit		Road exam (1st time success) probationary permit		Violations (1 or more during 1st 450 days)		Crashes (1 or more during 1st 450 days)	
		F (OR)	M (OR)	F (OR)	M (OR)	F (OR)	M (OR)	F (OR)	M (OR)	F (OR)	M (OR)
Age	16-17 (vs. 18-19)	1.88 ***	1.61 ***	1.06	1.26 **	1.25*	1.24 *	1.17	1.54 *	1.29	0.95
SAAQ exam preparation	No DE			(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
	DE driving only			0.90	0.79 *	0.93	1.38 *	0.95	1.02	1.09	1.03
	DE theory & driving			1.76 ***	1.62 ***	1.11	1.20	1.06	1.05	1.19	0.93
During learner's permit, number of supervised driving practice hours	<25	3.54 ***	1.54 **			1.29	1.09	0.80	0.71 **	0.61 *	0.70 *
	25-50	0.62 *	0.90			0.91	0.95	0.82	0.98	1.08	1.19
	> 50	(ref)	(ref)			(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Before learner's permit, experience (vs. no experience)	Moped or motorcycle in traffic									0.88	1.43 **
	Driving cars unsupervised	0.79	0.80 *	0.72 ***	0.88						
High self-confidence cycling in traffic (vs. low self-confidence)								0.98	1.69 *		
Self-rated learning to drive as "easy" (vs. difficult)						1.40 **	1.55 ***	1.54 ***	1.01		
Driving practice supervisors	Mainly parents					1.23 *	1.25 *	0.78 *	0.97		
	Parents & friends					(ref)	(ref)	(ref)	(ref)		
Owns or plans to buy a car (vs. no mention of ownership)								1.43 **	1.48 ***		
Anticipated reasons and times for driving (vs. no mention of activity)	Work - weekdays							1.38 **	1.18 *		
	Errands - weekend evenings	0.75 *	1.34 **								
	No special reason – weekend days			1.26 **	1.00						
Costs paid by family (vs. by novice alone or with family help)	Insurance					1.40 *	0.84				
	Car purchase	1.57 **	1.34 *			0.66 **	1.30				
	Gasoline					0.63 **	0.91				
	Repairs									0.49 **	0.87
Works full time or seeks full time work (vs. no mention)		1.06	0.81 *	0.96	0.82 **						
1st time performance on permit exams	Passed both theory & road							(ref)	(ref)	(ref)	(ref)
	Passed theory but not road							1.00	0.62 *	1.45	0.73
	Passed road but not theory							1.17	1.47 **	1.02	1.50 *
	Failed both theory & road							0.95	0.96	1.18	0.91
Violations in 1st 450 days	Zero									(ref)	(ref)
	One									0.80	0.89
	Two or more									3.64 **	1.64 **

*p<.05; ** p<.01; p<.001 ***

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 measuring attitude to risk (Maag, Nadeau, & Hirsch, 2004 in Appendix 10). 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 the suburbs), or family stability, as reflected by living with both parents compared to only one.

Hypothesis 2: DE attendance improves performance on theory and road exams

For both sexes, success on the first attempt on the theory exam was associated with attendance to DE courses that include theory. Table 4 shows that 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.

Table 4
Pass rates for 1st attempt at the learner's permit theory and probationary permit road exams by age controlling for sex

Sex	Age	n	Theory exam (% successful on 1st attempt)	Road exam (% successful on 1st attempt)
F * ††	16-17	438	74.0	81.5
	18-19	380	67.4	72.4
M *** ††	16-17	553	70.9	82.5
	18-19	433	56.6	73.7

$\chi 2$ with 1 df, theory exam, * p<.05; *** p<.001; road exam, †† p<.01

Table 5 shows that the actual number of practical driving lessons taken is variably related to first time success on the road exam. Females with the fewest lessons had the highest pass rate of any group, followed by males with exactly 12 lessons. Females and males with the most lessons had the lowest pass rates.

Table 5
Road exam success rates on the first attempt according to number of driving school lessons controlling for sex and age

Sex	Number of 1h lessons	n	Road exam (Success rate per 100 drivers)
F *	< 12	66	87.9
	exactly 12	536	78.5
	> 12	109	69.7
M **	< 12	102	77.5
	exactly 12	602	84.1
	> 12	104	72.1

χ 2 with 2 df, * p<.05; ** p<.01

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 6 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% females, 60.9% males). The highest failure rate for both theory and road exams combined, 19.1%, more than twice the rate of any other subgroup, belongs to males who did not take DE at all.

Table 6
Rates of combined first time exam performances 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 ***	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 ***	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

χ 2 with 6 df, *** p<.001

Table 7 shows that, compared with participants from the other two exam preparation method groups, proportionately more participants of both sexes who attended DE theory and driving courses had less supervised driving practice outside driving school lessons – proportionately more had fewer than 25 hours and proportionately fewer had more than 50 hours. Conversely, for both sexes, the non-DE group had the greatest proportional representation in the 50 hours or more category of driving practice. Over 85% of the non-DE group had over 25 hours of practice driving compared to less than 56% of the two DE groups combined. Interestingly, no significant association was found when the variable for driving practice hours was added to the binary logistic regression model predicting road exam success (see Table 3).

Table 7
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)
F ***	No DE	89	14.6	40.4	44.9
	DE driving only	177	41.8	31.1	27.1
	DE driving & theory	499	46.7	35.5	17.8
M **	No DE	157	25.5	37.6	36.9
	DE driving only	242	36.8	33.5	29.8
	DE driving & theory	471	39.9	35.7	24.4

χ 2 with 4 df, ** p<.01; *** p<.001

Hypothesis 3: Good performance on permit exams is inconsistently related to safer driving

Tables 8 and Table 9 respectively show the complete binary regressions for violations and crashes that are summarized in Table 3. These binary regression models measure the association between exam performance and driving outcomes taking into account other influences, e.g. age, driving practice. For females, passing driver's permit appears to be unrelated to violation or crash rates. For males, passing the theory exam and failing the driving exam on the first attempts is associated with a decreased risk of having violations (OR 0.68), and the reverse pattern of failing the theory exam and passing the driving exam on the first attempts is associated with an increased risk of having violations (OR 1.50). Regarding crashes, for males, failing the theory exam and passing the driving exam on the first attempts is associated with an increased crash risk (OR 1.50).

Hypothesis 4: Overall, DE attendance is not associated with safer driving

As indicated in Tables 8 and Table 9, the method of preparation for the permit exam, i.e. no DE, DE driving only, or DE theory and driving is not associated with violation or crash risk. This apparent lack of association may be related to the influences or confounding effects of differences in exposure, family support, and individual traits. Regarding exposure, Table 8 and Table 9 indicate three variables that are associated with increased risk of violations and crashes for females and males that are potentially related to driving exposure: owning or planning to own a vehicle, anticipating driving for work reasons during weekdays, and; having fewer than 25 hours of supervised driving practice during the learner's permit. The relationship between the first two variables and exposure is reasonably self-evident, the relationship between the third variable and exposure requires some explanation.

Table 8
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

Predictor variables	Females (n= 723)			Males (n= 832)		
	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 *	1.11 - 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 *	0.38 - 0.98	11.3	0.71 **	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 *	1.09 - 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 ***	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 *	0.61 - 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 **	1.13 - 1.80	19.4	1.48 ***	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 **	1.08 - 1.75	16.3	1.18 *	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 **	1.01 - 1.95	40.5
Passed theory not road	0.95	0.48 - 1.87	12.8	0.62 *	0.42 - 0.92	23.0
Passed both	Reference group		11.4	Reference group		34.6

*p<.05; ** p<.01; *** p<.001

Table 9
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

Predictor variables	Females (n= 730)			Males (n= 836)		
	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 *	0.38 - 0.98	4.0	0.70 *	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 **	1.15 - 1.77	20.0
No	Reference group		6.3	Reference group		9.1
Vehicle repair costs paid by						
Family only	0.49 **	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 *	1.02 - 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	0.89	0 .64 - 1.24	14.0
Two or more	3.64 **	1.42 - 9.32	36.4	1.64 **	1.14 - 2.36	25.8

*p<.05; ** p<.01; ***

The data indicate that there is a probable relationship between practice hours during the learner's permit and driving exposure with a probationary permit. Table 10 shows that the proportion of participants of both sexes with learner's permits who anticipated having access to a vehicle during the probationary permit "often to always" vs. "sometimes to never" increases as the number of practice hours during the learner's permit increases. Table 8 shows that as practice hours increase from less than 25 to over 50, violation rates increase from 11.3 to 19.2 for females and from 27.4 to 43.7 for males. Table 9 shows that as practice hours increase from less than 25 to over 50, crash rates increase from 4.0 to 10.3 and for females and from 8.5 to 15.5 for males. A separate chi-square cross tabulation (not shown) found that all these differences were statistically significant at .05 or less.

Table 10
Anticipated access to vehicles during probationary permit by supervised driving practice hours during learner's permit controlling for sex

Sex	Hours of supervised driving practice	n	Anticipated access to vehicles during probationary permit	
			Never to sometimes	Often to always
F **	< 25	315	33.3	66.7
	25 to 50	266	27.4	72.6
	> 50	176	19.3	80.7
M ***	< 25	317	34.2	65.8
	25 to 50	308	23.0	77.0
	> 50	245	12.9	87.1

$\chi 2$ with 2 df, ** p<.01; for males *** p<.001

Separate three-way tables examined violation rates and crash rates by method of exam preparation, (no DE, DE driving only, DE theory and driving), and hours of driving practice, controlling for sex. Small numbers in certain cells do not allow for strong conclusions, however, the Tables indicate that violations and crashes increase as practice hours increase regardless of method of exam preparation. Table 11 illustrates that the crash rate for females with DE theory and driving and more than 50 hours of supervised practice is 12.4, triple the rate for females with DE theory and driving and less than 25 hours of supervised practice, and higher than the crash rates of all other combinations of permit preparation and hours of practice.

Table 11
Rates of one or more crashes per 100 female novice drivers by permit preparation method and number of hours of supervised driving practice. n ( )

		Number of hours of supervised driving			
	Permit preparation method	< 25	25 to 50	> 50	Total
Rates of one or more crashes per 100 female drivers	No DE	0 (13)	5.6 (36)	7.5 (40)	5.6 (89)
	DE – only driving	2.7 (74)	7.3 (55)	8.3 (48)	5.6 (177)
	DE – theory & driving	4.1 (233)	5.6 (177)	12.4 (89)	6.2 (499)
	Total	3.8 (320)	6.0 (268)	10.2 (177)	6.0 (765)

For females, one variable that might indicate greater family support associated with decreased risk of violations is supervision of driving practice mainly with parents vs. friends and parents. Decreased risk of crashes, for females, is associated with another potential indicator of greater family support, complete financial support from family for vehicle repairs.

Some variables that are associated with increased risk of violations appear to be associated with differences in individual traits. Increased risk of violations was associated, for males, with being 16 to 17, and with high self-confidence riding a bicycle in traffic before the learner's permit, and for females, with greater self-rated facility in learning to drive. For both sexes, another variable associated with increased risk of crashes that potentially indicates individual differences in compliance with traffic laws is having two or more violations. For males, one variable that is associated with increased risk of crashes that potentially indicates a difference in individual traits is experience in traffic before the learner's permit with mopeds or motorcycles.

The potential confounding effects of the three groups of variables, exposure, family support, and individual differences, on evaluations of DE's safety benefits is more evident when Table 4 is read horizontally and the influence of one variable, while controlling for the influences of other variables on multiple events, is easier to observe. As discussed earlier, supervised practice hours is a potential proxy variable for exposure. Fewer than 25 practice hours, compared to over 50 hours of practice, is associated with three events or outcomes in Table 3 - for both sexes, fewer practice hours is associated with increased likelihood of DE attendance and lower risk of crashes, and for males, fewer practice hours is associated with lower risk of violations. However, for both sexes, family support for car purchase is associated with DE attendance, and car ownership is associated with increased risk of violations. For males, high self-confidence cycling in traffic is associated with increased risk of violations, and experience before the learner's permit with mopeds or motorcycles in traffic is associated with increased crash risk. For both sexes, self-rating driving as easy to learn is associated with first time success on the road exam and for males, greater ease of learning is associated with increased risk of violations. For both sexes, younger ages are positively associated with DE attendance and success on the road exam, and for males, younger ages are positively associated with theory exam success and increased risk of violations. For both sexes, increased risk of violations is associated with increased risk of crashes.

Hypothesis 5: The motivations of adolescents who do and do not attend DE courses vary in ways that influence safety

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 84% from both DE and non-DE groups gave eligible responses. All but three of the participants who did not attend DE, 35% 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% of the participants, followed by (a) and (c) together for 72%. 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 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, Table 6 shows 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% female, were organized into three mutually exclusive groups by type of motivation, learning, opportunity, or mixed, that account for 99.6% 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% of females attend DE for learning reasons, compared with only 14.7% of the males. Over 60% of females attend DE for mixed reasons, compared to 78.8% of males. Almost no females (1.0%) and relatively few males (6.5%) reported attending DE exclusively for opportunity reasons. For analysis purposes, the opportunity group and the mixed group may be combined.

Table 12 shows the results of cross tabulating DE motivation by age controlling for sex. For males, less than 14% at age 16-17, and less than 21% at age 18-19 attended DE for learning reasons. By comparison, for females, more than 35% at age 16 and more than 43% at age 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.

Table 12
Motivation for attending DE by age controlling for sex

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

χ 2 with 2 df, * p<.05

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 13 shows that motivation to attend DE is directly and linearly associated with higher rates of violations and crashes - the learning motivation group had the lowest rates, the mixed motivation group has the next highest rates, and the opportunity motivation group has the highest rates of violations and crashes.

Table 13
DE motivations and violations and crash rates per 100 drivers for first 450 days of probationary permit

DE motivations	n	Violation rates per 100 drivers ***	Crash rates per 100 drivers *
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

χ2 with 2 df, * p<.05; *** p<.001

Hypothesis 6: The quality of DE courses varies in ways that influence safety

Quality in driver education is difficult to define and measure. However, one fairly unambiguous indicator of poor quality would be a lack of professional standards. In Quebec, DE certificates that are redeemable for the time-discount with the SAAQ are granted by driving schools to permit candidates who have successfully completed a minimum of 12 hours of practical driving lessons. Within our study sample, 74.9% of the DE students reported taking exactly 12 lessons, 13.9% reported more than 12, and 11.1%, 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 14 shows that the less-than-12 subgroup had a higher rate of two or more violations than the 12-or-more group.

Table 14
Comparison between the less-than-12 and the 12-or-more DE lesson groups in relation to violations during first 450 days with probationary permit

DE lesson groups ***	n	Violation rates per 100 drivers		
		Zero violations	One or more violations	Two or more violations
Less-than-12	105	63.8	19.0	17.1
12-or-more	1,699	76.3	17.3	6.4

χ 2 with 2 df, *** p<.001

Table 15 shows a similar result in relation to crashes - although the statistical association is marginally significant, the less-than-12 group appears to have a higher rate of crashes than the 12-or-more group. These results appear to be associated with differences in their respective motivations for attending DE.

Table 15
Comparison between the less-than-12 and the 12-or-more DE lesson groups in relation to crashes during first 450 days with probationary permit

DE lesson groups	n	Rates of one or more crashes per 100 drivers (% within group)
Less-than-12	105	15.2
12-or-more	1,699	9.3

χ 2 with 1 df, † p<.10

Table 16 shows that the less-than-12 group were motivated more for opportunity than for learning reasons. Although the differences do not reach statistical significance, when the mixed and opportunity motivation groups are combined, the differences between the less-than-12 and the 12-or-more groups become significant for both sexes

Table 16
Motivation for attending DE by lesson groups

Lesson groups	n	Motivations for DE attendance		
		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

DISCUSSION

As predicted by previous research, the study data support hypothesis 4 that DE attendance is not associated with safer driving. 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. This exploration was organized under the remaining five hypotheses.

The study data supports hypothesis 1, 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% (Waller, Elliott, Shope, Raghunathan, Trivellore, & Little, 2001) or 6% (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 20-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-expense, and to have at least one parent with a university education, an indicator of higher socio-economic 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 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% for females and 182% 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% higher crash risk – the author found it "difficult to believe that practice does not help to improve a driver's skills."

There are two potential and complementary explanations for why more practice with a learner's permit is associated with greater crash risk with a probationary permit. One is increased exposure and other is increased driver risk-taking due to 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, 1990). Therefore, novice drivers are initially exposed to complex, demanding traffic situations that exceed their objective abilities and judgments. After sufficient driving experience, objective skill levels for most drivers will more closely match actual driving demands and over-confidence will decrease.

Precisely how much driving experience is required before over-confidence decreases 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 IIHS (2001) 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 US 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.

Hypothesis 2, that DE attendance improves performance (measured as success on the first attempt) on the permit exams (theory and road), is also partially supported by the study data. 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.

The study data supports Hypothesis 3, that good performances on permit exams, (theory and road), are 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 reasons why this particular combination of exam performances is associated with higher crash risk are not known, but Hirsch and Maag (2001) have suggested that this information can be used to study this subgroup in order to understand better the cause of their increased risk and to develop more effective preventive strategies.

The study data support Hypothesis 5, 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. The data show age and sex effects, younger candidates and females are more likely to attend DE exclusively for learning motivations – over 86% of the 16 to 17 year old males attended DE exclusively or partially for opportunity reasons.

Motivation to attend DE potentially confounds DE evaluations in 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% 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% 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.

Hypothesis 6 relates the quality of DE courses to safe driving outcomes. Testing this hypothesis is problematic because DE quality is difficult to define and measure. Nevertheless, an argument was 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% of our sample reported taking less than 12 hours of driving lessons but appeared to have obtained a DE certificate for 12 hours from one or more driving schools. Allegedly obtaining a fraudulent DE certificate is consistent with the motivation of the 6% subgroup who were less likely to attend DE exclusively for learning motives and more likely to attend DE exclusively or partially for opportunity motives. The driving records of this 6% subgroup are also 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% 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, and 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, and that these transactions would be difficult to detect by licensing authorities.

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, Simpson, Desmond, & Williams (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 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 with the highest crash rates use the DE time-discount incentive. Therefore, if licensing authorities are not prepared to protect adolescents and the public by raising the driving age or by ensuring that each novice driver has at least 120 hours of supervised practice before driving alone, then at least they should seriously consider discontinuing the DE incentives that allow adolescents to license earlier.

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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_____	○	○	○

CHAPTER 4

ARTICLE 2:

SELF-RATED DRIVING ABILITIES, RISK-TAKING ATTITUDES, AND FIRST YEAR DRIVING RECORDS OF ADOLESCENTS

Pierro Hirsch, Urs Maag, and Claire Laberge-Nadeau

Université de Montréal

ABSTRACT

Problem: Adolescent driver crash risk is associated with risk taking. Risk taking may result from overestimating driving skills in relation to driving dangers and risk avoidance may result from insight into the limitations of driving skills. These hypotheses require validation.

Objectives: This research paper explores three questions. One, do novice adolescent drivers who self-rate skills highly have more violations and crashes (the overestimation hypothesis)? Two, do novice adolescent drivers who self-rate safety highly have fewer violations and crashes (the insight hypothesis? Three, is there an interaction between these two hypotheses?

Method: A prospective cohort study was conducted of male and female novice drivers, aged 16- to 19-years old (n=1,804) in Quebec. Participants completed an extensive, 149-item questionnaire covering methods of learning to drive, including self-rated driving skills and safety, risk-taking perceptions and attitudes, and; lifestyle and driving exposure-related questions. Questionnaire responses were anonymized and combined with government records of permit exam performances and violation and crash records for the first 450 days of the probationary driving permit.

Results: The findings weakly support the overestimation hypothesis for a relatively small subgroup of females, and the insight hypothesis for the majority of females. However, the data show that when skill and safety self-ratings are combined, the new subgroups of paired self-ratings appear, for nearly half of the males, to be almost self-fulfilling prophecies of future crash rates - controlling for exposure, the highest crash rates were recorded by the subgroup that rated their own driving skills good and unsafe, and among the lowest crash rates were recorded by the subgroup that rated their driving skills good and safe. Also of interest is the finding that reduced crash risk for males is associated with confidence in preventive habits and not with confidence in driving skills.

Discussion: Recommendations are made regarding future research on understanding and positively influencing the development of driver self-ratings and scientifically validating a protocol of risk-reducing behavior that can guide driver permit evaluations, driver training, and other crash prevention interventions.

Keywords: adolescent drivers, self-rating, overestimation, insight, risk perception, lifestyle, crash risk.

INTRODUCTION

The World Health Organization (WHO) defines road traffic injury (RTI) as a preventable, non-random event (WHO, 2001). Despite the promise of controllability inherent in this definition, RTI is the leading cause of adolescent death in high-income countries (WHO, 1999). As Elvik (2004) points out, "most road safety measures have to influence human behavior in order to be effective." One explanation for adolescent RTIs is their risk-taking behavior, e.g. excessive driving speeds (Mayhew & Simpson, 1990). Risk-taking behavior is associated with lower risk perceptions which are determined, according to Groeger and Brown (1989), by a combination of lower perceptions of danger - underestimations of the likelihood or seriousness of negative outcomes, and higher self-ratings of driving skills - overestimation of ability to cope with danger. Gregersen (1996) suggests that if a driver believes he has the skills to handle a dangerous situation, "then the situation is not interpreted to be as dangerous as it would be by a driver who underestimates his skill," and concluded that overestimation of skills, especially by young males, probably contributes to higher crash risk. This is called the overestimation hypothesis.

The overestimation hypothesis implies that the correction for unrealistic confidence in driving skills is to train novice drivers to develop insight into the limitations of driving skills in relation to driving dangers. Gregersen (1996) conducted an experiment with 53 novice drivers and found that training for insight rather than skill reduced self-reported overestimation – however, to the best of my knowledge, there is no evidence to date that insight training reduces violation and crash rates. The idea that novice adolescent drivers who understand the limits of skill are safer can be conceptualized as the insight hypothesis.

Crash risk, especially for adolescents, is highest in the first few months after obtaining a full driver's permit (Maag, Laberge-Nadeau, Cedras, Desjardins, & Messier, 1999; Mayhew, Simpson, & Pak, 2003; West & Hall, 1998). Many of these crashes might be due, in part, to novice adolescent drivers overestimating their skills in relation to driving dangers. Therefore, the optimal time for novice adolescent drivers to develop insight about their driving skills would be *before* they are granted permits for unsupervised and relatively unrestricted driving.

With the goal of developing interventions to help adolescents develop insight into driving abilities, a wealth of research was reviewed and 60 articles including four literature reviews on the relationships between self-rating, risk-taking tendencies and behaviors, and driving outcomes were

analyzed. The results of the literature review are mixed in relation to the overestimation hypothesis – self-rated skills are associated in variable directions with violations and crashes. However, the review found that self-rated safety is consistently associated in the expected directions with violations and crashes. A prospective cohort study of novice drivers 17- to 20-years old of both sexes using self-reported crash rates found that, controlling for mileage, lower crash rates were associated with higher self-ratings for ease of learning, good driving, safe driving, and self-ratings of low probability of crash involvement (West & Hall, 1997). Roach, Taylor, and Dawson (1999) found that higher self-ratings of skill were associated with higher rates of speeding violations and higher self-rated safety was associated with fewer crashes and fewer speed violations. Forsyth (1992) reported that novice adolescent males who rated themselves to be much better than the average driver had a crash risk 68% higher than those who rated themselves worse than average. Harrington (1972) found that the 16- to 17-year old males who self-rated their driving skills as lower had higher crash rates and that novice drivers of both sexes who rated themselves as less safe had higher crash rates. McKay, Coben, and Larkin (2003) found that adolescent self-ratings of lower crash risk relative to others their age was the only predictor in the final model associated with a lower risk of crashing. Karlaftis, Kotzampassakis, and Kanellaidis (2003) analyzed 17,000 questionnaires from the European SARTRE 2 database and found that drivers who rated themselves as both more dangerous and faster than others reported breaking the speed limit more frequently, not wearing seat belts, and being involved in more crashes in the past than other drivers.

The potential influences of sex and driving experience on self-ratings of driver ability deserve mention. Males more than females tend to self-rate their driving abilities higher than the average driver (Williams, 2003). Males may seek out, and may be given access to, more opportunities to gain driving experience, possibly due to the combined influences of biology (see Kimura, 2000) and culture (Good, Sherrod, & Dillon, 2000). Relatively little practice is needed to increase adolescent male self-ratings of driving skills. Wittink and Twisk (1990 in Organization for Economic Co-operation and Development, 1994) found that after only a few hours or days of unsupervised driving, young novice male drivers rated themselves as equal to older males and better than elderly and female drivers - instead of behaving defensively due to lack of experience, they drove too fast and followed too closely. Brown (1982) argues that their lack of understanding of danger leads young males to develop self-ratings that are greater than their actual abilities. Rumar (1985) reverses the causality and contends that the initial higher self-ratings by young male drivers create a 'cognitive filter' that prevents them from properly understanding driving dangers. Neither argument considers fully the effects of driving experience on the self-ratings of both sexes.

There is evidence that the stereotypical sex differences in self-rated driving abilities and driving styles are partially due to different levels of driving experience. Spolander (1983) argues that females, having less driving experience relative to males, tend to adopt a more defensive driving style because they overestimate the traffic complications and underestimate their own potential, whereas males adopt a more aggressive driving style. Laapotti, Keskinen, and Rajalin (2003) noted that females, compared with males, consistently had a more positive attitude towards safety and that they also drove less. Moreover, when both sexes have approximately equal experience, the gap between their respective driver self-ratings narrows. McKenna, Stanier, and Lewis (1991) report that when driving experience was statistically controlled for, sex differences in self-rated abilities were substantially reduced. Harrison (2004) found that with only 100-200 kilometers of driving experience over a time period of 2-3 months, novice drivers of both sexes achieve high levels of confidence.

With the exception of the experimental results mentioned above (Gregersen, 1996), relatively few findings in the literature review provide clear indications of how to develop interventions to reduce overconfidence and increase insight among novice, adolescent drivers. Therefore, more needs to be known about the factors that influence the development of adolescent driver self-ratings of skill and safety, and how self-rated skills and safety are associated with risk-taking tendencies and violation and crash rates. To address these and other questions concerning adolescent drivers, the researchers conducted a prospective cohort study. Three of the study objectives that are presented in this article are: 1) to verify and explore the overestimation hypothesis that predicts that higher self-rated driving skills, ease of learning, and increased risk taking tendencies are associated with higher rates of violations and crashes; 2) to verify and explore the insight hypothesis that predicts that higher self-rated safety, lower estimates of crash risk, and lower risk taking tendencies are associated with lower rates of violations and crashes, and; 3) to study the interaction between self-rated skill and self-rated safety - to the best of our knowledge, this last topic has not been explored prior to the present research project.

METHOD

A prospective cohort study of 1,804 novice drivers of both sexes, 16 to 19 years of age, was conducted in Quebec that linked together and analyzed data from two sources, an extensive questionnaire on learning methods, risk taking, and lifestyles, and official records from the Société

de l'assurance automobile du Québec (SAAQ). For each study participant, the following records were available: performances on theory and road exams, and violations and crashes for the first 450 days of unsupervised driving with a probationary permit.

Participants

Participants were recruited from among candidates who had just passed their probationary permit road exams at SAAQ permit exam centers in and around Montreal. An incentive was offered in the form of a lottery for one of 33 available $100 prizes. Of the initial 2,134 participants who completed the first questionnaire, 1,804 (818 female), met the criterion of providing legal consent to access driving records. The mean age of the total sample for both females and males is 17.9 years.

Data sources

Data were collected from two sources, a questionnaire and SAAQ files. 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. With the permission of the SAAQ, the questionnaire was distributed and collected by four trained students on site in three service centers that administer the practical road exam and that delivers the probationary driver's permit to qualified candidates - one service center was located in urban Montreal and the other two in the suburbs, allowing access to drivers from both driving environments. Each participant signed a consent form to allow access to their driving records, and those below 18-years of age also had their consent forms signed by a parent or guardian on site or returned to the lead researcher in a stamped, self-addressed envelop that was available with each questionnaire. A participation incentive was offered in the form of a chance to win one of 33 prizes of $100 in a lottery.

The questionnaire contained 149 items organized into three sections (see Appendix 4). The first section collects information about self-rated learning and driving abilities, the process of learning how to drive, experience before the learner's permit with non-motorized and motorized vehicles, and hours of supervised driving practice. The second section consists of psychometric measures 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, and expectations about car ownership and driving patterns. The lifestyle habits questionnaire was derived from the work of Shope, Waller, Raghunathan, and Patil (2001). The English and the French versions of the questionnaire were pilot-tested for comprehension and ease of use with adolescent students from a driving school.

Government driving records were compared with the following questionnaire items: self-ratings of four dimensions of driving ability; scores from psychometric instruments of risk-taking attitudes and perceptions, and; a selection of descriptive variables related to driving experience, exposure, academic habits, and lifestyles.

Self-ratings

Participants were asked to signal their agreement, using a three-point scale, (very true, somewhat true, not at all true), to four statements about driving abilities - "I found driving easy to learn" and "I am a good driver" refer to the overestimation hypothesis, and "I am a safe driver", and "the probability that I will be involved in a crash over the next year is small" refer to the insight hypothesis. Following the examples of Sivak, Soler, and Trankle (1989) and Lajunen and Summala. (1995), participants were asked to self-rate on the basis of their own experiences and judgments and not in relation to other drivers, a popular method strongly criticized by Groeger (2000). Each answer was later recoded into binary variables. The variables easy, safe, and good were recoded as follows: 1 = yes, for very true, and 2 = no, for somewhat or not at all true. The variable for crash risk was recoded as 1 = low probability, and 2 = medium or high probability.

To the best of our knowledge, the next treatment of the data is original and requires an explanation. Erikson (1971) observes that during adolescence, discrepancies or incongruities of different magnitudes are part of the development and integration of the individual's self-identity. Driving abilities are arguably part of self-identity (see Markus and Nurius, 1986) and therefore, adolescent drivers' self-ratings are also likely to exhibit discrepancies or incongruities. This could explain, in part, how in one focus group 30% of the females who rated themselves as safe drivers also reported that they used their seatbelts rarely or never (Basch, De Cicco, & Malfetti, 1987). To explore the effects of normal adolescent incongruity, Hirsch & Maag (2002) combined a pair of binary self-ratings, safe and good, to create one variable, "safe-good", with four distinct, mutually exclusive subgroups: "good & safe"; "not good & safe"; "not safe & good", and; "not good & not safe"; Chi-square cross tabulations with the safe-good variable showed that the "good & not safe"

subgroup, compared to the other three subgroups, contained proportionately more males, licensed at a younger age, and showed greater risk-taking tendencies. To address the third objective of this article, the exploration of the interaction between self-rated skill and self-rated safety, all the binary skill and safety self-ratings in the study were combined into unique pairs, creating four variables: "easy-safe"; "easy-crash risk"; good-safe, and; "good-crash risk." Each of these paired variables yields four distinct subgroups, as in the example of the safe-good variable described above.

Psychometric scales

Prior to creating the questionnaire, the literature was reviewed for examples of psychometric scales of risk taking attitudes and perceptions. The three selection criteria were: demonstrated associations with risk-taking behavior or violations or crash rates; diversity of constructs, and; brevity. The following scales were chosen: the Attitude to Driving Violations Scale (ADVS) developed by West and Hall (1997); the Social Motivation Questionnaire (SMQ) yielding a score of social deviance, developed by West, Elander, and French (1993); time perspectives questionnaire that measures an individual's value for events in the present and future, developed by Chebat and Chandon (1986). A general risk perception questionnaire (GRQ) with non-driving items was constructed based on the work of Perkins et al. (1997) and Zuckerman (1979). Two driving risk questionnaires were constructed based on the work of Audet and Malet (1993), one for high-risk scenarios (DRQ-high), e.g. alcohol and speed, and the other for normal driving scenarios (DRQ-normal), e.g. night and rain. Finally, a crash beliefs questionnaire (CBQ) that adapts concepts from Becker (1974) and Bandura (1988) was created by the author.

The CBQ represents an original contribution to the field of crash prevention research that aims at discovering how drivers perceive crash risk, using the crash-susceptibility and injury-risk scales, and by measuring two potential sources of confidence in their ability to prevent crashes, driver self-confidence and preventive-habit confidence. The CBQ consists of four common crash scenarios, being rear-ended at a red light, hitting the vehicle in front that stopped on an expressway, being hit on the side in an intersection after accelerating on a fresh green light, and driving off the curve on a country highway. Each crash scenario is related to four different dimensions or scales of cognitive beliefs about crashes. Two of the four scales are inspired by the work of Bandura (1986): self-efficacy, defined as the "belief that one can achieve what one sets out to do", and; outcome expectation, defined as "a person's estimate that a given behavior will lead to certain outcomes" (Glanz, Lewis, & Rimer, 1990). Bandura only inspires these dimensions because the direct

application of his constructs requires the description of specific behaviors oriented towards specific goals and, as mentioned in the introduction, authoritative protocols of specific driving behaviors to prevent specific crashes do not exist. The adaptation of the self-efficacy construct was phrased as follows: "Given my abilities as a driver, the chances that I will be able to avoid this type of collision are..." with answers selected from a six-point Likert scale ranging from extremely high to extremely low. This is called the "driver self-confidence scale". The adaptation of the outcome expectation scale was phrased as follows: "Any driver can learn specific driving habits to reduce the risk of this type of collision..." with answers selected from a five-point Likert scale ranging from definitely to definitely not. This is called the "preventive-habit confidence scale."

Driver self-confidence and preventive-habit confidence may not be sufficient to motivate safe driving behavior. Deliberate preventive behavior, by definition, is a response to a perceived threat. The CBQ measures perceived threat with two scales adapted from Becker's Health Belief model (1974): personal-vulnerability (or susceptibility), defined as "one's subjective perception of the risk of contracting a health condition" and; seriousness-of-consequences, defined as "feelings concerning the seriousness of contracting a health condition." The adaptation of the susceptibility scale, called the "crash-susceptibility scale", was phrased as follows: "The risk that this [crash] will happen to me while I am driving during the next few years is..." and the adaptation of the seriousness-of-consequences scale, called the "injury-risk scale", was phrased as "The chances that someone will be injured in this type of collision are..." Answers for crash-susceptibility and injury-risk were selected from a six-point Likert scale ranging from extremely high to extremely low.

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 dates and details about permit exam performances (theory and road), demerit point infractions, permit suspensions and revocations, and police-reported crashes. The data from the SAAQ covered the participants' complete history to the end of the first 450 days of holding a probationary permit and were available for the entire study population. Minor property damage only crashes that parties settle between themselves with the insurers' joint report are not recorded by the SAAQ.

Exposure measures

The research protocol included a follow-up survey on the quantity and quality of driving exposure for the first year of driving (Appendix 8). The follow-up survey was mailed to the study participants after one year of holding a probationary permit. The response rate was low (28%) and reminder letters could not be sent. Therefore, a proxy measure for exposure was developed using the data from the initial questionnaire.

Analyses

Due to the well-established differential between adolescent female and male violation and crash rates, the results are mostly analyzed and reported separately by sex. Age is measured at the date of issuance of the probationary permit and mostly analyzed according to two-year age groups, 16-17 vs. 18-19. Psychometric scales were factor analyzed (principle components): higher values of the factor score are associated with more risk-taking except for the CBQ, where higher factor score values are associated with more confidence or more perceived threat. Explanatory variables were cross-tabulated with outcome variables. Tables not presented here are available for consultation. Discrepancies may appear when summing the counts for some factors because some participants did not answer every question. Unless otherwise indicated, all associations reported are statistically significant at 5% or less.

The psychometric scales were factor analyzed and presented in Appendix 10. The ADVS scale yielded one principle factor. The SMQ scale yielded two factors. The time perspectives questionnaire yielded two factors, one for present time and the other for future time orientation. The general risk perception questionnaire yielded one factor. The driving risk perception yielded two factors, one for high-risk driving scenarios involving speed and alcohol (DRQ-high), and the other for normal driving scenarios like night and rain (DRQ-normal). The CBQ yielded four factors, one for each scale. Cronbach alpha scores for each factor are: ADVS = 0.70; SMQ = 0.68; present time perspective 0.44; future time perspective = 0.63; GRQ = 0.61; DRQ-high = 0.77; DRQ-normal = 0.77; driver self-confidence (CBQ) = 0.67; preventive-habit confidence (CBQ) = 0.77; crash-susceptibility (CBQ) = 0.78, and; injury-risk (CBQ) = 0.74.

Other descriptive variables used in the analysis come from a previous analysis of the same population (Hirsch, Maag, & Nadeau, unpublished manuscript) that found associations between driving records, (violations and crashes), and several items taken from the following categories in the questionnaire: 1) levels of experience and confidence operating motorized or non-motorized vehicles before holding a learner's permit; 2) hours of supervised driving practice during the learner's permit period; 3) anticipated access to vehicles and reasons and times for driving during the probationary period of unsupervised driving, and; 4) financial support from family for licensing- and driving-related expenses and status as a full time worker. Variables derived from government files that were also associated with crash risk were: 1) first time performances on the theory and road permit exams, and; 2) violation records for the first 450 days of unsupervised driving.

Limitations 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 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 combines 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 10.32 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 crashes 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 selection of a proxy measure for driving exposure and provides an overview of the sex distributions within the self-rating subgroups as well as violation and crash rates. The following sections examine the overestimation hypothesis and the insight hypothesis. The final section explores the interaction between these two hypotheses.

Proxy for driving exposure

In the questionnaire, several variables might potentially serve as a proxy measure of driving exposure. After many trials, the best choice proved to be the item for "anticipated access to driving during the probationary permit," recoded into a binary variable (never or sometimes = low exposure, often or always = high exposure). The anticipated access variable has the additional advantage of very few non-responses (9 out of 818 females and 18 out of 986 males). Table 1 for females and Table 2 for males show that the anticipated driving variable is associated with several other possible proxy variables for exposure. Note that the variable for hours of supervised driving practice with a learner's permit, (non-respondents, 53 out of 818 females and 116 out of 986

males), was found in a previous analysis of this sample to be associated with crash rates for both sexes and violation rates for males (Hirsch, Maag, & Nadeau, unpublished manuscript). A separate cross tabulation shows an association between anticipated driving with a probationary permit and traffic- and driving-related experience and confidence before the learner's permit. Anticipating driving often to always was associated: for both sexes, with high confidence cycling and rollerblading in traffic; for females, with high confidence driving on private roads under supervision, and; for males, with experience riding a motorcycle in traffic.

Table 1
A binary-logistic regression model for the proxy variable for exposure, "anticipated access to driving with a probationary permit" † for females

Predictor variables	n=750	
	OR	95% CI
Number of cars at home		
2 or more	1.61 ***	1.34 - 1.92
1 or none	Reference group	
Hours of supervised driving with learner's permit		
> 50	1.41 *	1.04 - 1.91
25 to 50	0.97	0.75 - 1.25
<25	Reference group	
Anticipates driving on Friday & Saturday nights for socializing		
Yes	1.45 *	1.18 - 1.79
No	Reference group	
Owns now or plans to buy a car		
Yes	2.57 ***	2.02 - 3.27
No	Reference group	

*p<.05; *** p<.001

† high exposure = often or always vs. low exposure = sometimes or never

Table 2
A binary-logistic regression model for the proxy variable for exposure, "anticipated access to driving with a probationary permit" † for males

Predictor variables	n=844	
	OR	95% CI
Number of cars at home		
2 or more	1.53 ***	1.28 - 1.83
1 or none	Reference group	
Hours of supervised driving with learner's permit		
> 50	1.98 ***	1.47 - 2.67
25 to 50	0.97	0.76 - 1.26
< 25	Reference group	
Anticipates driving:		
Monday - Thursday daytime for school		
Yes	1.31 **	1.10 - 1.57
No	Reference group	
Monday - Thursday evening for errands		
Yes	1.28 **	1.07 - 1.53
No	Reference group	
Owns now or plans to buy a car		
Yes	2.30 ***	1.88 - 2.80
No	Reference group	

** p<.01; *** p<.001

† high exposure = often or always vs. low exposure = sometimes or never

Self-ratings of driving-related abilities

Table 3 shows the distributions in the responses to the self-rating questions by sex. Proportionately more males than females reported finding it easy to learn to drive, 50.5% to 28.5 % respectively, and being a good driver, 55.8 % to 47.7% respectively. Proportionately more females than males reported being a safe driver, 72.1% to 60.8 % respectively. There were no sex differences for self-rated low probability of accident, the item that had the lowest positive response rate for males, 41.1% and the second lowest for females, 39.3%. Because participants responded to the questionnaire immediately after passing the road exam, self-ratings might reflect this recent experience of success. Therefore, self-ratings were also cross tabulated with first time success on the road exam and found to be positively associated, for both sexes, with ease of learning and, for females only, with good and with safe driving.

Table 3
Self-rated driving abilities by sex

Self-ratings	Sex	n	Very true (% within sex)	Fairly or not at all true (% within sex)
Easy to learn to drive ***	F	814	28.5	71.5
	M	981	50.5	49.5
Good driver ***	F	809	47.7	52.3
	M	967	55.8	44.2
Safe driver ***	F	817	72.1	27.9
	M	975	60.8	39.2
Low probability of accident in next year	F	816	39.3	60.7
	M	977	41.1	58.9

$\chi 2$ with 1 df, *** $p<.001$

Associations between self-rating subgroups, violation and crash rates

Table 4 shows the violation and crash rates per 100 drivers during the first 450 days of unsupervised driving by self-ratings of driving abilities, controlling for sex. The first row of the Table gives the population means for violations, 12.7 for females and 34.2 for males, and, for crashes, 5.7 for females and 12.9 for males. Only one self-rating, ease of learning to drive, was associated with violations for both sexes, and none were associated with crashes, i.e. both sexes who found learning to drive easy have distinctly higher violation rates than those who did not find learning easy. However, when age and sex (but not exposure) were controlled, different patterns of association emerged. Self-rated ease of learning was associated with higher violation rates for 18- to 19-years old females, and with higher violation and crash rates for 16- to 17-year old males. Self-rated good driving was associated with higher violation rates for 16- to 17-year old males and 18-19 year old females, and, at a low level of significance ($p<.10$), with a *lower* violation rate for 17-year old females. Self-rated lower crash risk was associated with lower crash rates for 18-19 year old males.

Table 4
Violation and crash rates during first 450 days of unsupervised driving by self-ratings of driving abilities controlling for sex

Self-rating groups		Violations (1 or more per 100 drivers)				Crashes (1 or more per 100 drivers)			
		F	n	M	n	F	n †	M	n †
Total sample (n=1804)		12.7	818	34.2	986	5.7		12.9	
Single self-ratings of driving abilities									
Easy to learn *	Yes	19.8	232	37.8	495	6.5		14.9	
	No	10.0	582	30.7	486	5.5		10.9	
Good	Yes	13.0	386	36.5	540	5.7		13.9	
	No	12.1	423	31.4	427	5.9		11.5	
Safe	Yes	11.7	598	32.7	593	4.8		12.0	
	No	15.4	228	36.4	382	8.3		14.4	
Low crash risk	Yes	11.3	319	33.8	402	3.8		12.4	
	No	13.7	497	34.4	575	7.0		13.0	

† Subgroup populations same as for violations
* For violations only, for females, $p<.001$; for males $p<.01$

Violations and crashes were cross tabulated by sex (Table 5 and Table 6) for the self-ratings, controlling for exposure. For females, higher than expected violation rates are associated with the combination of ease of learning and high driving exposure (Table 5). For females, lower than expected crash rates are associated with the combination of safe driving and high driving exposure, and also with the combination of low crash risk and high exposure (Table 6). As exposure increases, rates of violations and crashes consistently increase, in many cases doubling, and in some cases tripling. These rates, particularly for males, tend to equalize for high exposure.

Table 5
Self-rated driving abilities and rates of one or more violations per 100 drivers controlling for exposure by sex

Sex	Self-rated ability		n	Rates one or more violations per 100 drivers	
				Low driving exposure	High driving exposure
F	Easy to learn	Yes	230	11.8	22.3 **
		No	575	5.5	11.9
M	Easy to learn	Yes	485	24.2	40.5
		No	478	16.2	37.0
F	Good	Yes	384	8.9	14.3
		No	416	4.4	15.8
M	Good	Yes	526	24.8	38.8
		No	423	15.9	38.8
F	Safe	Yes	584	7.4	13.5
		No	224	5.7	19.5
M	Safe	Yes	580	19.3	36.6
		No	377	19.4	42.2
F	Crash risk	Low	317	6.7	13.2
		High	490	7.0	16.4
M	Crash risk	Low	395	16.1	38.0
		High	564	21.3	39.4

** $p<.01$

Table 6

Self-rated driving abilities and rates of one or more crashes per 100 drivers controlling for exposure by sex

Sex	Self-rated ability		n	Rates one or more crashes per 100 drivers	
				Low driving exposure	High driving exposure
F	Easy to learn	Yes	230	0	8.4
		No	575	2.8	6.9
M	Easy to learn	Yes	485	10.5	15.5
		No	478	6.5	12.7
F	Good	Yes	384	3.3	6.5
		No	416	1.5	8.2
M	Good	Yes	526	9.9	14.1
		No	423	6.2	14.4
F	Safe	Yes	584	2.5	5.7 *
		No	224	1.4	11.7
M	Safe	Yes	580	5.7	13.4
		No	377	10.2	16.0
F	Crash risk	Low	317	2.2	4.4*
		High	490	2.1	9.2
M	Crash risk	Low	395	8.0	13.3
		High	564	6.9	15.1

* $p<.05$

Table 7 shows the results, for both sexes, of cross tabulations between self-rated driving abilities and two variables, the exposure proxy and homework time. Studies show that exposure is directly related driving risk. Homework time offers a plausible explanation or mechanism for risk-taking attitudes that might influence the quantity and quality of driving exposure. Cross tabulations (not shown) revealed that, for both sexes, reporting less than one hour of homework daily was positively associated with: 1) smoking cigarettes almost daily; 2) having all or most of one's friends as smokers; 3) drinking alcohol more frequently; 4) having less ambition to go to university and graduate school; 5) not living with both parents; 6) expecting to have access to vehicles always; 7) expecting to drive for no special reason on weekday nights and weekend nights, and; higher violation rates. For males only, reporting less than one hour of homework daily was also positively associated with higher crash rates. Table 7 shows that self-rated ease of learning and good driving are associated with higher levels of anticipated exposure, and that differences in self-rated safety, with the exception of males who self-rate crash risk as low, are not associated with differences in exposure. The Table also shows females report more homework than males and that relatively more homework time was reported by females who self-rated driving not easy to learn or safe or crash

risk low and by males who self-rated driving safe. Further cross tabulations (not shown) found that high exposure is also associated, for both sexes, with high confidence in traffic on non-motorized vehicles before the learner's permit, and with more hours of supervised driving practice with a learner's permit.

Table 7
Self-rated driving abilities by anticipated high exposure and reported average of one hour or more of homework daily by sex

Sex	Self-rated ability		Anticipated high driving exposure (% of self-rated subgroup)	n	One hour or more of homework daily (% of self-rated subgroup)	n
F	Easy to learn	Yes	77.8 *	230	58.6 **	199
		No	68.5	575	68.5	515
M	Easy to learn	Yes	80.4 ***	485	42.1	394
		No	67.8	478	48.4	403
F	Good	Yes	76.6 **	384	64.8	341
		No	67.1	416	65.9	369
M	Good	Yes	80.8 ***	526	44.5	443
		No	65.7	423	45.4	343
F	Safe	Yes	72.3	584	67.4 *	519
		No	68.8	224	58.9	197
M	Safe	Yes	75.9	580	48.9 **	485
		No	71.4	377	39.2	309
F	Crash risk	Low	71.9	317	70.6 *	282
		High	71.0	490	61.4	433
M	Crash risk	Low	78.0 *	395	45.4	335
		High	71.6	564	44.8	460

* $p<.05$; ** $p<.01$; *** $p<.001$

Overestimation hypothesis

According to the overestimation hypothesis, higher self-ratings of driving skill, e.g. ease of learning to drive and good driving, may increase risk-taking due to lower perceptions of danger and lead to higher violation and crash rates. Table 8 presents the results of binary logistic regressions, one for ease of learning and the other for self-rated good driving, each done separately by sex, yielding four separate models. The same set of explanatory variables was entered into each model - these included psychometric measures of risk perceptions and attitudes. For both sexes, age is not

associated with self-ratings. For both sexes, high exposure is associated with positive self-ratings for ease of learning and good driving. For both sexes, high scores on the DRQ for normal driving risk, e.g. snow, rain, expressways, are associated with ease of learning. For males, high driver self-confidence from the CBQ is associated with ease of learning, and for both sexes, high driver self-confidence is associated with self-rated good driving. For females, crash-susceptibility from the CBQ and a positive response to the questionnaire item that asked if any family member or friend had ever been a traffic injury victim were both negatively associated with self-rated good driving. For convenience, participants who answered yes to the question about family members or friend having been traffic injury victims are called positive for familiarity with road injury victims, or FRIV-positive.

Table 8
Binary-logistic regression models for self-ratings of ease of learning and good driving using age, driving exposure, familiarity with road injury victims, and psychometric factors as explanatory variables by sex

Explanatory variables	Positive self-ratings related to driving skill							
	Easy to learn				Good driver			
	Female (n=791)		Male (n=952)		Female (n=798)		Male (n=954)	
	(OR)	95% CI	(OR)	95% CI	(OR)	95% CI	(OR)	95% CI
Age								
16-17	1.00	0.85 - 1.17	0.89	0.78 - 1.02	1.10	0.95 - 1.27	1.09	0.95 - 1.25
18-19	Reference group		Reference group		Reference group		Reference group	
Exposure								
High	1.20 *	1.02 -1.47	1.40 ***	1.20 - 1.63	1.25 **	1.06 - 1.47	1.42 ***	1.26 - 1.66
Low	Reference group		Reference group		Reference group		Reference group	
DRQ-normal †	1.25 *	1.05 - 1.49	1.41 ***	1.23 - 1.61	1.03	0.88 - 1.21	1.13	0.99 - 1.29
CBQ - Crash-susceptibility †	1.02	0.86 - 1.20	0.98	0.86 - 1.12	0.80 **	0.69 - 0.93	0.96	0.85 - 1.10
CBQ - Driver self confidence†	1.00	0.86 - 1.19	1.26 **	1.10 - 1.43	1.26 **	1.08 - 1.46	1.23 **	1.08 - 1.40
FRIV								
Yes	1.06	0.95 -	1.03	0.90 -	0.82 **	0.71 - 0.94	1.13	0.99 - 1.30
No	1.24		1.18		Reference group		Reference group	

* p<.05; ** p<.01; *** p<.001
† Higher scores indicate riskier attitudes, greater perceived susceptibility to crashes, more self-confidence

To test the overestimation hypothesis, violations and crashes were used as dependent variables in binary regression models, done separately by sex and controlling for exposure. Self-rated ease of learning or good driving is not associated, for both sexes, with crashes, or with violations for males (Tables not shown). Table 9 shows the model for violations for females.

Females who rated driving easy to learn had a higher risk for violations, (OR 1.42), than those who did not. Females who anticipated high exposure also had a higher risk of violations, (OR 1.52). Every psychometric scale was introduced, one at a time, into the model and only the ADVS score, reflecting risky attitudes towards speed and other traffic laws, was associated with violation rates, (OR 1.43).

With specific reference to the overestimation hypothesis, it is interesting to note that although high driver self-confidence was associated with self-rated ease of learning for males, and with good driving for both sexes, high driver self-confidence was not associated with self-rated ease of learning for females. Further cross tabulations with questionnaire items (not shown) indicate that, compared to females who do not self-rate driving easy to learn, females who do self-rate driving as easy are more likely to: 1) report having experience and feeling very confident driving under supervision before the learner's permit and to; 2) attend DE courses for reasons totally or partially unrelated to learning; 3) succeed on the theory and the road exams on the first attempts; 4) anticipate higher driving exposure; 5) already own or plan to own a car; 6) have most of their friends who smoke; 7) smoke more frequently; and 8) do less than one hour of homework, on average, every day. A binary regression model for females found associations between reporting less than one hour of homework and risk tolerant scores on towards: driving violations (ADVS); high-risk driving (DRQ-high), and; normal driving (DRQ-low) - reporting less than one hour of homework was also associated with higher scores on the crash-susceptibility scale from the CBQ.

Table 9
Estimation of odds ratio, (OR), and rates of having one or more violations during the first 450 days of the probationary permit period per 100 adolescent novice drivers, for females, using a binary-logistic regression model

Predictor variables	n=805			
	OR	95% CI	Per driver violations (% per group)	n
Age				
16-17	1.03	0.67 - 1.57	13.3	430
18-19	Reference group		12.3	375
Driving exposure				
High	1.52 **	1.15 - 2.02	15.2	573
Low	Reference group		6.9	232
Self-rated easy to drive				
Yes	1.42 ***	1.15 - 1.77	20.0	230
No	Reference group		9.9	575
ADVS (Attitude to driving violations)				
Non-compliant	1.43 **	1.14 - 1.79	†	805

** p<.01; *** p<.001

† If factor score greater than or equal to 0, violation rate per 100 drivers = 15.1
If factor score less than 0, crash rate per 100 drivers = 11.2

Insight hypothesis

The insight hypothesis proposes that lower violation and crash rates are associated with higher self-ratings of safety, i.e. safe driving, low crash risk. Table 10 presents the results of binary logistic regressions, one for safe driving and the other for self-rated low risk of crashing, done separately for each sex, yielding four separate models. The same set of explanatory variables was entered into each model - these included psychometric measures of risk perceptions and attitudes. For both sexes, age is not associated with self-ratings. Exposure is only associated with self-rated low crash risk for males. High scores on the DRQ-normal, e.g. driving on snow, expressways, are associated, for males only, with self-rated safe driving and low crash risk. For both sexes, high driver self-confidence from the CBQ is associated with self-rated safety and low crash risk.

High scores on the ADVS, indicating risky attitudes towards traffic laws, are negatively associated, for both sexes, with self-rated safety and, for males only, with self-rated low crash risk. For males, self-rated safety was negatively associated with high scores on the SMQ, a measure of social deviance, and for both sexes, high SMQ scores were negatively associated with self-rated low crash risk. For males, a high score on the GRQ, measuring perceptions towards activities like bungee jumping, a potential marker for sensation seeking, was negatively associated with self-rated safety. For males only, self-rated low crash risk was negatively associated with being FRIV-positive. Table 10 also shows that, for both sexes, self-rated high crash risk was positively associated with high crash-susceptibility (CBQ) and high social deviance (SMQ). Also for both sexes, FRIV-positive status was associated with high crash-susceptibility (CBQ) and high social deviance (SMQ). For males, FRIV-positive status was associated with doing less than one hour of homework daily, high scores in social deviance (SMQ), and low scores in preventive-habit confidence (CBQ).

To test the insight hypothesis, violations and crashes were used as dependent variables in binary regression models, done separately by sex and controlling for exposure. Table 11 shows the regression model for self-rated safety for females. Each psychometric measure was introduced into the model, but none were associated with crash risk. However, self-rated safety is associated with a lower crash rate (OR 0.72) taking into account the exposure variable.

Table 10
Binary-logistic regression models for self-ratings of safe driving and low crash risk using age, driving exposure, familiarity with road injury victims, and psychometric factors as explanatory variables by sex

Explanatory variables	Self-ratings related to driving safety							
	Safe				Low Crash Risk			
	Female (n=799)		Male (n=952)		Female (n=798)		Male (n=954)	
	(OR)	95% CI	(OR)	95% CI	(OR)	95% CI	(OR)	95% CI
Age								
16-17	1.00	0.85 - 1.17	1.01	0.88 - 1.17	1.00	0.86 - 1.16	1.08	0.94 - 1.24
18-19	Reference group		Reference group		Reference group		Reference group	
Exposure								
High	1.07	0.90 - 1.27	1.14	0.97 - 1.33	0.99	0.84 - 1.17	1.18 *	1.00 - 1.39
Low	Reference group		Reference group		Reference group		Reference group	
DRQ - normal †	1.13	0.94 - 1.37	1.30 **	1.18 - 1.52	1.11	0.92 - 1.33	1.22 *	1.05 - 1.42
GRQ †	0.83	0.68 - 1.02	0.79 **	0.68 - 0.91	1.00	0.82 - 1.21	1.16	0.99 - 1.34
ADVS †	0.83 *	0.69 - 0.99	0.67 ***	0.59 - 0.78	0.68	0.80 - 1.15	0.81 **	0.70 - 0.93
CBQ - Crash-susceptibility †	0.94	0.79 - 1.12	0.92	0.80 - 1.05	0.54 ***	0.46 - 0.65	0.62 ***	0.54 - 0.72
CBQ - Driver self-confidence	1.22 *	1.03 - 1.44	1.22 **	1.07 - 1.40	1.29 **	1.10 - 1.51	1.36 ***	1.18 - 1.56
SMQ - social deviance †	0.85	0.71 - 1.00	0.77 ***	0.66 - 0.89	0.84 *	0.71 - 0.99	0.85 *	0.73 - 0.99
FRIV								
Yes	1.00	0.87 - 1.15	1.03	0.90 - 1.18	0.89	0.77 - 1.04	0.83 *	0.72 - 0.96
No	Reference group		Reference group		Reference group		Reference group	

p<.05; ** p<.01; *** p<.001

† Higher scores indicate riskier attitudes, greater perceived susceptibility to crashes, more self-confidence, more social deviance

Table 11
Estimation of odds ratio, (OR), and rates of having one or more crashes during the first 450 days of the probationary permit period per 100 adolescent novice drivers, for females, using a binary-logistic regression model

Predictor variables	n=808			
	OR	95% CI	Per driver crashes (% per group)	n
Age				
16-17	1.16	0.86 - 1.57	6.7	431
18-19	Reference group		4.8	377
Driving exposure				
High	1.89 **	1.18 – 3.04	7.3	576
Low	Reference group		2.2	232
Self-rated safe driver				
Yes	0.72 *	0.54 – 0.98	4.8	584
No	Reference group		8.5	224

Interaction between overestimation and insight

Preliminary evidence that there may be an interaction between self-rated skill and safety appears in Table 12, that gives a range of violation and crash rates, uncorrected for exposure, for subgroups that are formed by combining one skill self-rating, e.g. good, with one safety self-rating, e.g. low crash risk. Participants who self-rated driving abilities as easy to learn and not safe had the highest violation rates, 22.5 for females, a rate that is over 1.7 times greater than the mean for the female population, and 43.5 for males, a rate that is almost 1.3 times greater than the mean for the male population. For females, the highest crash rate is 12.5 for the self-rating subgroup easy to learn and not safe – a rate that is almost 2.2 times greater than the mean for the female population and superior to the crash rates of half of the male self-rating subgroups. For males, the highest crash rate is 19.3 for the self-rating subgroup good and not safe – a rate that is almost 1.5 times greater than the mean for the male population. As the population divides into more complex combinations of self-ratings, efforts to analyze the data are complicated by substantial decreases in the subgroup size. For example, the subgroup of males that self-rate their driving abilities as easy to learn, good, and not safe consists of 73 novice drivers. However, in the 450 days following the completion of the questionnaire, 38 of the 73, or 52%, had one or more violations, a violation rate that is 50% above the mean for the male population in the sample. Note that, for males, the subgroups within each paired self-rating with the highest violation rates also has the highest crash rates, and that the

lowest crash rates are associated with the male subgroups that combined low self-ratings of skills, i.e. not good, not easy, with high safe-ratings of safety and low crash risk.

Table 12
Violation and crash rates during first 450 days of unsupervised driving by self-ratings of driving abilities controlling by sex

Subgroups		Violations (1 or more per 100 drivers)				Crashes (1 or more per 100 drivers)			
		F	n	M	n	F	n *	M	n *
Total sample (n=1804)		12.7	818	34.2	986	5.7		12.9	
Paired self-ratings of driving abilities									
Easy-safe	Easy & not safe	22.5	40	43.5	154	12.5		18.8	
	Easy & safe	19.3	192	35.2	335	5.2		13.1	
	Not easy & not safe	13.8	188	31.7	227	7.4		11.5	
	Not easy & safe	8.1	393	29.8	255	4.6		10.6	
Easy-crash risk	Easy & low risk	21.6	97	34.8	244	5.2		14.3	
	Easy & high risk	18.5	135	40.8	245	7.4		15.5	
	Not easy & high risk	11.9	360	29.8	329	6.9		11.2	
	Not easy & low risk	6.8	220	32.9	155	3.2		9.7	
Good-safe	Good & safe	13.1	239	34.2	182	4.2		12.2	
	Not good & safe	9.2	343	29.1	403	5.2		11.5	
	Not good & not safe	15.8	183	33.5	242	8.2		11.6	
	Good & not safe	11.6	43	42.2	135	9.3		19.3	
Good-crash risk	Good & low risk	13.2	190	32.0	278	4.7		13.7	
	Good & high risk	12.8	195	41.3	259	6.7		13.9	
	Not good & low risk	8.6	128	38.0	121	2.3		9.1	
	Not good & high risk	13.6	294	28.8	306	7.5		12.4	
One triplet self-rating of driving abilities									
Not safe, good & high crash risk		12.5	24	52.1	73	12.5		16.4	

* Subgroup populations same as for violations

To test for interactions between self-rated skill and safety, violations and crashes were used as dependent variables in a series of binary regression models that always included one of the four self-rating subgroup pairs from Table 12. No associations were found for the good-crash risk subgroup. The easy-crash risk was associated, for males only, with violations but not crashes. The good-safe subgroup was not associated with violations for either sex and was associated with crashes for males only. The easy-safe subgroup was associated with violations for both sexes and with crashes for males only.

Table 13 shows two separate binary regression models for crashes using the same set of explanatory variables; one model is for the easy-safe subgroup and the other is for the good-safe

subgroup. In both models, the male and female groups are combined and sex is included as an explanatory variable. Each psychometric measure was introduced into the models one at time, but only preventive-habit confidence from the CBQ was associated with crash risk.

Table 13
Estimation of odds ratio, (OR), and rates of having one or more traffic crashes during the first 450 days of the probationary permit period per 100 adolescent novice drivers, for two paired self-rating subgroups, easy-safe and good-safe, controlling for sex, using a binary-logistic regression model

Predictor variables	Paired self-rating "easy-safe" (n=1,757)				Paired self-rating "good-safe" (n=1,743)			
	OR	95% CI	Per driver crashes (% per group)	n	OR	95% CI	Per driver crashes (% per group)	n
16-17	1.07	0.90 - 1.26	10.3	967	1.06	0.90 - 1.26	10.3	959
18-19	Reference group		8.6	790	Reference group		8.5	784
Male	1.44 ***	1.21 - 1.90	12.7	953	1.46 ***	1.22 - 1.75	12.6	944
Female	Reference group		5.8	804	Reference group		5.9	799
High Exposure	1.51 ***	1.08 - 2.28	11.3	1,279	1.52 ***	1.21 - 1.90	11.2	1.271
Low Exposure	Reference group		5.0	478	Reference group		5.1	472
Preventive-habit confidence (CBQ)	0.74 **	0.61 - 0.89	†	1,757	0.79 **	0.68 - 0.93	†	1,743
Paired self-rating (easy-safe)								
Easy & not safe	1.54 **	1.12 - 2.12	17.2	192				
Not easy & safe	0.73 *	0.55 - 0.97	6.7	640				
Not easy & not safe	1.00	0.75 - 1.33	9.8	408				
Easy & safe	Reference group		10.1	517				
Paired self-rating (good-safe)								
Good & not safe					1.47 *	1.05 - 2.06	16.6	175
Not good & not safe					1.04	0.78 - 1.38	10.3	419
Not good & safe					0.82	0.60 - 1.12	7.5	416
Good &safe					Reference group		8.6	733

*p<.05
† If factor score greater than or equal to 0, crash rate per 100 drivers = 10.5,
If factor score less than 0, crash rate per 100 drivers = 15.3.

Table 13 shows that positive self-ratings of driving skill, i.e. ease of learning and good driving, combined with positive self-ratings of safety or low crash risk are associated with lower crash rates than positive self-ratings of skill and negative self-ratings of safety, even after taking into account the contribution of driving exposure. The lowest crash rate is associated with the subgroup that self-rates driving not easy and safe, possibly indicating a protective effect due to lack of confidence in driving skills. Table 13 also shows that high scores in the preventive-habit confidence scale of the CBQ are associated with lower crash risk in both models. The association

between increased confidence in the efficacy of preventive or defensive habits and lower crash risk may have two complementary explanations. One, even relatively inexperienced adolescent drivers may have insight into the limits of driving skill alone to prevent crashes. Two, adolescents with greater confidence in preventive habits may have been influenced by the driving behaviors practiced by family and friends. The potential social influence on the preventive-habit confidence of male participants was tested in a binary regression model that used as the dependent variable the questionnaire item about whether a family member or friend had been injured in a traffic crash. Having a family member or friend injured in a traffic crash was positively associated with high scores in social deviance (SMQ) and crash-susceptibility (CBQ), and negatively associated with high scores in preventive-habit confidence (CBQ). Therefore, it appears that male adolescents whose family and friends are less likely to have been injured in traffic crashes are more likely to have confidence in the efficacy of preventive habits and less likely to have socially deviant behaviors and to expect to be involved in crashes.

The differences in crash risk between the two subgroups in Table 13 that shared high self-ratings for skill but not for safety may be partially accounted for by the results of a series of cross tabulations between these subgroups and questionnaire items on lifestyle and risk attitudes and perceptions. Compared to the two safety-positive subgroups, the two safety-negative subgroups were respectively more likely to: 1) have three or more vehicles at home; 2) have most or all of their friends as smokers; 3) smoke almost daily; 4) have most or all of their friends drink alcohol; 5) drink alcohol almost daily; 6) do less than one hour of homework daily; 7) disagree with respecting speed limits at night, decreasing speed limits on expressways, lowering residential speed limits to 30 km/h, and increasing the severity of speeding penalties; 8) accept a ride with a driver who had been drinking alcohol; 9) accept a ride with a driver who is speeding; 10) not wear a seatbelt; 11) drive after drinking alcohol; 12) consider it safe or neutral to bungee jump, cycle recklessly and without a helmet, and report that, if they were certain to go unpunished, they were very to quite likely to shoplift, defraud an insurance company, and hit someone who was annoying them. The profile that emerges of the safety-negative subgroups is one of young males who may have relatively easy access to vehicles, a social circle with lifestyles that are not considered to be health promoting, less commitment to academic values, possible sensation seeking tendencies, a tolerance or attraction for driving at high speeds or under the influence of alcohol, and possible aggressive tendencies.

DISCUSSION AND CONCLUSION

The results of the analyses provide limited support for the overestimation hypothesis. After taking exposure into account, violation and crash rates are relatively equal for both sexes within the good self-rating subgroups and for males within the easy to learn subgroup - *however*, females who self-rated driving easy to learn recorded higher violation rates. There is some evidence that these higher violation rates are due to unrealistic confidence in abilities - females who self-rated driving easy were also more likely to have more driving experience and feel very confident driving under supervision before the learner's permit. There is also some evidence that the higher violation rates of this subgroup may not be related to unrealistic self-confidence in driving abilities - driver self-confidence (CBQ) was associated with ease of learning for males and self-rated good driving for both sexes, but was not associated with self-rated ease of learning for females. Therefore, the higher violation rates of the female easy to learn subgroup may also be related to factors like an early interest in or initiation into driving, lower perceived risk for normal driving scenarios, and the lifestyles associated with investing less time on homework daily. Only 58.6% of the females who self-rated driving easy to learn reported doing more than one hour of homework daily compared with 68.5% of the females who did not self-rate driving easy to learn. For females, less time spent on homework is associated with more frequent use of cigarettes and alcohol, less academic ambition, not living with both parents, expecting to have access to vehicles always and to drive for no special reason every night of the week, and higher violation rates. The data suggest that overestimation may be a partial explanation for driver risk taking and increased risk of violations or crashes only for a subgroup of female drivers, the 28% who self-rated driving easy to learn, but that lifestyle factors that increase the quantity of risky exposure, e.g. night driving for no special reason, may also increase violation risk.

The study data also provide limited support for the insight hypothesis. Controlling for exposure, lower crash rates were associated with females who self-rated driving as safe. However, safe driving for females was associated with higher scores in driver self-confidence, i.e. a belief in their own abilities as a driver to avoid crashes, but not with higher scores in preventive-habit confidence, i.e. a belief that any driver can learn specific habits to reduce crash risk. Therefore, it is possible that the safer driving of these subgroups may not be based entirely on insight into the limits of driving skill. The lower crash rates of the female safe self-rating subgroup may be related, in part, to the protective effects of more law-abiding attitudes. Females who self-rated driving safe had lower scores on the ADVS, indicating more compliance towards traffic laws. Females who

self-rated driving safe also reported doing more than one hour of homework daily - 68.7 % of females who self-rated driving safe compared to the 58.9 % reported by females who did not self-rate driving safe. Therefore, the lower crash risk of female self-rated safe drivers may be due, at least in part, to protective factors other than insight.

Testing the interaction between participants' self-ratings of skill and safety produced novel results - some of the names of the subgroups that are constructed, e.g. good & not safe vs. good & safe, prove to be almost self-fulfilling prophecies of future driving records. The male members of the subgroups with the highest violation and crash rates or very low violation and crash rash rates appear to be aware of the driving crash risks that they intend to take or to avoid in the near future. These results generally corroborate the findings by West and Hall (1998) that the self-rated driving abilities of novice adolescent drivers' in the UK recorded at the time of licensing predicted violation and crash rates in the first six months of driving, although cultural differences preclude exact comparisons between their study and the present one. Awareness of future violation and crash risk may be related to the intentional nature of driving violations, as measured by the ADVS, and social deviance, as measured by the SMQ. Higher crash rates were associated with high scores on the ADVS (West & Hall, 1998) and high scores on the SMQ (West & Hall, 1993). In the present study, males who self-rated driving safe had lower scores on the ADVS and the SMQ.

Interestingly, the lowest male crash rates appear to be associated, in one case even after controlling for exposure, with the subgroups that self-rate driving skills low and safety high; this result may possibly be associated with a protective effect due to lack of confidence in driving skills. Forsyth (1992) reported that when novice male drivers were divided into two groups according to whether or not they would like to improve their skills, 61% who said that they need improvement had 28% fewer crashes than the males who did not express such a deficiency.

One of the two goals of this study was to learn more about how self-rated skills and safety are associated with risk-taking tendencies. One finding from the study is that males who self-rated driving unsafe had high scores on the GRQ, a measure of risk perceptions for activities such as bungee jumping, and a potential indicator of sensation seeking. Sensation seeking (SS) is a genetically determined need to experience varied, novel, and complex sensations and to take physical and social risks that peaks between 16- and 19-years of age (Zuckerman (1994). SS may be associated with feelings that momentarily overwhelm rational decision-making at a time when the prefrontal cortex of adolescent brains may lack the physiological development necessary to

suppress impulses and weigh the consequences of actions (Park, 2004). SS is associated with higher driving risks (Jonah, 1997), and a greater risk of substance abuse (Lerman, Patterson, & Shields, 2003). Adolescent males who self-rate driving unsafe, due, in part, to SS, might not be intentionally taking risks or overestimating their driving skills against perceived dangers - these young males might simply be expressing their preference for driving behaviors, e.g. speeding, that satisfy their own biologically driven needs, earn them status among their peers, and are tolerated or encouraged by adults, e.g. the marketing of powerful cars and motorcycles to adolescent males.

The second goal of the study was to learn more about the factors that influence the development of adolescent driver self-ratings of skill and safety. A growing body of research supports the association between the driving practices of family members and friends on adolescent novice driver violation and crash risk. Positive associations were found between the driving styles of parents and their adolescent children (Bianchi & Summala, 2004), and between the driving records of parents and their adolescent children (Carlson & Klein, 1970; Ferguson et al., 2001). For participants in this study, more hours of driving practice with friends and family, compared with only family, while holding a learner's permit, is associated with higher violation rates for females (Hirsch, Maag, & Nadeau, unpublished manuscript). Practicing more hours with friends while holding a learner's permit is associated with higher crash rates for novice drivers of both sexes (Forsyth, 1992). The above-mentioned studies indicate that the example of unsafe driving or the quality of feedback from peer-aged vs. adult supervisors may be associated with the development of riskier driving habits.

The present exploratory study did not directly measure the driving behavior of the participants' family or friends. However, one questionnaire item asked participants if any family member or friend had ever been a road injury victim (FRIV). It is possible that the road injuries of some of the family members and friends of some of the participants were associated with riskier driving behavior or lifestyles, and that these behaviors, and their outcomes, may have influenced the development of the participants' driving behaviors and self-ratings. There is some evidence for this hypothesis in the study data. FRIV-positive participants of both sexes are more likely to have higher scores on the social deviance scale (SMQ) and the crash-susceptibility scale (CBQ). In relation to self-ratings, controlling for exposure, FRIV-positive females are less likely to rate themselves good drivers. Also, FRIV-positive males are more likely to self-rate crash-risk high, have high scores in social deviance (SMQ), low scores in preventive-habit confidence (CBQ), and do less than one hour of homework daily. Remember that, controlling for exposure and self-rating,

males with low scores on the preventive-habit confidence scale (CBQ) had a higher risk of crashes. All the above associations with FRIV-positive responses are in line with previous findings that: having friends who have been injured in traffic crashes does not necessarily decrease individual risky behaviors (Rutter, Quine, & Albery, 1998); having a friend injured in the same way is a stronger predictor of injury than risk taking, gender, age and race combined, accounting for 28% of the variance compared to 5% (Jelalian et al., 1997); adolescents with riskier lifestyles have greater expectations of injury (Cohn, Macfarlane, Yanez, & Imai, 1995; Todesco & Hillman, 1999); individuals who expect to be exposed to harm feel more vulnerable (Gerrard, Benthin, & Hessling, 1996), and; during their first year and a half of unsupervised driving, novices who self-rated defensive driving skills low at the time of licensing were at higher risk of involvement in multi-vehicle crashes (Carstensen, 2002). Therefore, the degree to which adolescents feel susceptible to crashing or feel confident in preventive driving may be influenced, in part, by the lifestyles or driving-related attitudes and behavior modelled by family and friends.

Another complementary, potential explanation for the association between FRIV-positive responses and higher scores in the crash-susceptibility scale (CBQ) and lower scores in preventive-habit confidence (CBQ) may be related to general beliefs about the preventability of road injury. Smith, Sullivan, Bauman, Powell-Davies, and Mitchell (1999) found that fewer than 40% of the public surveyed believed that serious road injury is preventable in 50 to 100% of cases. Therefore, it is possible that having a personal relationship with a road injury victim may reinforce an existing belief in the ineffectiveness of preventive behaviour to control crash events.

General beliefs about the lack of preventability of road injury may also be related to a lack of authoritative definitions for safe driving and crash prevention behavior (see discussion in Hirsch, 2003). Consider the discrepancy between the positive self-ratings that female and male study participants gave for safe driving, 72.1% and 60.8% respectively, and the self-ratings they gave for low crash risk, 39.1% and 41.1% respectively. If safety is not identical to crash avoidance, what exactly does safety mean? McKenna (1993) conducted an experiment in which he influenced participants to lower their driving skill self-ratings by using an accountability manipulation, essentially informing them that their answers would be open to inspection by others or that their driving would be assessed in a driving simulator – however, the accountability manipulation did not reduce self-rated estimates of accident likelihood. McKenna remarked that individuals appear to believe that crashes are influenced more by factors outside their control, e.g. the environment, other drivers. The results of the present study and those of McKenna indicate that many drivers may not

believe that crashes can be prevented by using their own abilities or by practicing preventive driving habits. In other words, many drivers may not entirely agree with the WHO definition that RTIs are non-random and preventable, at least not by themselves. However, one encouraging finding in the present study is that some of the participants do appear to agree with the WHO definition, specifically, those males with high scores in preventive-habit confidence from the CBQ who were found to be at reduced risk of crash involvement.

Based on the findings from this study, two parallel research projects are recommended. One, adolescent self-ratings of driving abilities and beliefs about crashes should be explored further with the aim of learning more about how they develop and how to most effectively influence novice adolescents to adopt preventive habits. Questions of special interest are: why do some adolescent drivers, those who self-rated driving unsafe and crash risk high, appear to accept the risk of crashing, and; what factors influence confidence in preventive habits? The second research project aims at determining exactly which preventive habits are most reliable in systematically reducing crash risk and to develop a research-based protocol of safer behaviors that can be used to improve driver permit evaluations, driver training, and other crash interventions, including possible adjustments to road engineering and traffic rules that will increase the consistency and coherence of social norms of driving behavior.

In conclusion, the overestimation hypothesis and its complement, the insight hypothesis, do not appear to adequately explain differences in adolescent crash risk. An examination of the interaction of these hypotheses reveals a range of subgroups of adolescents with unique combinations of self-ratings, risk perceptions and attitudes, exposure patterns, lifestyles, and violation and crash records. Interventions to reduce risk taking among adolescent drivers will be more effective to the extent that they are based on a better understanding of the heterogeneity of the population of adolescent drivers.

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CHAPTER 5

DISCUSSION, RECOMMENDATIONS, CONCLUSION

This final chapter of the thesis is organized in four sections. First, the most salient findings from the data about potential risk markers, grouped under the headings, government, business, family background, and individual are discussed. Second, the originality of these findings and the contribution they represent to public health research are reviewed. Third, the limitations and strengths of the study are discussed. The chapter and the thesis concludes with recommendations for future research and policy changes. Some of the results discussed in this chapter are reported in more detail in the final report of the research study (Appendix 10). Unless otherwise specified, all results are significant at $p<.05$ or less.

RISK MARKERS

Government risk markers

The analysis of the data indicates the possibility that two specific government driver's licensing policies are potential markers of increased involvement in violations and crashes for adolescent drivers. The first policy is the time-discount that several jurisdictions across Canada have legislated to allow driver's license candidates who present a certificate of course completion (DE certificate) issued by an approved driving school to take a road exam for a permit allowing unsupervised driving several months earlier than permit candidates who do not present a DE certificate. In Quebec, the minimum course requirement for a DE certificate is twelve hours of driving lessons; candidates with DE certificates may license four months earlier than candidates without DE certificates. In this study, nearly one quarter of the participants who reported attending DE waited the extra four months and did not actually benefit from the time-discount. Therefore, it is important to distinguish between participants who attend DE and those who attend DE *and* benefit from the time-discount. The time-discount policy, not DE attendance, is the potential government risk marker. Participants who presented a DE certificate to license faster were on average five months younger than participants who did not present a DE certificate. When driving records for the first 450 days with a probationary permit were compared, male participants who presented DE certificates to license faster were found to have higher violation rates than those who did not have or use DE certificates. Further analysis controlling for age group indicates that, at a weaker level of significance ($p<.10$), the 16- to 17-year old male DE certificate subgroup was responsible for proportionately more of the increased violation risk. Possibly due to small numbers, associations between the presentation of the DE certificate and the existence of increased risk of violations for females and increased risk of crashes for both sexes could not be confirmed.

Negative associations between the time-discount licensing policy and adolescent driver safety were anticipated – Hirsch and Laberge-Nadeau (1995) predicted that adolescents who licensed faster, e.g. by presenting DE certificates for time-discounts, might comprise "a smaller cohort of new young drivers with a higher collision rate." The prediction was based on two findings that have consistently emerged in the research literature over the past several decades. First, adolescents who obtain driver's licenses at younger ages, particularly males, are at higher risk of injury crash involvement (Laberge-Nadeau, Maag, & Bourbeau, 1992). Long-term cohort studies of novice drivers indicate that every year an adolescent candidate for a driver's permit delays licensing reduces crash risk during the first year of driving by five to six percent (Maycock et al. 1991; Waller et al., 2001). Second, the driving records of novice adolescent drivers who attend DE are not safer than the driving records of novice adolescent drivers who do not attend DE (Hirsch, 2003). Subsequent large-scale program evaluations in three Canadian provinces confirmed the prediction of the negative association between the time-discount policy and adolescent driver safety by Hirsch and Laberge-Nadeau (1995) - Compared with novice drivers who not present DE certificates, novice drivers who licensed faster using DE certificates had crash rates that were 45% higher in Ontario (Boase & Tasca, 1998), 27% higher in Nova Scotia (Mayhew, Simpson, Williams, & Desmond, 2002), and 45% higher in British Columbia (Wiggins, 2004). Wiggins (2004) conducted a case-control study to determine the causes of the increased risk of novice drivers in British Columbia who used the time-discount and found that exposure was not a significant factor in the increased crash rate. Based on the preceding analysis of the study data and corroborative research, an argument can be made that the existence of a time-discount is a risk marker for the governments that maintain the policy and the adolescent drivers who take advantage of it.

The second licensing policy that potentially qualifies as a government risk marker is the set of evaluation criteria for the probationary permit road exam - an analysis of the first time performance of study participants on their permit exams in relation to violation and crash records indicates that the evaluation criteria of the road exam for the probationary permit do not differentiate between safe and risky novice drivers. In fact, using a binary logistic regression model that controls for age, hours of driving practice, and DE attendance reveals that when performances on the theory and the road exams are combined, males who pass theory on the first attempt and fail their first attempt on the road exam have fewer violations than males who pass both theory and road exams on the first attempt. The same binary logistic regression model reveals that males who fail their first attempt at the theory exam and succeed on their first attempt at the road exam have more violations. Another binary logistic regression model that controlled for violations in addition to age, driving practice, and DE attendance, reveals that males who fail their first attempt at the theory exam and succeed on their first attempt at the road exam have more

crashes. This last result replicates the finding of previous research on another sample of over 100,000 Quebec novice drivers (Laberge-Nadeau et al., 1999). The replication of that earlier finding in this thesis is potentially more interesting because of the smaller sample size and the use of an analytic model that controls for potential confounders. The finding that government permit road exam criteria do not differentiate safe from risky drivers is not unique to Quebec. As discussed in Chapter two, government licensing authorities in several other jurisdictions worldwide also appear to administer driver's permit road exams in which the candidates who are more likely to succeed are also more likely to have violations and crashes.

There are two interrelated potential reasons why driver's permit road exam evaluation criteria that do not differentiate high from low risk drivers are potential markers of risk. The first potential reason is overconfidence on the part of the adolescent driver. Job (1990) applied learning theory to study the development of driving confidence and deduced that success on the road exam is likely to encourage overconfidence – overconfidence, in turn, may lead to increases in driver risk taking. The second potential reason why driver's permit road exams that do not differentiate high from low risk drivers are potential markers of risk is that success on this type of exam is likely to encourage overconfidence on the part of the parents of adolescent drivers. Mayhew, Fields, and Simpson (2000) suggest that the parents of adolescent driver's permit candidates might regard the government permit exam and DE as two official "safeguards" that ensure that driver permit candidates are adequately prepared to drive without supervision. The data in this study reveal that DE attendance increases the probability of success on the road exam. Therefore, the combination of DE attendance, most often paid for entirely or partly by the parents, and first time success on the government permit exam may encourage parents to believe that their adolescent children are sufficiently safe drivers, despite the fact that research has not demonstrated that either of these two safeguards have any proven safety benefits. Overconfidence on the part of the parents of adolescent drivers may lead to decreases in controls over adolescent driving exposure. Licensing exam criteria of this type are arguably potential government risk markers of increased violations and crashes for adolescent male drivers.

Business risk markers

The analysis of the data suggest the possibility that two policies related to the DE certificate practiced by businesses might qualify as markers of increased violation and crash risk for adolescent drivers. The first policy is the practice common to many insurance companies of offering premium discounts to clients who present a DE certificate (Picard, 2004). In jurisdictions with high insurance

premiums, the insurance discount saving can offset most or all of the cost of tuition for DE, no doubt increasing the attractiveness of DE courses. Since the DE certificate allows candidates to license faster, and the insurance discount reduces the cost of DE, the insurance discount policy is a potential risk marker.

The second business practice related to the DE certificate that potentially qualifies as a risk marker relates to the possibility that one or more driving schools sell fraudulent DE certificates. The data indicate that a subgroup of approximately six percent of the study population may have "cheated" and licensed faster by presenting DE certificates for twelve hours of driving lessons when in fact they reported taking fewer than twelve lessons. This six percent subgroup recorded higher violation rates, and, at a weaker level of significance, higher crash rates as well. Given that the alleged cheating was self-reported by participants while they were waiting inside government permit exam centers, and that the study population is composed of volunteers who may already be biased towards compliance with authority, the six percent figure may be an underestimation. The average number of Quebec adolescents, 16- to 19-years of age, who are granted probationary permits annually, based on figures from the year 2000 to 2003, is approximately 55,200 (SAAQ, 2004). If six percent of these new drivers purchase fraudulent certificates, every year an average of over 3,300 novice adolescent drivers, who appear to be at above average risk of incurring violations and crashes, are able to license faster and pay lower insurance costs. Therefore, the unprofessional business practice of selling DE certificates, although difficult to detect, is arguably a marker of increased risk.

Family-based risk markers

There are three groups of potential family-based markers associated with increased crash risk in this study. The first group is related to the quantity and quality of exposure. The data show that males who were 16- and 17-years old when they licensed had higher violation rates and that overall, higher violation rates are associated with higher crash rates after controlling for sex, age, and exposure. Therefore, one potential risk marker is the parental consent given to all participants younger than 18. The data show that almost one third of the male participants operated motorcycles or mopeds in traffic before they had a learner's permit and that the males who reported having had experience in traffic with motorcycles or mopeds before the learner's permit had higher crash rates, controlling for age, when driving with their probationary permits. Therefore, another family marker of increased crash risk that can be inferred from the study data is parental consent for, or lack of parental supervision over, riding mopeds or motorcycles in traffic before the learner's permit.

The analysis of the data show that, controlling for the number of practice hours, females who were supervised during the learner's permit period by friends as well as by their parents, compared to females who practiced only under parental supervision, had higher rates of violations. Practicing more hours with friends while holding a learner's permit is associated with higher crash rates for novice drivers of both sexes (Forsyth, 1992). Theoretically, at least, parents have some control over who supervises the driving practice of their adolescent children. Therefore, another family-based marker of crash risk is the relative quantity and quality of supervised driving practice provided by parents.

A second group of potential family-based risk markers that is indirectly related to increased violation and crash risk is family financial support for licensing- and driving-related expenses. Females and males 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. Anticipated car ownership is associated, for both sexes, with higher violation rates. However, the data also show that families that pay full purchase costs for vehicles are also more likely to have at least one parent with a university education. A university education indicates higher SES, and families with higher SES are more likely to have adolescents with lower rates of unintentional injury (Laflamme & Engstrom, 2002). Therefore, some parents who provide full financial support for licensing and car purchase may be successfully compensating for the risk of increased adolescent driving exposure with protective behaviors, e.g. safer examples of driving behavior, greater driving restrictions, curfews etc...

Finally, another potential family-based risk marker is the presence of road injury victims among family members and friends. Road injuries are associated with riskier driving behavior or lifestyles. The present exploratory study did not directly measure the driving behavior or lifestyles of the participants' family or friends; however, one questionnaire item asked participants if any family member or friend had ever been a road injury victim (FRIV) – 49% of the female and 51% of the male participants answered positively to this question. For convenience, these participants are called FRIV-positive. It is possible that some of the family members and friends of some of the FRIV-positive participants may practice risky driving behavior or lifestyles, and that this behaviour and its outcomes may have influenced the development of the participants' driving behavior and self-rated abilities. There is some evidence for this hypothesis in the study data. FRIV-positive participants of both sexes are more likely to have higher scores on the social deviance scale (SMQ) and the crash-susceptibility scale (CBQ). FRIV-positive females are less likely to rate themselves good drivers and FRIV-positive males are more likely to self-rate crash-risk high, have high scores in social deviance (SMQ), low scores in preventive-habit confidence (CBQ), and do less than one hour of homework daily.

All the above associations with FRIV-positive responses are in line with previous findings. Rutter, Quine, and Albery (1998) conducted a prospective study of the sources and effects of risk perception among motorcycle riders and found that awareness that a friend had been injured in a traffic crash did not change risk perceptions, and that over the twelve months of their study, risky behaviors were as likely as non-risky behaviors to increase in frequency. The authors concluded that motorcyclists whose behaviors are already established in risky routines may have a strongly positive value for risk, and that this positive value may be shared among their social circle. With repetition over time, "these motorcyclists conform increasingly to the norm of risk, and increasing their risky behavior is their way of expressing that norm." Jelalian et al. (1997) investigated the relationships between self-reported injury, risk taking, and perception of injury risk in a sample of 1,426 adolescents, 14- to 18-years old, and found that having a friend injured the same way was the strongest predictor of injury, accounting for 28% of the variance - risk taking accounted for 4% of the variance and socio-demographic variables, (gender, age, and race), accounted for only 1% of the variance. Adolescents with riskier lifestyles have greater expectations of injury (Cohn, Macfarlane, Yanez, & Imai, 1995; Todesco & Hillman, 1999). Driver risk-taking behavior is most probably influenced by social learning, which begins with exposure in early childhood (Levelt, 1994). Adolescent driver risk-taking behavior may also be influenced by risk precursors such as genetic predispositions for sensation seeking (Zukerman, 1993) and aggressiveness (DiLallo, 2002). The combination of genetic predispositions and social learning potentially explains the positive associations found between the driving styles of parents and their adolescent children (Bianchi & Summala, 2004), and between the driving records of parents and their adolescent children (Carlson & Klein, 1970; Ferguson, Williams, Chapline, Reinfurt, & De Leonardis, 2001). Therefore, the degree to which adolescents feel susceptible to crashing or feel confident in preventive driving may be influenced, in part, by the lifestyles or driving-related attitudes and behavior modeled by family and friends.

Another complementary, potential explanation for the association between FRIV-positive responses and higher scores in the crash-susceptibility scale (CBQ) and lower scores in preventive-habit confidence (CBQ) may be related to general beliefs about the preventability of road injury. Smith, Sullivan, Bauman, Powell-Davies, and Mitchell (1999) found that fewer than 40% of the public surveyed believed that serious road injury is preventable in 50 to 100% of cases. Having a personal relationship with a road injury victim may reinforce a pre-existing belief in the ineffectiveness of preventive behavior to prevent crash events. Therefore, another potential marker of higher crash risk indicated by the data analysis is reporting that a family member or friend has been injured in a road crash.

Individual risk markers

As discussed in Chapter 1, over the past several decades researchers have consistently identified age, sex, and inexperience as markers of adolescent driver crash risk. The study data confirm some of these associations but, possibly due to small numbers, other expected associations were not confirmed. Age alone did not differentiate violation or crash risk. When sex was controlled, age did not differentiate crash risk, but the 16- to 17-year old males, compared to the 18- to 19-year old males, were found to have more violations. Sex alone, however, did differentiate violation and crash risk - males, compared to females, had more violations and crashes. The study data indicate that these expected age and sex trends can probably be accounted for by differences in traffic- and driving-experience that exist throughout the licensing process, beginning before the learner's permit and including the first year or more of unsupervised driving. This study found that before the learner's permit, males, particularly younger males, compared to females, appear to have more traffic-related experience cycling, using roller blades or skateboarding, and operating a moped or motorcycle, and more driving experience with and without supervision even before having a learner's permit. The data also show that males were more likely to express greater confidence than females in all the above activities, except for driving with supervision. During the learner's permit period, compared to females, males have more hours of driving practice. During the probationary permit period, compared to females, males appear to drive more kilometers.

However, when experience-related factors are controlled, sex differences decrease. Females with 50 practice hours or more, and probably more driving exposure with a probationary permit, were also more likely to anticipate driving during high-risk periods, i.e. weekend nights for socializing and for no special reason. When controlling for age and sex, the data show that females who self-rate learning to drive as easy have more violations, males who have fewer than 25 practice hours have fewer violations, females and males who have fewer than 25 practice hours have fewer crashes, females and males who already own a car or who anticipate owning a car soon, as well as participants who anticipate driving for work reasons during the weekday, have more violations, and females and males who have two or more violations also have more crashes. Therefore, the risk markers that appear to be most related to violation and crash risk are not age or sex or experience or exposure alone, but rather combinations of these and other risk markers.

Combining risk markers to create subgroups, each with different levels of violation and crash risk, is suggested by the findings of other researchers. Peck (1993) concluded, after attempting to identify crash correlates from a multivariate perspective, that a number of variables are associated with crash risk,

but no single variable, or combination of variables, accounts for a substantial percentage of the variation in the crash frequency of the general driving population. Peck (1993) acknowledges that the early identification of high-risk drivers requires the evaluation of variables, "that are more distal to actual driving, such as age, socioeconomic status, personality, attitudinal variables, indices of social adjustments, and cognitive functions." In the context of this thesis, variables are also markers. The challenge is to determine which individual markers most effectively indicate higher crash risk.

Based on previous studies and a new analysis of over 150,000 driving records, Peck (1993) found that the most powerful and consistent marker that predicted crash involvement was a history of one or more driving violations or crashes. This study replicated that finding - participants who had violations or crashes during the learner's permit were at considerably greater risk of having subsequent violations and crashes. Although the numbers are small, the following analysis drawn from the report in Appendix 10 has potential value for two reasons mentioned below. Among the participants, 18 had violations during the learner's permit. Within this subgroup of 18, 10 did not have any subsequent violations, 3 had one more violation each, and 5 had two more violations each for a subgroup violation rate of 44.4 per 100 drivers. The violation rate for the entire study sample is 24.4 per 100 drivers. Seventeen of the 18 participants with violations during the learner's permit were males. Five of these 17 males had subsequent crashes, for a rate of 29.4%; the crash rate for the male study population is 12.6%. Only 14 participants had crashes during the learner's permit but within this subgroup of 14, 4 had one subsequent violation each and another 4 had two subsequent violations each, for a rate of 57.1 per hundred drivers; the violation rate for the population is 24.2 per 100 drivers. Among the 14 participants who had crashes during the learner's permit, 4 had subsequent crashes, for a rate of 28.6%. Waller et al., (2001) also found that having a violation with a learner's permit increases the odds of having one or more crashes or one or more violations within one year after licensing. The first reason for the potential importance of the preceding analysis is that the finding that having one violation or crash increases the odds of having another corroborates the findings from the two large scale cohort studies mentioned above. Hence, despite the small numbers, the results of the preceding analysis are less likely to be spurious. Therefore, the occurrence of violations and crashes during the learner's permit period is probable individual marker of increased risk of violations and crashes.

The second reason for the present discussion of the driving records of adolescent drivers with a learner's permit is that this data is easily available and largely ignored by policymakers. Even though relatively few drivers would be affected, access to probationary permits could be limited to drivers with a clean record for violations and at-fault crashes. The fact that this step has not been taken in most, but not

all, licensing jurisdictions can be interpreted as further evidence of a mobility bias in licensing policy and another potential government risk marker for increased adolescent crash risk.

Another individual risk marker related to driving experience during the learner's permit is the number of hours of supervised driving practice reported by study participants. Contrary to the assumption that safety increases with experience in a linear relationship, participants of both sexes with more than 50, compared with less than 25, hours of supervised practice had higher crash rates, controlling for age, preparation method for the permit exams, performance on the permit exams, and violation rates. A similar finding is reported by Sagberg and Gregersen (unpublished manuscript). The most probable explanation for this result is that hours of driving practice with a learner's permit are positively associated with driving exposure with the probationary permit. Nevertheless, the fact that this quantity of practice hours is not associated with safer outcomes gives rise to questions about the assumption that driver safety increases with relatively few hours of practice.

Another individual marker of violation and crash risk is motivation to attend DE. This marker affects 85% of the participants in this study but is far less accessible. The data show that the motivations of the participants to attend DE are directly associated with their crash risk. 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 report any learning reasons and reported that they attended DE either to benefit from the time discount 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. The study data shows that motivation is directly and linearly associated with violation and crash rates per 100 drivers. The learning motivation group had the lowest violation and crash rates, 14.0 and 5.7 respectively. The mixed motivation group had the next highest rates, 24.9 and 9.6 respectively. Finally, the opportunity motivation group had the highest rates of violations and crashes, 40.7 and 14.8 respectively. Therefore, motivation concerning DE attendance appears to be a risk marker. To the best of my knowledge, the current study is the first to investigate the association between the motivations of adolescent drivers for attending DE courses and violation and crash risk. The finding that learning motivation increases with the age of the candidate may indicate that proportionately more of the adolescents who license at younger ages are less motivated to learn when they attend DE – this may help explain why DE has not been found to be effective with the youngest drivers.

Other individual risk markers found in this study relate to risk-taking attitudes, perceptions, and beliefs. The questionnaire contained six psychometric tests, five selected from the research literature on

the basis of demonstrated associations with risk-taking behaviors, violations or crash rates, and the sixth created by the author. The five selected instruments were Attitude to Driving Violations Scale (ADVS) developed by West and Hall (1997); the Social Motivation Questionnaire (SMQ) yielding a score of social deviance, developed by West et al., (1993); a time perspectives questionnaire that measures an individual's value for events in the present and future, developed by Chebat and Chandon (1986), and; two composite tests - a general risk perception questionnaire (GRQ), constructed with non-driving items based on the work of Perkins et al. (1997) and Zuckerman (1979) and, a driving risk questionnaire covering high risk scenarios (DRQ-high), e.g. alcohol and speed, and normal driving scenarios (DRQ-normal), e.g. night and rain, based on the work of Audet and Malet (1993). The sixth test, the crash beliefs questionnaire (CBQ), was created for this study, based on concepts from Becker (1974) and Bandura (1988), to explore different adolescent drivers' beliefs about four different belief dimensions of crashes: crash-susceptibility; severity of injury-risk; driver self-confidence in prevention, and; confidence in the efficacy of preventive habits or preventive-habit confidence.

Items from the first five tests, and the four belief scales from the sixth test were treated with a principal components analysis (see Appendix 10). The analysis of the first five tests produced eight factor scores that were combined to produce one risk-taking index. The four dimensions of crash beliefs from the CBQ produced four factor scores. In total, twelve factor scores were produced. Higher scores on the risk-taking index indicate greater risk taking tendencies. Higher scores on the CBQ indicate stronger belief in the respective dimensions described, e.g. crash-susceptibility. In the study population, on average, males, compared to females, had higher risk index scores, and scores decreased as the age of the driver candidate increased. No interaction between sex and age was found. Due to the large variations and the extreme values within each score, the index has little predictive value. The four CBQ factor scores were also found to be significantly associated with different risk markers but the models created explained only a small percentage of the variation.

The preventive-habit confidence scale of the CBQ was found to be associated with a lower crash risk for males in a binary regression model that controlled for age and self-rated unsafe driving. This result corroborates a similar finding by Carstensen (2002) that novice drivers with high self-assessments of defensive driving skills are at lower risk of multi-vehicle crashes. The association between increased confidence in the efficacy of preventive or defensive habits and lower crash risk could indicate that even relatively inexperienced adolescent drivers may have insight into the limits of driving skill to prevent crashes. An alternative explanation is that greater confidence in preventive habits may be influenced by the driving norms of family and friends. A binary logistic regression model revealed that high scores in

preventive habit confidence from the CBQ were negatively associated with family-based risk markers discussed earlier, knowing that a family member or friend is a road injury victim (FRIV). Byrnes (2003) reports on research studies that suggest that environmental feedback can sometimes have a stronger effect on choice of behavior than insight. The family constitutes the adolescent driver's most immediate environment.

However, lack of confidence in preventive habits may also be influenced by general beliefs about the lack of preventability of road injury related to a lack of authoritative definitions for safe driving and crash prevention behavior (see discussion in Hirsch, 2003). Consider the discrepancy between the positive self-ratings that female and male study participants gave for safe driving, 72.1% and 60.8% respectively, and the self-ratings they gave for low crash risk, 39.1% and 41.1% respectively. If safety is not identical to crash avoidance, what exactly does safety mean? McKenna (1993) conducted an experiment in which he influenced participants to lower their driving skill self-ratings by using an accountability manipulation, essentially informing them that their answers would be open to inspection by others or that their driving would be assessed in a driving simulator – however, the accountability manipulation did not reduce self-rated estimates of accident likelihood. McKenna remarked that individuals appear to believe that crashes are influenced more by factors outside their control, e.g. the environment, other drivers. The results of the present study and those of McKenna indicate that many drivers may not believe that crashes can be prevented by using their own abilities or by practicing preventive driving habits. In other words, many drivers may not entirely agree with the WHO definition that RTIs are non-random and preventable, at least not by themselves. Therefore, low scores in preventive-habit confidence from the CBQ can be considered an individual marker of increased crash risk.

Although academic accomplishment, i.e. grades, has been linked to safer driving (Murray, 1998), the finding in this study that time devoted to homework is associated with violation and crash risk is, to the best of my knowledge, new to the literature on adolescent driver risk taking. Homework time is not necessarily linearly related to grades; when grades and homework time were cross tabulated controlling for the four male subgroups from the paired self-rating variable, good-safe, the "not good & not safe" subgroup reported proportionately more homework time and lower grades than the "good & not safe" subgroup (Hirsch & Maag, 2004). The data show that less than one hour of homework was associated with higher rates of violations for both sexes and higher crash rates for males. Several interrelated factors, lifestyle, risk-taking tendencies, and self-rated driving abilities, might explain the riskier driving records of the participants who reported doing less homework. For both sexes, less homework was associated with smoking cigarettes almost daily and having all or most of one's friends as smokers, more frequent

use of alcohol, less academic ambition, not living with both parents, and expecting to have access to vehicles always and to drive for no special reason every night of the week. For males only, less homework was associated with reporting that a family member or friend was a road injury victim (FRIV-positive). Higher scores (denoting greater risk) on psychometric measures of risk-taking tendencies are also associated with less time on homework. For females, less homework time was associated with higher scores on attitudes towards violations (ADVS), high risk and normal driving scenarios (DRQ-high and DRQ-normal), and the crash susceptibility scale (CBQ). For males, less homework time was associated with higher scores on social deviance (SMQ) and lower scores on preventive-habit confidence (CBQ). High factor scores on the ADVS scale were associated with higher rates of violations in a previous study by West and Hall (1997). The SMQ score indicates to what degree an individual expects to behave in a responsible and socially desirable manner and has been associated with increased risk taking in previous research (West et al., 1993). The construction of the high-risk driving and normal-driving risk perception scales (DRQ-high and DRQ-normal) is original, but the individual items have each been tested previously (Audet & Malet, 1993) so the association between this scale and risk-taking was as expected. The crash susceptibility scale from the CBQ measures perceived threat and has never been tested prior to this study. The finding that high scores on crash-susceptibility scale are directly associated with less than one hour of homework and indirectly associated with higher rates of violations and crashes corroborates previous research that found that individuals who expect to be exposed to harm feel more vulnerable (Gerrard, Gibbons, Benthin, & Hessling, 1996). Both females and males who reported doing less homework were less likely to rate their driving abilities as safe or their crash risk as low and females who did less homework were more likely to self-rate driving easy to learn. Note that attendance to DE did not differentiate the amount of time participants spent on homework.

The individual markers of violation and crash risk that might be most proximally linked to driving behavior are self-rated driving abilities. The questionnaire included items on four self-rated abilities taken from a prospective study on the prediction of novice driver crashes by West and Hall (1993): ease of learning, good driving, safe driving, and; probability of crashing in the next year. The first two self-rated abilities, ease of learning and good driving, relate to driving skill or performance. One popular hypothesis about adolescent crash risk states that inexperienced adolescent drivers, particularly males, tend to overestimate their skills and therefore crash more frequently because they do not perceive and respond to hazards in a correct and timely manner. For convenience, this is called the overestimation hypothesis. The other two self-rated abilities, safe driving and probability of crashing, explore the relatively untested hypothesis that inexperienced novice drivers possess insight into the limits of their

driving skills and that they are capable of accurately predicting their own safety. For convenience, this is called the insight hypothesis.

The results of the analyses provide limited support for the overestimation hypothesis. After taking exposure into account, violation and crash rates are relatively equal for both sexes within the good self-rating subgroups and for males within the easy to learn subgroup - however, females who self-rated driving easy to learn recorded higher violation rates. There is some evidence that these higher violation rates are due to unrealistic confidence in abilities - females who self-rated driving easy were also more likely to have experience and feel very confident driving under supervision before the learner's permit. There is also some evidence that the higher violation rates of this subgroup may not be related to unrealistic self-confidence in driving abilities - driver self-confidence (CBQ) was not associated with self-rated ease of learning for females. Therefore, the higher violation rates of the female easy to learn subgroup may also be related to factors like an early initiation into driving, lower perceived risk for normal driving (DRQ-normal), and the lifestyles associated with investing less time on homework daily' i.e. more frequent use of cigarettes and alcohol, less academic ambition, not living with both parents, and expecting to have access to vehicles always and to drive for no special reason every night of the week. The data suggest that overestimation may be a partial explanation for driver risk taking and increased risk of violations but only for a subgroup of female drivers, the 28% who self-rated driving easy to learn; however, lifestyle factors that increase the quantity of exposure to risky situations may also increase this subgroup's violation risk.

The study data also provide limited support for the insight hypothesis. Controlling for exposure, lower crash rates were associated with females who self-rated driving as safe. However, safe driving for females was associated with higher scores in driver self-confidence (CBQ), i.e. a belief in their own abilities as a driver to avoid crashes, but not with higher scores in preventive-habit confidence, i.e. a belief that any driver can learn specific habits to reduce crash risk. Therefore, it is possible that the safer driving of these subgroups may not be based entirely on insight into the limits of driving skill. The lower crash rates of the female safe self-rating subgroup may be related, in part, to the protective effects of more law-abiding attitudes. Females who self-rated driving safe had lower scores on the ADVS (indicating more compliance with traffic laws), and they also reported doing more than one hour of homework daily. Therefore, the lower crash risk of female self-rated safe drivers may be due, at least in part, to protective factors other than insight.

Testing the interaction between participants' self-ratings of skill and safety produced novel results - some of the names of the subgroups that are constructed, e.g. good & not safe vs. good & safe, prove to be almost self-fulfilling prophecies of future driving records. For example, compare the self-rated "easy & not safe" female subgroup (n=40), that has the highest rates of any female subgroup for violations and crashes, 22.5 and 12.5 respectively, and the self-rated "easy & safe" female subgroup (n=192), that also has a high violation rate, 19.3, but a crash rate of only 5.2, a little below the average for the female sample. For the males, the same comparison applies - the "easy & not safe" subgroup has violation and crash rates of 43.5 and 18.8 respectively, compared to the "easy & safe" subgroup that has violation and crash rates of 35.2 and 13.1 respectively. These results generally corroborate the findings by West and Hall (1998) that the self-rated driving abilities of novice adolescent drivers' in the UK recorded at the time of licensing predicted violation and crash rates in the first six months of driving, although cultural differences preclude exact comparisons between their study and the present one.

Awareness of future violation and crash risk may be related to the intentional nature of driving violations, as measured by the ADVS, and social deviance, as measured by the SMQ. Higher crash rates were associated with high scores on the ADVS (West & Hall, 1998) and high scores on the SMQ (West & Hall, 1993). In the present study, males who self-rated driving safe had lower scores on the ADVS and the SMQ. Interestingly, the lowest male crash rates appear to be associated, in one case even after controlling for exposure, with the subgroups that self-rate driving skills low and safety high; this result may possibly be associated with a protective effect due to lack of confidence in driving skills. Forsyth (1992) reported that when novice male drivers were divided into two groups according to whether or not they would like to improve their skills, 61% who said that they need improvement had 28% fewer crashes than the males who did not express such a deficiency.

Self-rated skills and safety are associated with risk-taking tendencies that are unintentional in the sense that they may be momentarily outside the driver's awareness or control (see discussion in Hirsch, 2003). One finding from the study is that males who self-rated driving unsafe had high scores on the GRQ, a measure of risk perceptions for activities such as bungee jumping, and a potential indicator of sensation seeking. Sensation seeking (SS) is a genetically determined need to experience varied, novel, and complex sensations and to take physical and social risks that peaks between 16- and 19-years of age (Zuckerman, 1994). SS may be associated with feelings that momentarily overwhelm rational decision-making at a time when the prefrontal cortex of adolescent brains may lack the physiological development necessary to suppress impulses and weigh the consequences of actions (Park, 2004). SS is associated with higher driving risks (Jonah, 1997), and a greater risk of substance abuse (Lerman, Patterson, & Shields,

2003). Adolescent males who self-rate driving unsafe, due, in part, to SS, might not be intentionally taking risks or overestimating their driving skills against perceived dangers - these young males might be expressing their preference for driving behaviors, e.g. speeding, that satisfy their own biologically driven needs, earn them status among their peers, and are tolerated or encouraged by adults, e.g. the marketing of powerful cars and motorcycles to adolescent males. The degree to which the risky behavior of this subgroup of adolescent males is under their direct control is a complex scientific question requiring further research.

The question remains, why do male adolescents who rate themselves unsafe drivers persist in driving? Cross tabulations with explanatory variables from the data set reveal that, compared with the three other male safe-good subgroups, the "not safe & good" males were more likely to: 1) already own or soon plan to own a vehicle; 2) have two or more vehicles at home; 3) have most or all of their friends as smokers; 4) have most or all of their friends drink alcohol; 5) do less than one hour of homework daily; 6) not be working or looking for part-time work; 7) anticipate driving weekday evenings for no special reason, weekend nights for errands and sports, and; 8) at weaker statistical significance ($p<.10$), anticipate driving for no special reason weekend nights. When the safe-good male subgroups were cross tabulated with individual items from the ADVS, the "not safe & good" subgroup was more likely than the other three subgroups to disagree with: 1) decreasing speed limits on expressways; 2) respecting speed limits at night; 3) lowering residential speed limits to 30 km/h, and; 4) increasing the severity of speeding penalties. When the four safe-good male subgroups were cross tabulated with individual items from the driving risk questionnaire, the "not safe & good" subgroup were more likely than the other three subgroups to consider the following activities to be safe or neutral: 1) accepting a ride with a driver who had been drinking; 2) accepting a ride with a driver who is speeding; 3) not wearing a seatbelt; 4) driving after drinking alcohol, and; 5) speeding on residential streets and on expressways. When the safe-good male subgroups were cross tabulated with individual items from the SMQ, the "not safe & good" subgroup were more likely than the other three subgroups to report that, if they were certain to go unpunished, they were very to quite likely to: 1) shoplift; 2) defraud an insurance company, and; 3) hit someone who was annoying them. The profile that emerges of the "not safe & good" male subgroup indicates relatively easy access to motor vehicles, a social circle that smoke cigarettes and drink alcohol, less commitment to school, a low perception of risk for or strong attraction to driving at high speeds or under the influence of alcohol, and certain delinquent and aggressive tendencies. It is not clear from the data whether these young males are overconfident in their abilities and unaware of the risks they may incur or whether they are aware and accept the higher risks as a normal price to pay for a preferred lifestyle.

ORIGINALITY AND CONTRIBUTION TO HEALTH PROMOTION IN PUBLIC HEALTH

This thesis makes several original contributions to health promotion solutions to the public health problem of adolescent overrepresentation in RTI crashes. One, it created an original and extensive three-part questionnaire based on an adapted version of the Rational Model of Risk Taking that expands the concept of risk markers beyond individuals to include risk taking by families, business, and government policymakers. The questionnaire examines and links three groups of potential risk markers associated with adolescent violations and crashes: driving-related experience; risk-taking perceptions and values, and; lifestyles. Measurements of driving-related experience span several years, starting before the learner's permit and continuing through the learner's period to include anticipated exposure during the first year of the probationary permit; these measurements describe the development of adolescent driving exposure before and during the learner's permit and with a probationary permit. Hours of driving practice with a learner's permit are directly related to violation and crash risk and have not received sufficient study. The questionnaire also asked about motivations for attending DE. The results suggest strongly that the youngest adolescents are more likely to attend DE in order to license faster and less expensively and less likely to attend DE for learning reasons. To the best of my knowledge, this finding is new and provides a potential explanation for the apparent lack of success of DE to reduce crashes among the youngest adolescents.

Risk markers from the second group, risk-taking perceptions and beliefs, were measured by several diverse instruments with demonstrated associations to crash risk, as well as an original instrument, the CBQ, that was developed specifically for this thesis to measure crash beliefs related to injury-risk (crash-susceptibility and injury-severity in case of a crash), and to crash-prevention (driver self-confidence and preventive-habit confidence). For females, crash-susceptibility, and for males, injury-risk were directly associated with less than one hour of homework and less than one hour of homework was associated with higher violation rates for both sexes and higher crash rates for males. For males, lower crash risk was associated with confidence in preventive-habits but not with confidence in one's own abilities to prevent crashes. This is an original finding. As discussed above, social learning and environmental influences appear to be associated with preventive-habit confidence.

The lifestyle section of the questionnaire, which examined items related to family background, academic involvement, cigarette and alcohol use, produced two original findings. The first is that the amount of time spent on homework, which is most probably influenced by family background, is linked to risky lifestyles and driving exposure and to several psychometric measures of risk-taking tendencies

included in the questionnaire. The second finding is the association between reporting that a family member or friend is a road injury victim (FRIV) and low self-ratings for good driving for females and high self-rated crash risk for males. These findings highlight the potential importance of two relatively under-researched aspects of family background that appear to influence adolescent crash risk.

Previous research has defined subgroups of risky adolescent drivers using a variety of analytic techniques (Gregersen & Berg, 1994; Wurst, 2002). This thesis applied an original technique for organizing the self-ratings that avoids any statistical manipulation or subjective interpretation of the data and allows for the emergence of self-ratings that reflect self-expressed incongruities in self-rated driving abilities. Four binary self-ratings, two for skill and two for safety, were combined to create four paired variables: "easy-safe"; "easy-crash risk"; "good-safe"; and; "good-crash risk." Each paired variable yields four distinct, mutually exclusive subgroups, and the resulting combinations, are associated, for the most part, in the expected directions with violation and crash records and with risk-taking attitudes and lifestyles consistent with driving records. To the best of my knowledge, this approach to studying self-rated driving abilities has never been reported in the literature.

This thesis also adds an original model, the Licensing process (LP) model, to the public health approach to reducing adolescent crash risk. The LP model organizes risk markers along a time-line spanning several years and links them directly to government licensing controls. The identification of risk markers for high-risk subgroups could lead to earlier identification and more effective interventions for high-risk subgroups of adolescent drivers. Under the assumption that the high-risk subgroups influence the behavioral norms of other adolescent drivers by example, the judicious use of the licensing system to discourage the highest risk takers might possibly improve the practice of safer driving behavior norms by all novice drivers.

Finally, all the original contributions of this thesis combined lend support to the argument that the population of adolescent drivers is too heterogeneous and the sources of risk taking are too diverse to be treated effectively by standardized population-based approaches such as traditional DE or driver's permit exams or GDL. None of the population-based approaches discussed in this thesis is designed either to detect or to effectively discourage intentional risk taking or to verify that every novice adolescent driver permit candidate has sufficient experience to drive safely without supervision or sufficient confidence in the efficacy of preventive driving behaviors. In order to address the diverse sources of adolescent driver crash risk most effectively, a new strategy that combines both high-risk subgroup and population approaches into a single comprehensive and coherent program seems to be indicated. Some of the

potential components of this new strategy are indicated in the final section of this thesis, the recommendations for future research and interventions.

LIMITATIONS AND STRENGTHS

This study is an exploration of the relationship between markers of risk-taking tendencies and the government records of violations and crashes during the first 450 days of driving with a probationary permit of a cohort of 1,804 adolescent drivers. The focus of the study is on risk markers because actual risk-taking behaviors are difficult to observe in the short-term and long-term observation of behavioral tendencies is prohibitively expensive. Therefore, the existence of risk-taking tendencies is inferred from the association between risk markers and violation and crash rates. The method of inference of behavioral tendencies from driving records without corroboration of observed or self-reported driving behaviors is a limitation in the interpretation of the study data. Risk-taking behavior does not always involve violations, e.g. driving at legal speed limits on slippery road surfaces may qualify as risk taking even if it does not elicit a speeding ticket. Risk-taking behavior does not always result in crashes, e.g. luck or the preventive behavior of other road users may intervene to prevent a crash. Police-reported violations or crashes may result from rare and uncharacteristic driving behaviors and do not necessarily indicate risk-taking tendencies, and violations may be repeated frequently without detection by the police. The police do not investigate and report all crashes. In Quebec, crashes with only minor material damage are settled between the insured parties using a standard reporting form issued by all insurance companies – police only report crashes if the material damage is extensive or if someone is injured. Also, police-reported crashes may under-represent crash frequency. Based on US studies, Hauer and Hattaka (1988) found that police only report 95% of the deaths, 80% of the serious injuries, and less than 50% of the minor traffic-related injuries. However, any under reporting of violation and crash frequency in my study might lead to an underestimation of the strength of association found between risk markers and violations and crashes.

Participants were recruited from three licensing centers where over a period of approximately four months research assistants approached successful adolescent candidates for a probationary permits 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 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 combines 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 10.32 for the study population and 8.2 and 14.6 in Quebec (SAAQ, 2004). Any selection bias that exists might possibly be associated with an underestimation of the magnitude of some of the study findings related to risk taking and increased violation and crash risk. Due to budget limitations, direct measures of driving exposure could not be obtained.

There are two possible limitations in the interpretation of the study data on self-rated subgroups. One, some of the paired self-rated subgroups have small numbers. Two, the exact definitions of "safe" or "good" driving were not specified in the questionnaire, so it is not possible to determine the range of different interpretations that participants gave these labels. However, given that the violation and crash records were associated with the paired self-ratings in the expected directions, it appears that the interpretations of good and safe may have been relatively consistent across subgroups.

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 149 items in the questionnaire covered a wide range of variables with demonstrated associations with crash rates, allowing for the emergence of profiles of violation and crash risk subgroups composed of distinct combinations of markers like age, sex, lifestyle, traffic- and driving-related exposure and experience. 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 and may be useful in developing more effective interventions.

RECOMMENDATION FOR FUTURE RESEARCH / INTERVENTIONS

What is the optimal strategy for reducing RTIs when adolescents are driving? This question can be divided into two questions. First, what is the optimal licensing age? Second, what is the optimal preparation for unsupervised driving? Each question is examined in relation to research and intervention recommendations.

Optimal licensing age

Given the heterogeneity of the adolescent driver population, it is unlikely that an optimal driving age can be determined. From a scientific perspective, the research findings cited throughout this thesis indicate that many, but not all, of the youngest driver's permit candidates are most at risk for reasons potentially related to lack of biospsychosocial maturity and lifestyles. The population-based crash countermeasure is to increase the driving age. Increasing the driving age by only one year has proven to be effective at reducing injury (Williams, Karpf, & Zador, 1983). However, increasing the driving age is an issue of great social, economic, and political complexity.

The subgroup-specific countermeasure is to screen for and treat the highest risk adolescent drivers. Hirsch and Maag (2001) demonstrated that by combining a limited number of risk markers, a subgroup of novice adolescent males with a relative risk of 1.9 for injury crash involvement during the first year of unsupervised driving could be identified. In theory, future research might possibly produce screening tests for high risk drivers based on measurements of MAO enzyme levels for sensation seeking or MRI exams for brain development. However, all screening procedures must meet acceptable standards of sensitivity and specificity and should also include feasible treatment options. The determination of what is acceptable in relation to licensing adolescent drivers will always involve political considerations. Therefore, in relation to the question of optimal driving age, the following recommendations for future research and interventions are suggested.

1. Research the reasons why the DE time-discount is associated with increased crash risk among adolescent drivers who use it. The data in this thesis indicate that adolescents who license at younger ages

appear to be least motivated to attend DE for learning reasons. Moreover, there is strong, consistent evidence that DE incentives allow adolescents who have the highest crash rates to license earlier. If the reasons that the DE time-discount is associated with increased crash risk among adolescent drivers cannot be explained and remedied, then for public health reasons the DE time-discount should be discontinued, as recommended by Wiggins (2004) and Mayhew, Simpson, Desmond, & Williams (2002).

2. Continue measuring, documenting, and publicizing the magnitude of the association between biopsychosocial immaturity and increased adolescent driver crash risk. The most immediate practical application of this research is to inform the licensing decisions of parents of adolescents and the policy decisions of government officials. Greater public awareness of the complex nature of the adolescent driver problem could lead, ideally, to greater social and political acceptance for licensing policies that reduce the harmful consequences of normal adolescent immaturity by: 1) increasing the participation of parents in the training and supervision of adolescent drivers; 2) increasing public acceptance for policies that reduce and restrict adolescent driving exposure, e.g. raising the licensing age, curfews, passenger restrictions; 3) highlighting the potential advantages of driver screening and rehabilitation programs, and; 4) increasing the attractiveness of alternative, safer, more environmentally friendly modes of transportation, e.g. buses, trains.

Optimal preparation for unsupervised driving

Due to society's increasing dependence on motor vehicle transportation, exposure reduction strategies for adolescent drivers, although certainly valuable, are only temporary and limited countermeasures - there are practical limits to how much the driving age can be increased. Until technology advances to the point where human error can be substantially eliminated from the driving task, society will still need to prepare novice drivers to practice safe driving behavior when they are unsupervised. Therefore, research is needed to determine the optimal preparation for unsupervised driving. Preparation can be divided along three inter related stages of the licensing process. The first stage is before and during the learner's permit and involves the content and delivery of DE programs, (it appears that the majority of adolescent driver's permit candidates attend some DE courses), and the quantity and quality of supervised driving experience. Supervised driving experience is treated here as an intervention. The second stage is the driver's permit exam criteria and the third stage is post-licensing sanctions for driver risk taking. Given the heterogeneity of the adolescent population and the diversity of the potential sources of driver risk taking, a multilevel strategy appears to be indicated. The ideal multilevel strategy would combine a population-based approach aimed at improving the behavioral norms

of all adolescent drivers and other road user behaviors, i.e. adult drivers, cyclists, pedestrians, with a subgroup-approach that aims at improving the behavioral norms of specific subgroups of adolescents who represent high injury risk for themselves and the public and who are unlikely to be influenced by the population-based approach.

The data in this thesis and previous research findings provide support for the intuitive hypothesis that the combined effect of road safety interventions can be greater than the sum of the individual interventions. In other words, the safety effectiveness of interventions at each stage of the licensing process appears to be enhanced or diminished by the degree to which they are reinforced by other interventions within that same stage and in other stages. For example, in this thesis, controlling for age, exposure, and DE attendance, female participants who practiced driving mainly with their parents were less likely to have driving violations than female participants who practiced driving with their friends as well as with parents. This result might be explained, in part, by the possibility that the quality of feedback provided by peers is different from the quality of feedback provided by parents and may undermine the safety lessons taught at driving schools. Another example from the thesis is that, compared with participants who did not attend DE, participants who did attend DE were more likely to succeed on the first attempt at the driver's permit road exam but were not more likely to be safer drivers. In Quebec, adolescent driver overrepresentation in road crashes has increased slightly over the past decade. These results indicate that the DE intervention combined with the criteria of the permit exams is not producing safer adolescent drivers. By contrast, Carstensen (2002) reports that modifications to novice driver preparation in Denmark that emphasized crash prevention knowledge and skills in both the DE curriculum content and the driver's permit exam criteria did in fact produce safer novice drivers.

However, two aspects of the Danish experience merit attention. One, the modifications to novice driver preparation in Denmark reduced multi-vehicle crashes but had little or no effect on the frequency of single vehicle crashes, which are usually associated with intentional risk taking. Therefore, it appears that the modified Danish DE curricula and permit test criteria are insufficient for reducing intentional risk taking, which is, in all probability, part of a complex of lifestyle-related risk behaviors that may require a comprehensive long-term strategy beginning several years before licensing age and continuing after licensed driving begins. The second aspect of the Danish DE program worth noting is that the safety benefits appeared to only last for the first one and a half years of unsupervised driving. This might indicate that the social norms of the majority of adult Danish drivers may be exerting a negative influence on the recently learned safe driving behaviors of novice adolescent drivers. To the degree that this interpretation is correct, it indicates that the long term success of improvements in stages one and two of

the licensing process, exam preparation and permit testing, ultimately depend upon the effectiveness of stage three interventions, i.e. sanctions against driver risk taking. Based on the findings in this thesis and the extensive review of the research literature, I suggest the following recommendations for research and interventions on optimal preparation for unsupervised driving.

1. Research ways to improve the content and delivery of the DE curricula and the criteria of the driver's permit exams to more effectively teach and test crash prevention knowledge and skills. The data from this thesis and previous research (Carstensen, 2002) indicate that confidence in crash prevention habits is associated with decreased crash risk and that many of the novice drivers in the sample did not equate safe driving with the ability to prevent crashes. Therefore, DE curricula and driver's permit exam criteria that positively reinforce the benefits of crash prevention skills and that clarify the relationship between safe driving and crash prevention may improve the safe driving of novice adolescent drivers.

2. Research exactly which preventive habits are most reliable in systematically reducing crash risk and to develop a research-based protocol of safe behaviors that can guide driver permit evaluations, driver training, and other crash interventions.

3. Conduct more research into the diverse sources of driver risk taking and develop programs to address these sources. Unintentional risk taking due to lack of experience or competence or cognitive and perceptual deficiencies may be detected by professional driving teachers or driving permit evaluators and remedied with special educational interventions (for discussion see Hirsch, 1997). Intentional driver risk taking may require long-term lifestyle education beginning in the school system several years before licensing age.

4. Conduct more research into the relationship between adolescent self-ratings of driving abilities and beliefs about crashes and their driving records. Data from this thesis indicate that adolescent drivers may actually have more awareness of their own risk taking and risk avoidance than was previously assumed. A better understanding of the developmental trajectories of novice driver self-ratings, risk perceptions and attitudes, and crash-related beliefs can be applied to improve DE programs, permit test criteria, and public education campaigns.

5. Research ways of improving the predictive validity of the driver's permit exam. The Hazard Perception Test (HPT) is, to the best of my knowledge, the only driver's permit exam with predictive validity and should be adapted and used in every licensing jurisdiction. A research-based exit road exam

with predictive validity in the context of GDL programs may also have potential safety benefits (see point 1 above).

6. Research the optimal quantity and quality of supervised experience before unsupervised driving begins. The data in this thesis indicate that violation and crash risk is greater for participants who have 50 hours or more supervised driving practice compared to participants who have fewer hours of practice. However, a study by Sagberg and Gregersen (unpublished manuscript) indicates that the effect is not linear but rather follows an inverted U pattern – implying that crash risk diminishes after a threshold of about 120 hours of practice is reached. These results require further investigation, especially since only between 30 and 50 hours of supervised driving practice is currently recommended by the IIHS and required by US licensing jurisdictions (IIHS, 2003).

7. Research ways of optimizing the integration of DE, supervised driving practice, permit exam criteria and post-license sanctions into the licensing process. Examine the advantages of multi-phase systems as recommended by Lonero (1998) and by Mayhew and Simpson (2002).

8. Research the development of a screening program similar to the one proposed by Hirsch and Maag (2001) using risk markers to identify high-risk subgroups. Licensing authorities may be able to identify some high-risk adolescent drivers through their violation records, e.g. during the learner's permit, combined with details from their performance on theory and permit exams. Early identification of high-risk drivers may facilitate timely and effective preventive interventions to protect these individuals and the public. Zink, Levin, Rosenthal (2003) recommend that medical professionals assume a more active role in screening adolescents for injury risk behaviors and Shope, Blow, Gregor, Maio, and Zakrajsek (2004) report on a successful intervention to reduce risk behaviors conducted in a hospital emergency department. Fischer and Smith (2004) reports on a growing body of research indicating that recommending alternative thrill seeking activities to sensation seekers may induce them to engage in activities with less negative outcomes.

9. Research ways of improving social driving norms and making the road environment safer for all road users. Previous research indicates that safer driving norms save lives. For example, higher speed limits are associated with increases in the fatality rate (Baum, Wells, & Lund, 1990; Transport Research Laboratory, 2002). Enforcing speed laws is a population-based strategy that will create a public climate of expectancy about speed behavior that will may possibly increase the effectiveness of public education about the danger of speed.

10. Research ways to create a more unified perspective on the true costs of road injury for society. Friedland, Trebilcock, and Roach (1990) point out that the existing institutional fragmentation of public-sector responsibilities in road safety administration severely inhibits cost benefit analysis of proposed improvements in licensing policies. This fragmentation increases the difficulty of attaining the information needed to analyze the cost benefits of countermeasures and may discourage investment in road safety.

11. Research ways to create a more unified approach to road injury prevention. Lonero (1997) remarks that "the DE industry, school authorities, insurers, governments, families, and communities must decide that they care enough about the safety of novice drivers that they will coordinate their efforts." This form of coordination may require leadership from government planners. As Rose and Day (1990) observe, "What is needed is an acceptance of collective responsibility for the population's health and social well-being."

CONCLUSION

The goal of this thesis was to develop new concepts and to uncover new findings to aid in the development of interventions to reduce RTIs among all road users. The goal is simple but the sources of the problem are complex and require the patient and deliberate application of scientific methods. Overall, it appears that the high crash risk of adolescent drivers is associated with a social norms of relatively easy access to driving privileges supported by adults at many levels of society, i.e. families, businesses, and government policymakers. Therefore, major reductions in risk taking among adolescent drivers, whose behavior may be linked to a biologically driven and normative underdeveloped ability to inhibit impulses and weigh the consequences of one's actions, will most likely require major changes in the training methods, evaluation criteria, and licensing policies for adolescents. I hope that this thesis can serve to increase awareness of the complex nature of the problem and aid in the development of interventions to increase public health.

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APPENDICES

APPENDIX 1 – HIRSCH, P. (2003) DRIVER EDUCATION AND ADOLESCENT DRIVER RISK TAKING: EVIDENCE OF A MOBILITY BIAS IN PUBLIC POLICYMAKING. JOURNAL OF SAFETY RESEARCH, 34, 289-298

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Adolescent driver risk taking and driver education: Evidence of a mobility bias in public policymaking

Pierro Hirsch *

Université de Montréal, 4575 Hutchison, Montreal, Quebec, Canada H2V 4A1

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Abstract

Problem: Road traffic injury is the leading cause of death among adolescents in high-income countries. Researchers attribute this threat to driver risk taking, which driver education (DE) attempts to reduce. Many North American authorities grant DE graduates earlier access to unsupervised driving despite no evidence of this being a safety benefit. This theoretical article examines risk taking and DE in relation to an apparent mobility bias (MB) in policymaking. *Method*: The MB is defined, the history and sources of driver risk taking are examined, and the failure of DE to reduce collision risk is analyzed in relation to a potential MB in licensing policies. *Discussion*: The author argues that DE's failure to reduce adolescent collision risk is associated with a MB that has produced insufficient research into DE programs and that influences public policymakers to grant earlier licensure to DE graduates. Recommendations are made regarding future research on DE and risk taking, coordinated improvements to DE and driver licensing, and a plan to reduce collision risk by encouraging parental supervision after adolescent licensure. *Impact on Industry*: Research on adolescent driver risk taking would have direct applications in DE curricula development, driver's license evaluation criteria, graduated licensing (GDL) policies, as well as other aspects of human factor research into the crash-risk problem.

Keywords: Adolescent drivers; Traffic injury; Risk taking; Driver education; Graduated licensing

1. Introduction

Road traffic injuries are the leading cause of death and the third leading cause of burden of disease among adolescents in high-income countries worldwide (World Health Organization, 1999). The increased traffic collision risk of novice adolescent drivers is so robust a phenomenon that Evans (1991) has called it a law of nature. Mayhew and Simpson (1990) attribute this health problem to the relative immaturity and inexperience of adolescent drivers, which leads to riskier driving behavior. Mathews, Zollinger, Przybylski, and Bull (2001) cite numerous studies that demonstrate that different adolescent risk taking behaviors (i.e., alcohol use, nonuse of seat belts) are major predictors of traffic-related injuries. Recently, researchers have recommended that adolescent road injuries can be decreased by reducing adolescent driver risk taking (Beirness & Simpson, 1997; Evans, 1993; MacDonald, 1987; McKnight, 1999). However, driver risk taking is underdeveloped as a research topic relative to its importance as a source of adolescent injury.

The traditional intervention for improving novice driver behavior, which implies a reduction in risk taking, is driver education (DE). DE programs exist in almost all jurisdictions around the world, presumably because "they are generally accepted as an efficient and effective means for learning to drive, and more importantly, for learning to drive *safely*" (Mayhew, Simpson, Williams, & Ferguson, 1998). Both assumptions about DE bear closer inspection. If licensure rates are used as a proxy for learning to drive, DE appears to be efficient and effective; licensure rates increase among younger drivers whenever DE availability increases (Mayhew & Simpson, 1996; Potvin, Champagne, & Laberge-Nadeau, 1988; Robertson, 1980). If collision rates are used as a proxy for safe driving, DE appears less efficient and effective because the youngest licensed drivers also have the highest collision rates (Potvin et al., 1988; Robertson, 1980; Williams, 1998). The finding that there is little or no evidence that DE reduces collision rates (Groeger, 2000; Mayhew & Simpson, 1996) may be due, in part, to the increased exposure of these youngest drivers.

* Tel.: +1-514-276-5396; fax: +1-514-844-2119.
E-mail address: pierro.hirsch@umontreal.ca (P. Hirsch).

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Paradoxically, despite DE's potentially negative effect on adolescent collision rates, governments continue to grant DE graduates earlier access to unsupervised and relatively unrestricted driving (Mayhew et al., 1998).

The goal of this article is to examine the possibility that the promotion by governments of current versions of DE and DE's apparent ineffectiveness at reducing adolescent driver risk taking are both related to an apparent mobility bias in public policymaking. Part 2 of this article discusses the mobility bias in more detail and questions the assumption that this bias is shared by the majority of parents of adolescent drivers. The remaining sections point out, where applicable, possible evidence of the mobility bias at work in DE program development and license testing. Part 3 briefly reviews the concept of driver risk taking from a historical perspective, one that Evans (1991) finds is "presently often lacking" in traffic safety research. Part 4 examines different sources of risk-taking behavior and their underlying theoretical and empirical support. Part 5 analyzes the apparent failure of DE as a collision countermeasure in relation to different sources of adolescent risk taking and the potential mobility bias. The article concludes with recommendations for future research and interventions to improve adolescent driver safety.

2. The mobility bias

One plausible explanation for the curious lack of research on adolescent driver risk taking and the paradoxical promotion of DE by policymakers is a mobility bias in their decision making. By mobility bias, I mean the nonrandom selection of policies that promote access to privately owned and operated motor vehicles over alternative means of transport. Society's investment in private motor vehicles is so pervasive that in nearly all traffic safety discussions the word "transportation," which should properly denote all ground vehicles including bicycles, buses, and trains, has been replaced by the word "mobility," which appears to refer almost exclusively to automobiles and driver licensing. Køltzow (1993) interviewed transportation policymakers and concluded that when mobility conflicts with safety they give primary consideration to the "freedom of the car."

Other statements in the research literature reflect the assumption that the public always values mobility over safety. Dussault (1994) observes that "the demand for safety turns out to be a by-product of the demand for mobility" and concludes that "mobility has won out and will always win out over safety." Mayhew and Simpson (1990) acknowledge the safety value of raising the driving age in North America but speculate that this policy "may be politically and socially unacceptable." Drummond (1994) observes that "a reduction in the number of young driver crashes does not necessarily indicate the best outcome from a community perspective...an effective and equitable balance must be reached between a range of competing objectives." Simpson (1995) claims that parents "are well aware of the dangers young people face on the road...but are often prepared to accept these risks in exchange for the convenience that accrues from licensing young people." None of the above authors cite any empirical evidence to support their statements.

A contrary perspective emerges when researchers test the assumption that the public and parents in particular prefer adolescent driver mobility to adolescent driver safety. Williams, Ferguson, Leaf, and Preusser (1996) found that most parents preferred tougher driving restrictions, despite the explicit recognition that they and their children would be inconvenienced to some extent; in a Connecticut survey, 82% of the parents of 15-year-olds were in favor of a night driving curfew for newly licensed drivers that the legislators rejected. In California, 79% of a sample of parents of adolescents in a graduated licensing (GDL) program strongly endorsed the new system of driving restrictions and longer learning periods (Williams, Nelson, & Leaf, 2002). There is even some evidence of public support for the most mobility reducing and safest intervention of all, raising the driving age (Raise the driving age, 1989).

Considering that affirmations of the public's universal preference for mobility over safety appear to be exaggerated and that licensing policies that hasten or increase adolescent driving exposure also appear to increase adolescent collision risk, it is critical to question whether a public policy mobility bias is exerting a negative influence on adolescent health. I begin by reviewing the concept of driver risk taking.

3. A brief history of the driver risk taking concept

Throughout the 20th century, governments issued driver's licenses after minimal evaluations to increasing numbers of progressively younger adolescents with relatively little training or experience. These licenses allowed adolescents to drive competitively marketed motor vehicles capable of increasingly higher speeds without adult supervision on increasingly more complex road and traffic systems where the enforcement of speed and alcohol laws was initially and still remains relatively lax. As this form of mobility increased so did the health problem of adolescent road injury. Logically, researchers could focus collision injury prevention efforts either on the driver or on the vehicle and the road environments (Haddon, 1972). Until the 1950s, researchers tended to attribute responsibility for collisions primarily to drivers who were considered to be "accident-prone," a vague label signifying higher than average collision risk (Grayson & Maycock, 1988).

Critics observe that this early conceptualization of accident proneness had no empirical foundation (Sass & Crook, 1981) and was based upon a mistaken interpretation of collision statistics (Brehmer, 1994; McKenna, 1983). Campbell and Levine (1973) and Szasz (1984) suggest that accident proneness research continued for several decades

despite its lack of success because the promise of improving safety by eliminating the minority of "problem" drivers was preferable to expensive improvements to road systems and automobile manufacturing. In fact, research on vehicle safety was discouraged actively during this period by the prevailing belief that any safety improvements to the vehicle or the road would be offset totally or partially offset by increased driver risk taking (Gibson & Crooks, 1938, in Evans, 1991; Smeed, 1949, in Summala, 1988).

By the mid-1950s, most researchers abandoned their focus on the driver and began to recognize the potential for saving lives by engineering forgiveness for driver error into the vehicle and road environments (Nader, 1991). In 1966, despite powerful opposition from automotive industry lobbyists, safety standards for the manufacture of automobiles were legislated in the United States (Nader, 1991). These safety standards and publicly funded road improvements are credited for saving over 100,000 lives over the two decades that followed (Robertson, 1986). Nader (1991) estimates that the actual number of lives saved by safety engineering in the United States during this period is closer to 200,000 and that even this higher number could easily have been doubled if automobile industry sponsored political lobbyists had not succeeded in delaying scheduled safety initiatives (e.g., strong side impact crash protection). Recently, researchers have warned that the limits of engineering safety have been reached (Evans, 1993; MacDonald, 1987). Evans (1993) attests that further reductions in road injury will require "more frontally and directly addressing driver risk taking in traffic." The question remains: What exactly is driver risk taking?

A review of the research literature has not produced a single consensually accepted definition of driver risk taking. Some argue that because no human behavior can guarantee total certainty of outcome, all behaviors may be viewed as risk taking (Simonet & Wilde, 1997; Trimpop, 1994). Evans (1993) attests that "it is essentially impossible to conjure up any crash scenario in which the crash could not have been avoided if the drivers had behaved differently." Because licensing and driving are self-selected activities, individuals appear to control their own level of collision risk by choosing when and how they drive. These logical arguments are supported by empirical findings from detailed collision investigations that confirm driver behavior as the sole or contributory factor in about 80% of traffic collisions according to some estimates (Sabey & Taylor, 1980; Streff, 1991) and between 94% and 99% according to others (Rumar, 1985, in Evans, 1985).

Scientific rigor demands close scrutiny of the above definitions of driver risk taking and the empirical basis for conclusions about the dominant role of driver behavior in automobile collisions. First, the definition of driver risk taking as any and all driver behavior is unacceptable because it violates a basic rule of definition by being too broad (Conway & Munson, 1997). If all driver behaviors are risk taking then driving and risk taking become synonymous. Second, all the empirical studies mentioned above were retrospective in design and did not have control groups. Therefore, it is impossible to conclude with certainty that a specified driver error (e.g., driving too fast for conditions) was the sole or contributory factor in a collision event. Only seconds before the collision event in question, other drivers might have traveled at equal or greater speeds over that same stretch of road without incident.

Uncertainty in defining driver risk taking has at least two sources. One, on methodological grounds, valid descriptive information about the specific driver behaviors that precede rare events like collisions is extremely difficult to obtain (Rothengatter, 1997). Two, the complexity of the interactions between drivers and their environments prior to a collision event challenges the development of simple definitions. These difficulties may explain partially why traffic safety researchers have not been able to specify precisely and exhaustively which driving behaviors qualify as risky (Simpson, 1995) or as safe (Evans, 1991; Gregersen & Bjurulf, 1996; Mayhew & Simpson, 1990). Nor have they yet developed a single, widely accepted, authoritative theory or model to explain how automobile collisions occur (McKenna, 1983; Ranney, 1994).

The lack of a research-based theory or model of collision events leads directly to the practical problem, noted by Gregersen and Bjurulf (1996), that although "most of us want to drive safely," we lack a definition of "what this implies in actual behavior." This lack of definition may be the least obvious and most critical manifestation of the mobility bias because it reflects decades of neglect by decision makers who set agendas and allocate funding for research. In the following sections, I argue that the absence of an authoritative set of safe driving behaviors increases injury risk by hindering the development of effective DE curricula and driver license evaluations.

In summary, one might conclude that driver risk taking is another vague label like accident proneness, whose chief practical value is that it is unlikely to produce any intervention that infringes upon mobility. If so, then researchers should focus collision prevention research exclusively on environmental factors. However, progress in vehicle and road technology has not advanced sufficiently to eliminate or reduce considerably the problematic role of the human driver. Therefore, research into the contributory role of driver behavior, whether we call it accident proneness or risk taking, appears to be essential in the overall effort to reduce collision injury risk. Following the suggestion by McKenna (1983), I begin by outlining some psychological processes that describe the driver's contribution to collision events, what I call the sources of risk-taking behavior.

4. Sources of driver risk taking

Researchers have identified four distinct sources of driver risk-taking behavior. The first two are identified by Evans

(1993) and Simpson (1995) as miscalculation of risks and intentional risk taking for its own sake. Evans (1993) adds a third source for intentional self-destructive acts or suicide. I add a fourth source of risk-taking behavior that is unintentional in the sense that the behavior or its significance is momentarily outside the driver's direct awareness or control. For presentation purposes only, I examine each source separately.

The claim that a collision results from a driver's miscalculation of risk assumes that the driver possesses the necessary knowledge and ability to avoid traffic collisions. As noted earlier, this necessary knowledge has not yet been determined authoritatively. Therefore, methods for evaluating a driver's collision avoidance ability are equally undetermined. Scientific explanations for inter- and intra-individual differences in abilities to cope with the driving task are provided by theories such as information processing, behavior feedback, and decision making that accounts for both (Comsis, 1995). The results of studies that compare collision risk to measures from instruments based on these theories are mixed. Higher collision risk is associated with information processing deficits such as slower hazard detection (Rumar, 1990), slower reaction times (Fergensen, 1971), and poor selective attention (Arthur & Doverspike, 1992). Cognitive ability, as reflected by higher academic achievement, correlates with lower collision risk (Harrington, 1972; Murray, 1998). Driving competence, as measured by performance on a practical road exam, appears to interact with sex in relation to collision risk—increased competence is associated with increased collision risk for males and decreased collision risk for females (Laberge-Nadeau et al., 1999). Poor decision-making skills correlate with higher rates of specific types of collision involvement for female drivers only (French, West, Elander, & Wilding, 1993). Competence, as measured by advanced driving skills, appears to interact with drivers' age in relation to collision risk. New drivers below the age of 21 years with skid training had more crashes on icy roads than age group matched drivers without the training—drivers 21 years and older with skid training had fewer crashes on icy roads than age group matched drivers without the training (Katila, Keskinen, & Hatakka, 1996). Overall, these findings indicate that driving skills are associated with collision risk but that the direction of the association is influenced by interactions with driver age or sex or both. These interactions may reflect differences in motivation, quantity and quality of driving exposure, and intention to take risks.

The second source of risk taking is driver intention. Attempts to explain scientifically intentional risk taking are found in such theories as reasoned action (Fishbein & Ajzen, 1975), risk homeostasis (Wilde, 1994), planned behavior (Ajzen, 1991) and problem behavior (Jessor, 1987). These theories share the assumption that drivers' intentions and beliefs, as determined by a complex interaction of different factors, can predict drivers' behavior. Weak to moderate empirical support for the claim that collisions result from intentional risk taking is provided by prospective research questionnaires that measure drivers' intentions and beliefs and that have predicted collisions, sometimes several years in advance (Maycock, 1995; Rutter & Quine, 1996; West, Elander, & French, 1993; West & Hall, 1997). In all these studies, the drivers' intentional risk taking was often related to their disregard for legal driving rules (i.e., speed limits). Therefore, it is possible that these drivers intentionally risk legal sanctions but do not believe strongly that they are also risking injury. This distinction is important because it might signal a lack of comprehension about the relationship between driving behaviors and driving outcomes.

In the third source of risk taking, suicidal intent, the drivers' comprehension of the relationship between specific driver behaviors and their expected driving outcomes is assumed to be unambiguous. Evans (2002) cites several studies that estimate suicide may account for as many as 5% of driver fatalities. Theories that might explain driver risk taking with suicidal intent are beyond the scope of this article.

The fourth source is unintentional risk taking—risk-taking behavior that is outside the driver's direct awareness or intentional control. Unintentional risk taking is explained within theories such as planned behavior (Ajzen, 1991) and risk homeostasis (Wilde, 1994). Elander, West, and French (1993) consider that some drivers more than others are prone to errors or lapses in their cognitive functioning. Cognitive psychology proposes that well-practiced behaviors, like driving, become habitual or automatic (Ranney, 1994). Therefore, given the random nature of collision events and the uncertainty of what constitutes safe behaviors, it is possible that some drivers develop risky driving habits unintentionally. Unintentional risk taking may increase during adolescence due to person-centered traits like impulsiveness, sensation seeking, or emotional instability, all of which may interact with biopsychosocial maturity and lifestyle influences. The tendency to violate traffic laws related to sensations (i.e., speed and alcohol) may result directly from certain traits over which some adolescents may have not yet developed sufficient self-awareness and self-control. Researchers claim that, compared with adults, adolescents who are experiencing personal problems or who are sensation seekers or both are not necessarily capable of understanding and directing their own risk-taking behavior (Irwin & Millstein, 1986; Jessor, 1987; McKnight, 1999).

To summarize, the sources of risk-taking behavior are diverse. Studying these sources is complicated by at least two factors. One, the potential loss or losses from a particular risk-taking behavior (i.e., speeding) may not be understood clearly or equally by all adolescents. Some adolescents may consider that the primary risk of speeding is legal sanctions while others may understand the increased potential for injury associated with higher speeds. There is

also the possibility that for some adolescents, particularly males, slower driving entails the risk of a loss of self-esteem or status among peers for failure to meet the challenge of mastering the fear of high-speed driving.

The second factor that complicates risk-taking research is the probability that at any given moment or during successive moments two or more sources of risk taking may influence driver behavior. As Evans (1993) states, the "dividing lines between...[sources of risk taking] are far from sharp." Adolescent drivers may seek thrills or they may miscalculate their collision risk or both. Driver intake of drugs, specifically alcohol, is acknowledged as a major factor in blurring the lines between sources of risk taking and in increasing driver risk taking from each source. Only research conducted with the most rigorous of designs and methodologies can disentangle the different sources or combinations of sources of risk-taking behavior associated with injury collisions. The next section analyzes the apparent failure of DE as an intervention against adolescent driver risk taking in the context of an apparent mobility bias in public policy decision making.

5. Risk taking, DE, and the mobility bias

I suggest three main reasons for the apparent failure of DE to reduce adolescent driver collision risk. (1) DE curricula are not based on valid scientific research of driver risk taking. (2) Driver risk taking has multiple, potentially covarying sources that are not treated easily by a single-measure, short-term intervention like the current forms of DE. (3) Transportation policymakers are not informed fully about the public health risks of the DE time discount within GDL. I now examine each reason in relation to the potential mobility bias in policymaking.

5.1. The DE curriculum

In the late 1940s, a DE program was implemented extensively in North American high schools without the benefit of the "developmental requirements of...objective based curricula...and program-evaluation documenting effectiveness before program expansion begins"; once it became widespread, efforts to evaluate and document the effectiveness of DE were hampered by "the fact that insurance companies and some State Licensing agencies provide incentives for...graduates based on undocumented assumptions" (NHTSA, 1975). Over the years, the effectiveness of DE as a collision-risk reduction countermeasure was questioned repeatedly.

In response to these questions, NHTSA awarded a 6-year contract (1977–1983) of US$4,277,771.00 to a research laboratory to determine the crash reduction potential of a quality, competency-based driver training program known as the Safe Performance Curriculum (SPC; Stock, Weaver, Ray, Brink, & Sadof, 1983). The study came to be known by the name of the location of its final stage, DeKalb County, Georgia. Nearly two decades later, Mayhew et al. (1998) report:

> The DeKalb County project, conducted to evaluate the effectiveness of a comprehensive driver education program, still stands as the most large-scale, well-designed and ambitious effort to assess the impact of formal instruction.... Data from this well-designed and large-scale study have been the object of intense scrutiny and sophisticated reanalyses. Despite the different methods and statistical procedures that have been applied to the data, however, the findings have been extremely consistent...driver education was not found to be associated with reliable or significant decreases in crash involvement (p. 53).

The above conclusion is vulnerable to the criticism by Evans (1991) that the "focus on statistical detail often obscures the fact [that the] main uncertainty in traffic safety research is usually in interpretation." The authors cited above make two errors of interpretation. First, they overgeneralize. Regardless of the quality of the DeKalb SPC DE program, its failure to improve novice driver safety does not imply that another program would not succeed. Second, the authors and the traffic safety researchers to whom they refer missed a critical flaw in the execution of the DeKalb study that appears to invalidate any firm conclusions about the study's data.

The critical flaw in the DeKalb study is that the SPC program was never pilot tested prior to its implementation in the large-scale controlled evaluation. This is equivalent to a pharmaceutical company conducting a large-scale clinical trial on an experimental drug without any prior laboratory testing. A few excerpts from the study's final report (Stock et al., 1983) reveal the flaw.

> The evaluation of the SPC project is part of the...twelve-year on-going research program...that called for an analysis of the driving task, identification of those tasks with a high or moderately high criticality, development of curriculum specifications and then a curriculum with a safe performance orientation, and finally, evaluation of that curriculum for its instructional effectiveness and *crash reduction potential*.... The fifth listed item, [evaluation of the curriculum], was *accomplished* in a pilot program conducted in Kansas City. (pp. 1–3)...Difficulties were experienced throughout the implementation phases of the Kansas City Project.... Because of these problems and, primarily, because sample sizes were smaller than anticipated and a relatively low percentage of students participating in the program obtained driver's licenses, *long-term follow-up measures (accidents and violations) of crash reduction potential were not obtained*, although they were originally planned. [italics added] (pp. 1–4)

Note the contradiction. First, the authors state that the pilot evaluation of the crash reduction potential of the SPC was accomplished, then they admit that during the pilot, evidence of crash reduction, accidents and violations records, was *never* obtained. Stock et al. (1983) conclude that study demonstrates that the SPC was not an effective accident reduction countermeasure. However, there was never any empirical basis for assuming that the SPC would be effective.

One might argue that the SPC was based upon an extensive analysis of the driving task and the identification of those tasks with a high or moderately high criticality. However, the validity of that task analysis is highly questionable. Nearly one decade after DeKalb, Mayhew and Simpson (1990) observe that "precisely what the critical factors are that contribute to the collisions of young and older novice drivers remains elusive." More recently, Mayhew and Simpson (2002) admit that the empirical basis for DE curriculum development remains limited.

I submit that the lack of a research-based set of safe driving rules can be seen as further evidence of the influence of a policymaker mobility bias. Taylor (1976) recognized the subjective nature of individual driver risk perception and suggested that safety could be achieved best by developing driving rules based on scientific research. To date, the only existing set of authoritative driving rules are the legal ones in the Highway Code. Legal rules discourage some risky driving by penalizing violators and assigning fault after the collision occurs. However, legal rules do not define clearly all the driving behaviors necessary to prevent collision involvement. Drivers could endanger their own safety by complying fully with some Highway Code rules (Hirsch, 1995). If policymakers valued safety more than mobility, a research-based set of driving rules designed to reduce collision risk systematically might already exist.

5.2. Multiple, covarying sources of driver risk taking

The four sources of driver risk taking, (a) miscalculation, (b) intention, (c) suicide, and (d) lack of intention, reflect the heterogeneity of the driving population and the variability of the driving task. Therefore, it is questionable whether single-measure interventions like DE can treat effectively these multiple and most likely covarying sources of risk taking. DE in its current form is unlikely to be effective against and may even increase one or more of the sources of risk taking.

For example, by increasing knowledge and skill, DE promises to reduce risk from driver miscalculation. However, increased skill might also lead to overconfidence or underestimation of risk or both, thereby increasing collision risk by increasing driving exposure or reducing caution, or both. Obviously, skills are necessary for safe driving, but adolescent drivers may have cognitive or emotional problems that increase miscalculation of risk or intentional risk taking. DE teachers are not qualified to treat such problems and they can only present rational arguments and emotional appeals against intentional risk taking. DE teachers have little power or authority to deter adolescents from expressing nonrational, biologically based sensation seeking or developmental needs (e.g., the exploration of the limits of their own abilities). DE teachers cannot intervene against adolescent suicidal tendencies. Finally, DE cannot counteract the effects of psychosocial immaturity that appear to be associated with all sources of driver risk taking, especially risk taking that is outside the adolescents' awareness.

The need for a global approach to the multiple forms of risk taking was addressed by two recommendations in the final report of the DeKalb study (Stock et al., 1983). The first called for a provisional/restricted license to limit new drivers' exposure to high-risk driving circumstances for the first year. This exposure reduction has been legislated into effect with positive results in most of the recently implemented GDL programs (Williams & Mayhew, 1999).

The second DeKalb study recommendation called for the development of an interim measure of personality/emotional/attitudinal factors predictive of collision and violation occurrence. There is little evidence that any scientific progress has been made in this direction, possibly due, in part, to what Mayhew and Simpson (1990) describe as the concerns of licensing authorities about "invasion of personal privacy, discriminatory and unfair practices." It is fair to ask whether policymakers would allow these issues to over rule automatically and absolutely the potential health benefits of a screening program if it were not for a mobility bias.

5.3. Policymakers need to be informed fully

Adolescent driver risk taking rarely occurs under adult supervision. At present, in many jurisdictions with GDL, novice drivers who graduate from DE, compared to those who do not, have earlier access to unsupervised driving privileges. Policymakers need to be aware that DE does not necessarily reduce all and may even increase different sources of risk taking. Apparently, policymakers do not always have or act upon this awareness. For example, Boase and Tasca (1998) claim that when policymakers in Ontario granted a 4-month reduction on the waiting period for new license candidates with DE "there was certainly an absence of evidence suggesting that [DE] caused any harm."

However, as noted in the Introduction of this article, research published prior to the implementation of GDL in Ontario reported increases in rates of licensing and collisions among younger adolescents where DE courses were more available or compulsory. Based on a critical review of the scientific basis for GDL policies, Hirsch and Laberge-Nadeau (1995) predicted that GDL delays and restrictions would discourage licensure mainly among adolescents who were less motivated to drive, hence less

likely to be exposed, leaving those adolescents who licensed faster (i.e., who use the DE time discount) to comprise "a smaller cohort of new young drivers with a higher collision rate."

This prediction was confirmed by two subsequent evaluations of the DE time discount within GDL. In Ontario, 16- to 19-year-old novice drivers who graduated from DE courses had a collision rate that was 45% higher than novice drivers without DE (Boase & Tasca, 1998). Mayhew, Simpson, Williams, and Desmond (2002) found that in Nova Scotia, novice drivers with DE, compared with drivers without DE, had a collision rate that was 27% higher in the first 6 months and nonsignificantly higher in the following two 6-month periods. An experimental drug that produced unhealthy side effects of such magnitude would immediately be withdrawn from the market. The fact that the time discount continues to be offered to DE graduates corroborates the observation by Køltzow (1993) that policymakers favor DE because DE never interferes directly with the demands for increased mobility.

6. Discussion

In this article I have argued that the apparent failure of DE to reduce collision risk is associated with two factors, both related to a mobility bias in policymaking. One is the underdevelopment of a research-based DE curriculum designed to reduce effectively risk taking among unsupervised adolescent drivers. The other factor is the government practice of granting DE graduates earlier access to unsupervised driving.

Three recommendations follow from this argument. One, research on the multiple, covarying forms of adolescent driver risk taking is urgently needed to improve the content and delivery of DE. Two, the results of this research should be used to develop a multiphase DE program that is well integrated within the licensing system, as recommended by Lonero (1998) and Mayhew and Simpson (2002). A multiphase, integrated DE program could address more of the diverse sources of risk taking. For example, novice adolescents with special needs (i.e., lower skill levels or perceptual abilities) could potentially be identified and given special training (Mayhew et al., 2002). Preliminary research indicates that professional driving teachers may possess a certain ability to predict the collision risk of their students (Hirsch, 1997; West & Hall, 1995). Elander et al. (1993) propose that "methods could be developed to help driving instructors identify pupils at greater risk because of limited perceptual abilities." The detection and treatment of other sources of risk taking may be achieved with a long-term screening procedure, as proposed by Hirsch and Maag (2001), which complements the improved DE program and is also integrated within the licensing system.

A note of caution is necessary. For several related reasons, improvements to DE may not produce expected safety gains without matching improvements to other components of the licensing system, particularly the driver's license exam. DE is only one of several stages in the driver licensing system. DE is normally delivered by the private sector where market forces make it difficult to control. The primary motivation of DE students is to acquire a driver's license (Mayhew & Simpson, 1995) and driving schools must satisfy their client's needs (NHTSA, 1975). Therefore, the passing criteria of the government driver's license exam effectively set the agenda for DE (MacDonald, 1987; McKenna, 2002). Lax license exam requirements encourage minimal preparation by DE students and their teachers. In short, future improvements to DE may receive proper attention only if they are coherent and consistent with all other components of the licensing system, especially the passing criteria of the license exam.

The third recommendation of this article involves the implementation of DE as a time reduction within GDL. Mayhew et al. (1998) recommend that policymakers in jurisdictions that have not yet implemented the DE time reduction into their GDL programs would be advised not to do so. I recommend further that the licensing authorities in those jurisdictions where the DE time discount is already legislated should fully inform the parents of adolescent driver's license candidates about the limits of DE effectiveness. This can be achieved practically whenever parents of minor age licence candidates sign government consent forms. In the future, these consent forms should include a warning to the effect that research demonstrates the DE does not necessarily reduce all sources of risk taking among adolescents and therefore should be complemented, for a recommended time period, with driving practice under adult supervision and restrictions on unsupervised driving.

An official government warning about DE's limited safety benefit could improve adolescent driver safety by reducing parental confidence in the protective effects of DE. Plato and Rasp (1983) found that parents of adolescents had confidence in the safety value of DE and felt that no further driver training was required after licensing. Lowering parental confidence in DE could increase parental supervision of adolescent drivers after licensing. Simons-Morton, Hartos, and Leaf (2002) report that programs that heighten parental awareness of collision risk appear to increase parental involvement in the adolescent drivers' learning process and supervision and restriction of driving after licensing. More frequent parental supervision and restricted adolescent driving were associated with safer driving behaviors (Beck, Shattuck, & Raleigh, 2001) and low parental monitoring and control were related to risky driving behaviors, traffic violations, and collision among adolescents (Hartos, Eitel, & Simons-Morton, 2001). Therefore, increased parental supervision and restrictions may be an effective collision countermeasure, especially against the increased collision risk of adolescent lifestyles that resist deliberately traditional interventions.

7. Conclusion

The goal of this article was to examine the possibility that the official promotion of current versions of DE and DE's apparent ineffectiveness at reducing adolescent driver risk taking are both related to a public policy mobility bias. This bias increases adolescent driver injury risk through the underdevelopment of risk taking research within DE curricula and the increased driving exposure of younger DE graduates. Given the economic importance of access to a driver's license, the mobility bias among policymakers is understandable. What is regrettable, however, is that this bias creates and perpetuates a false dichotomy between mobility and safety that undermines basic reasoning about safety research. For example, Evans (1991) acknowledges that if drivers with above average crash rates were screened and prevented from driving, "the percent reduction in crashes will exceed the percent reduction in driving," but he affirms that improved safety does "not justify denying driving privileges to a group of people." The denial of driving privileges is neither the purpose nor the necessary outcome of a research-based DE program and drivers' licence exam. Rather, the purpose of such an intervention is to improve public safety and mobility by increasing the probability that every licensed driver understands and reduces voluntarily risk-taking behavior. The reasons why researchers have developed few if any effective countermeasures against risk taking by unsupervised adolescent drivers may be due as much to the effects of a public policy mobility bias as to the complexity of the research topic.

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Pierro Hirsch earned a BA in Philosophy from the University of California at Berkeley in 1978. In 1997, he earned a MSc in Community Health at the Université de Montréal where he is now a PhD candidate in Public Health. Publications include articles presented at Canadian Multidisciplinary Road Safety Conferences as well as studies published by the Center for Research in Transportation at the Université de Montréal. He is a member of the Canadian Association of Road Safety Professionals, an advisor to the CAA-Québec Approved Driving School program, and a board member of the Montreal chapter of MADD Canada. He works extensively as a road safety educator, program developer, and consultant.

APPENDIX 2 - EXPLANATION LETTER & CONSENT FORM

1ST QUESTIONNAIRE - FRENCH VERSION

Centre de recherche sur les transports (C.R.T.)

Campus de
l'Université de Montréal
C.P. 6128
Succursale Centre-ville
Montréal QC H3C 3J7
Canada

Téléphone:
(514) 343-7575
Télécopieur:
(514) 343-7121

crt@crt.umontreal.ca
www.crt.umontreal.ca/crt/

Felicitations !

Tu viens tout juste d'obtenir le privilège de conduire un véhicule routier sans être accompagné(e). Comme détenteur (trice) ayant ce nouveau privilège, l'équipe de récherche de l'Université de Montréal demande ta participation à une étude portant sur les nouveaux conducteurs et les nouvelles conductrices de 16 à 19 ans. Tu pourras ainsi apporter ta contribution pour augmenter la sécurité sur les routes, pour ta propre protection et celle des autres. En plus, tu peux gagner un des **33 prix de 100$** qui sera tiré parmi les répondants. Tout ce que tu as à faire consiste à compléter le questionnaire suivant, qui ne te prendra qu'une vingtaine de minutes et, dans un an, compléter un second questionnaire qui consistera en un bref suivi de ton expérience de conduite au cours de ta première année. Tous les renseignements recueillis demeureront ***strictement confidentiels*** et seront traités ***uniquement par l'équipe de recherche*** dans une banque de données ***rendue anonyme***. Si tu le désires, tu pourras te retirier de cette étude à n'importe quel moment et sans avoir à fournir de raison en le demandant par écrit à Prof. Urs Maag, CRT, l'Université de Montréal, C.P. 6128, succ. Centre-ville, Montréal, (Qc), H3C 3J7.

Consentement de participation à l'étude et autorisation pour divulgation du dossier de conduite par la Société de l'assurances d'automobile du Québec :

Je soussigné(e) consens à participer à l'étude et j'autorise la Societé de l'assurance automobile du Québec à communiquer au chercheur mentionné ci-dessous l'état de mon dossier de conduite incluant les caractéristiques des infractions, suspensions, révocations et accidents m'impliquant. Cette autorisation est valide à compter de la date de signature et se terminera le 31 décembre 2001.

_____ /__ __ __ __ __ - __ __ __ __ __ __ - __ __

(Nom en lettres moulées) **(Numéro permis de conduire, ou No de dossier)**

_____/_____/_____/_____

(Signature) **(Jour)** **(Mois)** **(Année)**

Si tu as moins de 18 ans, signature des parents (père, mère ou tuteur) et s.v.p., retourner cette feuille dans l'enveloppe pré-adresseées et pré-affranchie :

_____/_____/_____/_____

(Signature) **(Jour)** **(Mois)** **(Année)**

J'apprécie ta collaboration.

Urs Maag

Urs Maag, Ph.D., responsable du projet de recherche.
Professeur titulaire au département de mathématiques et de statistique.
Membre du Laboratoire sur la sécurité des transports.

1	5	3	1

euille d'identification nous permettant de te rejoindre si tu gagnes un des 33 prix de 100 $. Seuls ceux qui ont complété le questionnaire et la feuille de consentement de participation avec la(les) signature(s) requis(es) seront admis au tirage.

Inscrire en lettre moulées, s.t.p. :

Nom : _____ Prénom : _____.

Adresse:_____
(Rue)

_____/_____
(Ville) (Code postale)

Numéro de téléphone : (___ ___ ___) - ___ ___ ___ - ___ ___ ___ ___.

Date de naissance :_____ / _____ / 198__. Sexe : F ☐ H ☐
(Jour) (Mois) (Année)

e tiens à te remercier de prendre le temps de répondre à ce questionnaire. C'est par ta collaboration que nous pourrons continuer à approfondir les connaissances sur la conduite automobile et atteindre les objectifs souhaités au chapitre de la sécurité routière.

Urs Maag, Ph.D., responsable du projet de recherche.

Instructions :

Si tu as moins de 18 ans, et qu'il n'y a pas un de tes parents présent lors de ton examen pratique, détache la première feuille et apporte la à la maison pour la faire signer par ton père, ta mère ou ton tuteur, après l'avoir complétée et signée toi-même. Il faut ensuite nous la retourner par la poste, dans un délai de deux semaines, en utilisant l'enveloppe pré-adressées et pré-affranchie. Remets nous la copie du questionnaire immédiatement après l'avoir complété. Merci.

Si tu as moins de 18 ans et qu'au moins un de tes parents est présent lors de ton examen pratique, fait signer la première feuille par ton père, ta mère ou ton tuteur, après l'avoir complétée et signée toi-même. Il faut ensuite nous remettre le tout. Merci.

Si tu as 18 ans ou plus, n'oublie pas de compléter et signer la première page et de nous la remettre avec le questionnaire. Merci.

Le questionnaire est imprimé recto-verso, il est donc important de bien suivre l'ordre des questions selon le numéro de chacune.

APPENDIX 3 - EXPLANATION LETTER & CONSENT FORM – 1ST QUESTIONNAIRE - ENGLISH VERSION

Centre de recherche sur les transports (C.R.T.)

Campus de l'Université de Montréal
C.P. 6128
Succursale Centre-ville
Montréal QC H3C 3J7
Canada

Téléphone:
(514) 343-7575
Télécopieur:
(514) 343-7121

crt@crt.umontreal.ca
www.crt.umontreal.ca/crt/

Congratulations!

You have just earned the privilege to drive without supervision. As the holder of this new privilege, a team of researchers from the Université de Montréal is requesting your participation in a study on new drivers 16 to 19 years of age. Through your participation you will be able to contribute to improvements in road safety for yourself and others. In addition, as a study participant you will be eligible to win one of **33 prizes of $100.** You only have to complete the following questionnaire, which will take approximately 20 minutes, and in one year, a second, brief follow-up questionnaire about your first year of driving experience. All the information you provide will remain ***strictly confidential*** in an ***anonymized data bank*** and will be treated ***only by the research team*** at the Université de Montréal. If you wish, you may withdraw from this study at any time without providing a reason simply by writing to Prof. Urs Maag, Université de Montréal, C.P. 6128, succ. Centre-ville, Montréal, (Qc), H3C 3J7.

Consent for participation in this study and authorization to the Société de l'assurance automobile du Québec to disclose the driver's record :

I, the undersigned, consent to participate in this study and I authorize the Societé de l'assurance automobile du Québec to transmit to the researcher named below the details of my driving record, including violations, suspensions, revocations and accidents.This authorization is valid from the date of this signature and will end on the 31st of December, 2001.

_____ / __ __ __ __ __ -__ __ __ __ __ __ - __ __
(Name - please print) **(Probationary permit number, or No of dossier)**

_____ / _____/_____/_____
(Signature) **(day / month / year)**

If you are below 18 years of age, please include the signature of a parent (father, mother or guardian) and return this form in the addressed, postage-paid envelope:

_____ / _____/_____/_____
(Signature) **(day / month / year)**

We appreciate your participation.

Urs Maag

Urs Maag, Ph.D., Project Co-ordinator.
Professor of Mathematics and Statistics.
Member of the Laboratory on Transportation Safety.

4418

dentification form to allow us to contact you if you win one of the 33 prizes of $100. To be eligible for ,ne drawing, the questionnaire must be completed and the consent form must be remitted with all the required signatures.

Please print.

Family name: _____ First name: _____.

Address:_____
(street)

_____ / _____
(city) (postal code)

Telephone number : (__ __ __) - __ __ __ - __ __ __ __.

Date of birth :_____ / _____ / 198__. Sex : F ☐ M ☐
(day) (month)

I wish to thank you for taking the time to repsond to this questionnaire. Through your collaboration we can continue to deepen our understanding of automobile driving and achieve the desired road safety objects.

Urs Maag, Ph.D., Reseach project co-ordinator.

Instructions :

If you are **below 18 years of age** and you are **not accompanied** by a parent or a legal guardian, please detach the consent form (page 1) and take it home to be signed by your father, mother or legal guardian after you have completed and signed it yourself. Please return it to us within two weeks using the prepaid, self-addressed envelop. Please return the completed questionnaire to us immediately. Thank-you.

If you are **below 18 years of age** and you **are accompanied** by a parent or a guardian with the legal authority to sign the consent form (page 1) on the first page, please ask him or her to sign the form after you have completed and signed it yourself. Please return the consent form and completed questionnaire to us immediately. Thank-you.

If you are **18 years of age or older**, please remember to complete and sign the consent form (page 1) and return it along with the completed questionnaire. Thank-you

The questionnaire is printed recto-verso, therefore, it is important to answer the questions in the correct order.

APPENDIX 4 – 1ST QUESTIONNAIRE - FRENCH

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Noircis une seule réponse par question, sauf indication contraire, et suis bien les flèches.

IL EST IMPORTANT DE NOIRCIR LES CERCLES AVEC UN STYLO À ENCRE NOIRE OU BLEUE, COMME CECI. ○ → ●

PREMIÈRE PARTIE - APPRENTISSAGE DE LA CONDUITE

1. Comment t'es-tu préparé pour l'examen théorique de la SAAQ pour obtenir le permis d'apprenti conducteur ? (Noircis tout ce qui s'applique à toi.)

- ○ J'ai suivi un cours théorique dans une classe avec un professeur présent.
- ○ J'ai pratiqué l'examen sur un ordinateur d'une école de conduite.
- ○ J'ai pratiqué l'examen sur un CD-ROM, à la télé par câble ou sur des sites internet
- ○ J'ai étudié à l'aide de manuels ou de brochures de la SAAQ.
- ○ J'ai étudié à l'aide d'autres manuels.
- ○ Autres: (Précise s.t.p.) _____

2. As-tu réussi chacune des trois parties de l'examen théorique de la SAAQ dès la première tentative ?

oui ○ non ○

3. Avant d'obtenir ton permis d'apprenti, quel était ton niveau de confiance lorsque tu :

	très confiant	un peu confiant	pas vraiment confiant	ne s'applique pas à moi
roulais à bicyclette dans la circulation ?	○	○	○	○
faisais de la planche à roulettes ou du patin à roues alignées dans la circulation ?	○	○	○	○
conduisais une mobylette ou une motocyclette dans la circulation ?	○	○	○	○
conduisais une automobile avec un accompagnateur sur un chemin privé ?	○	○	○	○
conduisais une automobile non accompagné sur un chemin privé ?	○	○	○	○

4. Jusqu'à quel point les situations décrites ci-dessous sont-elles vraies ou s'appliquent-elles à toi, selon ton expérience ou ton jugement ?

	tout à fait vrai	assez vrai	pas du tout vrai
J'ai trouvé que c'est facile d'apprendre à conduire.	○	○	○
Je suis un(e) conducteur(trice) prudent(e).	○	○	○
Je suis un(e) bon(ne) conducteur(trice).	○	○	○
La probabilité d'être impliqué dans un accident dans la prochaine année est faible.	○	○	○

5. As-tu suivi des leçons de conduite pratique dans une école de conduite ?

O non

O oui

Si tu as répondu non, continue à la question 6.

Si tu as répondu oui, passe directement à la question 7.

6. Pourquoi as-tu décidé de NE PAS passer par une école de conduite ? La 1ière raison étant la plus importante. (Inscrire un maximum de trois raisons.)

	1ière	2ième	3ième
Un parent ou un ami m'a dit qu'il était prêt à m'apprendre à conduire.	O	O	O
Le réduction de quatre mois de la période d'apprentissage ne font aucune différence.	O	O	O
Le rabais sur les primes d'assurance n'était pas un incitatif suffisant.	O	O	O
Les cours de conduite sont trop dispendieux.	O	O	O
Les cours de conduite ne sont pas très accessibles.	O	O	O
Les cours de conduite est inutile pour moi.	O	O	O
Autres raisons (précise s.t.p.)_____	O	O	O

Passe à la question 14.

LEÇONS DE CONDUITE PRATIQUES

7. Quelles étaient tes raisons pour décider de passer par une école de conduite ? La 1ière raison étant la plus importante, (Inscrire un maximum de trois raisons.)

	1ière	2ième	3ième
pour apprendre à conduire	O	O	O
pour acheter une automobile	O	O	O
pour être bien préparé pour l'examen de conduite pratique	O	O	O
pour sauver les 4 mois dans la période d'apprentisage	O	O	O
pour économiser de l'argent sur les primes d'assurances automobile	O	O	O
à cause du manque d'accès à une automobile	O	O	O
à cause du manque d'accès à un accompagnateur	O	O	O
par obligation venant de mes parents	O	O	O
autres raisons (précise s.t.p.)_____	O	O	O

8. Après avoir reçu ton permis d'apprenti de la SAAQ, quand as-tu communiqué avec ton école de conduite pour planifier ta première leçon de conduite PRATIQUE :

O au cours de la première semaine

O entre une semaine et trois mois après

O plus de trois mois après

9. Est-ce que ta première leçon de conduite PRATIQUE était ta toute première expérience comme conducteur (trice) ?

oui O non O

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10. Quel est le nombre total de leçons de 55 minutes de conduite pratique que tu as suivies à l'école de conduite?

moins de 12	exactement 12	entre 12 et 20	plus de 20
O	O	O	O

11. Avant d'avoir obtenu ton permis probatoire, quand as-tu suivi ta dernière leçon de conduite pratique avec l'école de conduite ?

durant la semaine avant	entre un semaine et trois mois avant	plus que trois mois avant
O	O	O

12. Quelle réponse décrit le mieux ton avis sur les cours pratiques de l'école de conduite ?

	fortement en accord	modérément en accord	indécis	modérément en désaccord	fortement en désaccord
Le cours pratique m'a bien préparé pour passer l'examen de la SAAQ.	O	O	O	O	O
Le cours pratique m'a bien préparé pour être un(e) conducteur(trice) sécuritaire.	O	O	O	O	O
Tous les nouveaux conducteurs devraient suivre un cours de conduite pratique.	O	O	O	O	O
Tous les conducteurs devraient suivre un cours de perfectionnement tous les dix ans.	O	O	O	O	O

13. Au cours de la période d'apprentissage, as-tu pratiqué la conduite avec une personne ayant un permis de conduire autre que ton professeur (moniteur) de conduite ?

O oui

O non

Si tu as répondu oui, réponds aux questions 14 et 15.

Si tu as répondu non, passe directement à la question 18.

14. Quelle personne t'a accompagné(e) lorsque tu as pratiqué ta conduite ?

	Toujours	Souvent	Parfois	Rarement	Jamais
ma mère et mon père ensemble	O	O	O	O	O
ma mère seule	O	O	O	O	O
mon père seul	O	O	O	O	O
quelqu'un de mon entourage ou un ami de moins de 20 ans	O	O	O	O	O
quelqu'un de mon entourage ou un ami de 20 ans ou plus	O	O	O	O	O

15. Lorsque tu avais ton permis d'apprenti conducteur, as-tu pratiqué ta conduite au moins une fois chaque mois ?

O non

O oui

Si tu as répondu non, réponds aux questions 16 et 17.

Si tu as répondu oui , passe directement à la question 17.

16. Quel est le nombre total de mois sans aucune pratique de conduite ?

un seul mois	entre deux et cinq mois	six mois ou plus
O	O	O

17. Quel est le nombre *total* d'heures que tu as pratiqué la conduite avec une personne autre que ton professeur (moniteur) de conduite ?

en bas de 25 hres	entre 25 hres et 50 hres	plus de 50 hres
O	O	O

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DEUXIÈME PARTIE - ATTITUDES GÉNÉRALES

. Quelle réponse décrit le mieux ton opinion vis-à-vis des énoncés suivants ?

	tout à fait d'accord	modérément d'accord	modérément en désaccord	tout à fait en désaccord
Réduire les limites de vitesse sur les autoroutes est une bonne idée.	O	O	O	O
Même en conduite de nuit sur des routes tranquilles il est important de respecter les limites de vitesse.	O	O	O	O
Les conducteurs qui provoquent des accidents à cause de leurs comportements imprudents ne devraient plus pouvoir conduire pour le reste de leur vie.	O	O	O	O
Les conducteurs devraient conduire plus lentement que la limite permise lorsqu'il pleut.	O	O	O	O
Les conducteurs ne devraient jamais dépasser par la droite même si un conducteur plus lent entrave la voie de gauche.	O	O	O	O
Dans les villes où il y a beaucoup de piétons, les limites de vitesse devraient être de 30 km/h.	O	O	O	O
Les pénalités pour les excès de vitesse devraient être plus sévères.	O	O	O	O

19. Quelle réponse correspond le mieux à ton opinion sur les sujets suivants ?

	fortement en accord	modérément en accord	indécis	modérément en désaccord	fortement en désaccord
Profitons de la vie aujourd'hui car personne ne connait le futur.	O	O	O	O	O
Il est inutile d'essayer de prévoir les événements.	O	O	O	O	O
Économiser est inutile aujourd'hui.	O	O	O	O	O
Il faut se préparer longtemps à l'avance pour les choix de vie.	O	O	O	O	O
Les succès de demain sont le fruit des efforts d'hier.	O	O	O	O	O
Pour se préparer au futur, vaut mieux consacrer plus de temps aujourd'hui.	O	O	O	O	O

20. Quelle est la probabilité que tu fasses l'une des actions suivantes si tu étais tout à fait certain de t'en sortir sans pénalité ?

	très probable	assez probable	pas du tout probable
utiliser les transports en commun sans payer ton passage	O	O	O
stationner dans une zone de stationnement interdit	O	O	O
recevoir un salaire en argent comptant sans payer les impôts	O	O	O
quitter un magasin avec un article sans l'avoir payé	O	O	O
faire une réclamation d'assurance frauduleuse	O	O	O
conduire sur l'accotement de la route lorsque les autres voies sont congestionnées	O	O	O
garder un billet de $50.00 que tu as trouvé dans la rue	O	O	O
frapper quelqu'un qui t'as importuné ou dérangé	O	O	O
appeler et te déclarer malade si tu as quelque chose d'intéressant à faire	O	O	O

20045

1531

. . Nous aimerions que tu nous dises si tu trouves que ces situations sont sécuritaires ou dangereuses. Il n'y a pas de bonnes ou de mauvaises réponses.

	très sécuritaire	sécuritaire	neutre	dangereuse	très dangereuse
faire du vélo sans porter de casque protecteur	O	O	O	O	O
sauter d'un pont en bungie	O	O	O	O	O
avoir des relations sexuelles non protégées	O	O	O	O	O
faire du vélo, de la planche à roulettes ou du patin à roues alignées de façon risquée	O	O	O	O	O
ne pas aller chez le médecin lorsque survient un problème de santé	O	O	O	O	O
ne pas faire de l'exercice régulièrement	O	O	O	O	O

22. Nous aimerions que tu nous dises si tu trouves que ces situations de conduite sont sécuritaires ou dangereuses. Il n'y a pas de bonnes ou de mauvaises réponses.

	très sécuritaire	sécuritaire	neutre	dangereuse	très dangereuse
:pter d'être passager d'un véhicule lorsque le conducteur a pris quelques verres	O	O	O	O	O
accepter d'être passager d'un véhicule lorsque le conducteur va trop vite	O	O	O	O	O
ne pas attacher sa ceinture de sécurité en voiture	O	O	O	O	O
conduire la nuit	O	O	O	O	O
conduire sur une autoroute	O	O	O	O	O
conduire sur des routes enneigées	O	O	O	O	O
conduire lorsqu'il pleut	O	O	O	O	O
conduire le jour	O	O	O	O	O
dépasser d'autres voitures	O	O	O	O	O
conduire après avoir pris quelques bières	O	O	O	O	O
conduire vite dans des rues résidentielles	O	O	O	O	O
duire vite sur des autoroutes	O	O	O	O	O
conduire lorsqu'il y a beaucoup de circulation	O	O	O	O	O

20045

Les questions 23 à 26 portent sur certains situations d'accidents typiques.

1531

3. J'arrête ma voiture à un feu rouge et le conducteur du véhicule qui me suit ne freine pas à temps et frappe l'arrière de ma voiture.

Le risque que ceci m'arrive pendant que je conduis dans les prochaines années est :

extrêmement élevé	très élevé	modérément élevé	modérément bas	très bas	extrêmement bas
O	O	O	O	O	O

Tous les conducteurs peuvent apprendre comment réduire le risque associé à ce type de collision :

définitivement	probablement	peut-être	probablement pas	définitivement pas
O	O	O	O	O

Compte tenu de mes habiletés comme conducteur, les chances que je sois en mesure d'éviter ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

Les chances que quelqu'un soit blessé dans ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

24. Je conduis sur l'autoroute. Le conducteur du véhicule devant moi s'arrête brusquement et je frappe l'arrière de son véhicule.

Le risque que ceci m'arrive pendant que je conduis dans les prochaines années est :

extrêmement élevé	très élevé	modérément élevé	modérément bas	très bas	extrêmement bas
O	O	O	O	O	O

Tous les conducteurs peuvent apprendre comment réduire le risque associé à ce type de collision :

définitivement	probablement	peut-être	probablement pas	définitivement pas
O	O	O	O	O

Compte tenu de mes habiletés comme conducteur, les chances que je sois en mesure d'éviter ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

Les chances que quelqu'un soit blessé dans ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

20045

1531

25. Je suis arrêté à un feu rouge à une intersection achalandée. La lumière devient verte et j'appuie sur l'accélérateur. Un autre véhicule brûle la lumière rouge et frappe le côté de ma voiture.

Le risque que ceci m'arrive pendant que je conduis dans les prochaines années est :

extrêmement élevé	très élevé	modérément élevé	modérément bas	très bas	extrêmement bas
O	O	O	O	O	O

Tous les conducteurs peuvent apprendre comment réduire le risque associé à ce type de collision :

définitivement	probablement	peut-être	probablement pas	définitivement pas
O	O	O	O	O

Compte tenu de mes habiletés comme conducteur, les chances que je sois en mesure d'éviter ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

Les chances que quelqu'un soit blessé dans ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

26. Je conduis sur une route de campagne qui est en bonne condition et il n'y a pas de circulation. Alors que je tente de négocier une courbe, ma voiture se dirige en ligne droite et sort de la route.

Le risque que ceci m'arrive pendant que je conduis dans les prochaines années est :

extrêmement élevé	très élevé	modérément élevé	modérément bas	très bas	extrêmement bas
O	O	O	O	O	O

Tous les conducteurs peuvent apprendre comment réduire le risque associé à ce type de collision :

définitivement	probablement	peut-être	probablement pas	définitivement pas
O	O	O	O	O

Compte tenu de mes habiletés comme conducteur, les chances que je sois en mesure d'éviter ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

Les chances que quelqu'un soit blessé dans ce type de collision sont :

extrêmement élevées	très élevées	modérément élevées	modérément basses	très basses	extrêmement basses
O	O	O	O	O	O

20045

1531

TROISIEME PARTIE - MILIEU FAMILIAL ET STYLE DE VIE

27. Où as-tu habité le plus longtemps ?

- O en ville
- O en banlieue
- O à la campagne

28. Quel est le plus haut niveau de scolarité complété par :

ta mère ?

- O Primaire
- O Secondaire
- O Collégial (CEGEP)
- O Universitaire

ton père ?

- O Primaire
- O Secondaire
- O Collégial (CEGEP)
- O Universitaire

29. Quelle est l'occupation principale de :

ta mère ?

(précise s.t.p.):

_____

ton père ?

(précise s.t.p.):

_____

30. Est-ce que tu vis seul ?

- O non
- O oui

Si tu as répondu non, complète la question 31.

Si tu as répondu oui, passe à la question 32.

31. Avec quelles des personnes de la liste suivante vis-tu le plus souvent ou toujours ? (Noircis un seul cercle.)

- O avec ma mère et mon père
- O avec ma mère uniquement
- O avec mon père uniquement
- O demi-temps avec ma mère et demi-temps avec mon père
- O avec ma mère et mon beau-père (suite à une seconde union)
- O avec mon père et ma belle-mère (suite à une seconde union)
- O avec un autre ou d'autres proches parents
- O avec quelqu'un d'autre qu'un proche parent

20045

1531

32. Est-ce que tu es déjà le propriétaire de ta propre voiture ou est-ce tu vas acheter ta propre voiture au cours de l'année prochaine ?

oui ○ non ○

33. Combien de véhicules routiers possèdent ou louent toutes les personnes habitant avec toi ?

aucun ○ un ○ deux ○ trois ou plus ○

34. Au cours de la prochaine année, à quelle fréquence vas-tu avoir accès à un véhicule routier ?

jamais ○ rarement ○ quelquefois ○ souvent ○ toujours ○

35. Connais-tu quel est le modèle spécifique de voiture que tu vas conduire et quelle est son année de fabrication ?

○ non

○ oui **Si oui, inscris les détails décrivant le véhicule :** _____

36. Combien de tes ami(e)s fument la cigarette ?

aucun ○ quelques-uns ○ la majorité ○ tous ○

37. À quelle fréquence tes ami(e)s t'offrent-ils (elles) une cigarette ?

jamais ○ rarement ○ quelquefois ○ souvent ○

38. As-tu déjà fumé une cigarette ?

○ non

○ oui

39. As-tu fumé une cigarette au cours des deux derniers mois ?

oui ○ non ○ je n'ai jamais fumé ○

40. A quelle fréquence fumes-tu des cigarettes actuellement ?

tous les jours ○ trois ou quatre jours par semaine ○ environ une fois par semaine ○ environ une fois par mois ○ moins d'une fois par mois ○ je ne fume pas présentement ○ je n'ai jamais fumé ○

20045

1531

41. Combien de tes ami(e)s boivent des boissons alcoolisées ?

aucun	quelques-uns	la majorité	tous
O	O	O	O

42. À quelle fréquence tes ami(e)s t'offrent-ils (elles) des boissons alcoolisées ?

jamais	rarement	quelquefois	souvent
O	O	O	O

43. As-tu déjà bu une boisson alcoolisée ?

O non

O oui

44. As-tu bu une boisson alcoolisée au cours des deux derniers mois ?

oui	non	je n'ai jamais bu de boisson alcoolisée
O	O	O

45. À quelle fréquence bois-tu des boissons alcoolisées actuellement ?

tous les jours	trois ou quatre jours par semaine	environ une fois par semaine	environ une fois par mois	moins d'une fois par mois	je ne bois pas d'alcool présentement	je n'ai jamais bu de boisson alcoolisée
O	O	O	O	O	O	O

46. Est-ce qu'un membre de ta famille ou un ami a déjà été blessé dans un accident de la route ?

O non

O oui

47. Es-tu actuellement inscrit(e) de façon régulière à une école ?

O oui

O non

Si tu as répondu oui, passe aux questions 48 à 51.

Si tu as répondu non, passe directement à la question 52.

48. À quel niveau es-tu présentement ?

secondaire	CEGEP/Université	Métier	autre
O	O	O	O

49. Dans l'ensemble, tes résultats pour cette année sont généralement :

excellents (des A)	très bons (des A et B)	dans la moyenne (des B et C)	en dessous de la moyenne (des C et D)	faibles (des D ou moins)
O	O	O	O	O

50. Quel est le plus haut niveau de scolarité que tu envisage atteindre ?

une partie du secondaire	compléter le secondaire	métier	CEGEP	Université	études de maitrise ou de doctorat
O	O	O	O	O	O

51. En moyenne, combien de temps passes-tu chaque jour pour faire tes travaux scolaires à la maison ?

moins d'une demi-heure	entre une demi-heure et une heure complète	une et deux heures	plus de deux heures
O	O	O	O

20045

1531

52. Travailles-tu présentement à temps partiel ou cherches-tu un travail à temps partiel ?

- O oui
- O non

53. Travailles-tu présentement à temps plein ou cherches-tu un travail à temps plein ?

- O oui
- O non

54. Si tu n'es pas présentement inscrit dans une école, envisages-tu de retourner à l'école dans le futur ?

oui	non	peut être	je fréquente une école
O	O	O	O

55. Qui a payé ou qui va payer pour les dépenses suivantes ?

	moi-même uniquement	un membre de ma famille ou mon tuteur	moi-même et un membre de ma famille ou mon tuteur	ne s'applique pas à moi
les frais pour obtenir le permis d'apprenti	O	O	O	
les frais pour obtenir le permis probatoire	O	O	O	
les frais pour l'école de conduite	O	O	O	O
les primes d'assurance pour le véhicule que tu vas conduire	O	O	O	O
le coût d'achat du véhicule que tu vas conduire	O	O	O	O
l'essence du véhicule que tu vas conduire	O	O	O	O
l'entretien et les frais de réparations du véhicule que tu vas conduire	O	O	O	O

56. Au cours de ta première année suivant l'obtention du permis probatoire, quand et pour quelles raisons prévois-tu conduire ? (Noircis chacun des cercles appropriés.)

	du lundi au jeudi		du vendredi au dimanche	
	jour	soir/nuit	jour	soir/nuit
travail	O	O	O	O
école	O	O	O	O
magasinage/commissions/ courses	O	O	O	O
visiter amis ou parents/ socialiser	O	O	O	O
sport/loisirs	O	O	O	O
sans raison spécifique	O	O	O	O

Merci pour ta participation. Tu peux ajouter tes commentaires au verso de cette page.

APPENDIX 5 - 1ST QUESTIONNAIRE – ENGLISH VERSION

19874

4418

Please fill in one answer per question, unless otherwise indicated, and follow the arrows.

IT IS IMPORTANT TO COMPLETELY FILL IN THE CIRCLES WITH A BLUE OR BLACK INK PEN, AS SHOWN HERE. → ●

PART ONE - LEARNING TO DRIVE

1. How did you prepare for the SAAQ theory exam for the learner's permit? (Fill in the circle for each applicable item.)

- O I attended theory classes with a teacher present.
- O I practiced taking tests on a computer at a driving school.
- O I practiced taking tests on a CD-ROM, cable TV or internet site.

- O I studied from manuals and brochures from the SAAQ.
- O I studied from other textbooks and brochures.
- O Other, please specify: .....

2. Did you pass all three sections of the SAAQ theory exam on the first attempt?

- O yes
- O no

3. Before you obtained your learner's permit, how confident did you feel:

	very confident	a little confident	not very confident	does not apply to me
riding a bicycle in traffic?	O	O	O	O
skateboarding or rollerblading in traffic?	O	O	O	O
riding a moped or motorcycle in traffic?	O	O	O	O
driving a car under supervision on private roads?	O	O	O	O
driving a car without supervision on private roads?	O	O	O	O

4. How accurately do the following statements describe your experiences or your judgements?

	very true	fairly true	not at all true
I found it easy to learn to drive.	O	O	O
I am a safe driver.	O	O	O
I am a good driver.	O	O	O
The probability that I will be involved in a collision over the next year is small.	O	O	O

19874

4418

5. Did you take a course of practical lessons at a driving school?

O no

O yes

If you answered no, please complete question 6.

If you answered yes, please go directly to question 7.

6. 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.	O	O	O
The four month time savings did not make any difference.	O	O	O
The insurance discount was not a sufficient incentive.	O	O	O
Driving courses are too expensive	O	O	O
Driving courses are too inconvenient.	O	O	O
Driving courses are useless for me.	O	O	O
Other reason: Please specify _____	O	O	O

_____

Please go to question 14.

PRACTICAL DRIVING LESSONS

7. What were your reasons for deciding to go to a driving school? The first reason being the most important. (Maximum three choices.)

	1st	2nd	3rd
to learn how to drive	O	O	O
to buy a car	O	O	O
to be well prepared for the practical driver's licence exam	O	O	O
to save four months on the learning period	O	O	O
due to lack of access to an automobile	O	O	O
due to lack of access to a driver to accompany me	O	O	O
to save money on automobile insurance	O	O	O
because my parents wanted me to	O	O	O
other reason: please specify_____	O	O	O

8. After you passed the SAAQ learner s permit theory exam, when did you contact your driving school to schedule your first PRACTICAL driving lesson?

O within one week

O between one week and three months after

O over three months after

9. Was your first PRACTICAL driving lesson the first time you had ever driven a car?

O yes

O no

19874

4418

10. What is the total number of 55-minute practical driving lessons that you received from the driving school ?

less than 12	exactly 12	between 12 and 20	over 20
O	O	O	O

11. Prior to obtaining your probationary permit, when did you take your final practical driving lesson at the driving school?

less than one week before	between one week and three months before	more than three months before
O	O	O

12. Which answer best describes your opinions about practical driving school courses:

	agree strongly	agree moderately	undecided	disagree moderately	disagree strongly
The practical lessons effectively prepared me to pass the SAAQ exam.	O	O	O	O	O
The practical lessons effectively prepared me to be a safe driver.	O	O	O	O	O
All new drivers should take a practical driving course.	O	O	O	O	O
All drivers should take refresher courses every ten years.	O	O	O	O	O

13. When you had your learner's permit, did you practice driving with a licenced driver other than your driving school teacher?

O yes

O no

If you answered yes, please complete questions 14 and 15.

If you answered no, please go directly to question 18.

14. Who supervised your driving practice?

	always	mostly	some-times	rarely	never
Mother alone	O	O	O	O	O
Father alone	O	O	O	O	O
Mother and Father together	O	O	O	O	O
A relative or friend younger than 20 years of age	O	O	O	O	O
A relative or friend 20 years of age or older	O	O	O	O	O

15. When you had your learner's permit, did you practice driving at least once every month?

O yes

O no

If you answered no, please complete questions 16 & 17.

If you answered yes, please go directly to question 17.

16. How many months in total did you *not* practice any driving?

only one	between two and five	six or more
O	O	O

17. *In total*, how many hours did you practice driving with someone other than your driving school teacher?

less than 25 hrs	between 25 and 50 hrs	more than 50 hrs
O	O	O

19874

4418

PART TWO - GENERAL ATTITUDES

18. Which answer best describes your attitude towards the following statements:

	agree strongly	agree moderately	disagree moderately	disagree strongly
Decreasing the speed limit on expressways is a good idea.	O	O	O	O
Even at night time on quiet roads it is important to keep within the speed limit.	O	O	O	O
Drivers who cause collisions due to reckless driving should be banned from driving for life.	O	O	O	O
People should drive slower than the speed limit when it is raining.	O	O	O	O
Drivers should never pass on the right even when a slower driver is blocking the left lane.	O	O	O	O
In cities where there are a lot of pedestrians the speed limit should be 30 km/h.	O	O	O	O
Penalties for speeding should be more severe	O	O	O	O

19. Which answer best describes your opinion on the following:

	agree strongly	agree moderately	undecided	disagree moderately	disagree strongly
Let us live for today, nobody knows what the future is made of.	O	O	O	O	O
It is useless to try to make forecasts.	O	O	O	O	O
Saving is useless today.	O	O	O	O	O
One should get prepared long in advance for life's choices.	O	O	O	O	O
The successes of tomorrow are the fruits of yesterday's efforts.	O	O	O	O	O
To prepare for one's future, one should dedicate much time today.	O	O	O	O	O

20. How likely is it that you would do each of the following if you were completely certain of getting away with it?

	very likely	quite likely	not at all likely
ride on public transport without paying a fare	O	O	O
park in a no-parking zone	O	O	O
receive salary in cash without paying income tax	O	O	O
leave a store with goods you have not paid for	O	O	O
make a fraudulent insurance claim	O	O	O
drive on the shoulder of the road when the other lanes are jammed	O	O	O
keep a $50.00 bill you have found on the street	O	O	O
hit someone who has annoyed or upset you	O	O	O
call in sick when you have something interesting to do	O	O	O

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4418

21. We would like you to tell us if you find each of these decisions safe or risky. There are no good or bad answers.

	very safe	safe	neutral	risky	very risky
cycling without wearing a helmet	O	O	O	O	O
bungie jumping off a bridge	O	O	O	O	O
having unprotected sexual intercourse	O	O	O	O	O
riding a bicycle or a rollerblading recklessly	O	O	O	O	O
not seeing a physician in the presence of a health problem	O	O	O	O	O
not exercising regularly	O	O	O	O	O

22. We would like you to tell us if you find each of these driving situations safe or risky. There are no good or bad answers.

	very safe	safe	neutral	risky	very risky
accepting a ride with a driver who has had a few alcoholic drinks	O	O	O	O	O
:cepting a ride with a driver who is ıriving too fast	O	O	O	O	O
not wearing a seat-belt when riding in a car	O	O	O	O	O
driving at night	O	O	O	O	O
driving on expressways	O	O	O	O	O
driving on snow-covered roads	O	O	O	O	O
driving in the rain	O	O	O	O	O
driving during the day	O	O	O	O	O
passing other vehicles	O	O	O	O	O
driving after drinking a few beers	O	O	O	O	O
driving fast on residential streets	O	O	O	O	O
driving fast on expressways	O	O	O	O	O
riving in heavy traffic	O	O	O	O	O

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Questions 23 to 26 concern common collision situations.

23. I AM STOPPING MY CAR FOR A RED-LIGHT AND THE DRIVER OF THE VEHICLE COMING FROM BEHIND FAILS TO STOP AND COLLIDES WITH THE REAR OF MY CAR.

The risk that this may happen to me while I am driving during the next few years is:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

Any driver can learn specific driving habits to reduce the risk of this type of collision:

definitely	probably	maybe	probably not	definitely not
O	O	O	O	O

Given my abilities as a driver, the chances that I will be able to avoid this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

The chances that someone will be injured in this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

24. I AM DRIVING ON THE EXPRESSWAY. THE DRIVER OF THE CAR IN FRONT OF MINE STOPS SUDDENLY AND I COLLIDE WITH THE REAR OF HIS VEHICLE.

The risk that this may happen to me while I am driving during the next few years is:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

Any driver can learn specific driving habits to reduce the risk of this type of collision:

definitely	probably	maybe	probably not	definitely not
O	O	O	O	O

Given my abilities as a driver, the chances that I will be able to avoid this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

The chances that someone will be injured in this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

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. I AM STOPPED AT A RED LIGHT AT A BUSY INTERSECTION. MY LIGHT TURNS GREEN AND I PRESS ON THE GAS PEDAL. ANOTHER VEHICLE RUNS THE RED LIGHT AND COLLIDES WITH THE SIDE OF MY CAR.

The risk that this may happen to me while I am driving during the next few years is:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

Any driver can learn specific driving habits to reduce the risk of this type of collision:

definitely	probably	maybe	probably not	definitely not
O	O	O	O	O

Given my abilities as a driver, the chances that I will be able to avoid this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

The chances that someone will be injured in this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

26. I AM DRIVING ON A COUNTRY HIGHWAY WITH GOOD ROAD CONDITIONS AND NO TRAFFIC. AS I ATTEMPT TO TAKE A CURVE MY CAR GOES STRAIGHT OFF THE ROAD.

The risk that this may happen to me while I am driving during the next few years is:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

Any driver can learn specific driving habits to reduce the risk of this type of collision:

definitely	probably	maybe	probably not	definitely not
O	O	O	O	O

Given my abilities as a driver, the chances that I will be able to avoid this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

The chances that someone will be injured in this type of collision are:

extremely high	very high	moderately high	moderately low	very low	extremely low
O	O	O	O	O	O

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PART THREE - FAMILY BACKGROUND AND LIFESTYLE

27. Where have you lived the longest time?

- O in the city
- O in the suburbs
- O in the country

28. What is the highest level of education completed by your:

Mother

- O Primary school
- O High school
- O College (vocational) or equivalent
- O University

Father

- O Primary school
- O High school
- O College (vocational) or equivalent
- O University

29. What is the primary occupation of your:

Mother

Please specify:

_____

Father

Please specify:

_____

30. Do you live by yourself ?

- O no
- O yes

If you answered no, please complete question 31.

If you answered yes, please go directly to question 32.

31. With which of following people do you live most of the time? (Darken only one circle.)

- O Mother and Father
- O Mother only
- O Father only
- O half time with Mother, half time with Father
- O Mother and stepfather
- O Father and stepmother
- O other relatives
- O someone other than relatives

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32. Are you presently the owner of a motor vehicle or will you purchase one during the next year ?

yes ○ no ○

33. How many motor vehicles are owned or leased by members of the household where you live?

none ○ one ○ two ○ three or more ○

34. During the next year, how often will you have access to a motor vehicle?

never ○ rarely ○ sometimes ○ often ○ always ○

35. Do you know the model(s) and year(s) of one of the motor vehicle(s) you will be driving?

○ no

○ yes **If yes, please supply descriptive details:**_____

36. How many of your friends smoke cigarettes?

none ○ some ○ most ○ all ○

37. How often have your friends offered you a cigarette?

never ○ rarely ○ sometimes ○ often ○

38. Have you ever smoked a cigarette?

○ yes

○ no

39. Have you smoked a cigarette in the past two months?

yes ○ no ○ I have never smoked ○

40. How often do you smoke cigarettes now?

everyday ○ three or four days a week ○ about once a week ○ about once a month ○ less than once a month ○ I don't smoke now ○ I have never smoked ○

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41. How many of your friends drink alcoholic beverages?

none	some	most	all
O	O	O	O

42. How often have your friends offered you an alcoholic drink?

never	rarely	sometimes	often
O	O	O	O

43. Have you ever had an alcoholic drink?

O no

O yes

44 Have you had an alcoholic drink in the past two months?

yes	no	I have never had an alcoholic drink
O	O	O

45. How often do you have an alcoholic drink now?

everyday	three or four days a week	about once a week	about once a month	less than once a month	I don't drink alcohol now	I have never had an alcoholic drink
O	O	O	O	O	O	O

46. Have any of your family members or friends been injured in a traffic collision?

O no

O yes

47. Are you currently enrolled in school?

O yes

O no

If you answered yes, please complete questions 48 to 51.

If you answered no, please go directly to question 52.

48. Which school are you currently attending?

high school	CEGEP/university	vocational	other
O	O	O	O

49. Overall, your grades this year are usually:

Excellent (A's)	Very good (A's and B's)	Average (B's and C's)	Below average (C's and D's)	Poor (D's and below)
O	O	O	O	O

50. What is the farthest you plan to go in school?

some high school	graduate from high school	vocational training	CEGEP	University	Graduate or professional school
O	O	O	O	O	O

51. On average, how much time do you spend on homework each day?

less than half an hour	between half and one full hour	one to two hours	more than two hours
O	O	O	O

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52. Are you currently working *part time* or looking for *part time* work?

- O yes
- O no

53. Are you currently working *full time* or looking for *full time* work?

- O yes
- O no

54. If you are not currently in school, are you planning to return to school in the future?

yes	no	maybe	I am in school
O	O	O	O

55. Who paid for, or who will pay for, each of the following expenses:

	Myself	A family member or guardian	Myself and a family member or guardian	Does not apply to me
the learner's permit fees	O	O	O	
the probationary permit fees	O	O	O	
the driving school fees	O	O	O	O
the insurance premiums on the vehicle you will be driving	O	O	O	O
the purchase costs of the vehicle you will be driving	O	O	O	O
the gasoline for the vehicle you will be driving	O	O	O	O
the maintenance and repair costs of the vehicle you will be driving	O	O	O	O

56. During your first year with a probationary permit, when do you expect that you will be driving and for what reasons? (Darken each appropriate circle)

	Mon - Tues - Wed - Thurs		Fri - Sat - Sun	
	Daytime	Evening Night	Daytime	Evening Night
work	O	O	O	O
school	O	O	O	O
errands / transport	O	O	O	O
socializing	O	O	O	O
sport / recreation	O	O	O	O
no special reason	O	O	O	O

Thank you for your participation. Please feel free to make any additional comments on the back of this page.

APPENDIX 6 - FOLLOW-UP QUESTIONNAIRE – EXPLANATION LETTER - FRENCH VERSION

le 6 janvier 2003

Madame, Monsieur,

Je vous remercie de votre participation à notre projet de recherche sur les nouveaux conducteurs et conductrices. Vous aviez répondu à notre questionnaire le jour de l'obtention de votre permis de conduire en été 2000. Les réponses au questionnaire des participants et participantes furent indispensables pour cette étude.

Afin de mieux interpréter les données, je sollicite maintenant votre participation pour la phase finale du projet. Il s'agit d'un questionnaire court qui porte sur votre expérience de conduite depuis l'obtention du permis probatoire. Veuillez s.v.p. remplir le questionnaire ci-joint (deux feuilles, dont une recto et verso) et nous le retourner dans l'enveloppe pré-adressée et affranchie ci-jointe. Soyez assuré que les réponses seront traitées de façon confidentielle au Laboratoire sur la sécurité des transports du Centre de recherche sur les transports. Nos fichiers informatiques sont anonymisés et aucune donnée individuelle ne sera dévoilée à quiconque.

Félicitation si vous avez reçu un chèque au montant de 100 dollars, l'un des 33 prix ! Votre participation dans cette phase finale du projet vous donne de nouveau la possibilité de gagner un prix de 100 dollars.

J'apprécie votre collaboration.

Urs Maag, Ph.D., responsable du projet de recherche
Professeur associé au Département de mathématiques et de statistique
Membre du Laboratoire sur la sécurité des transports

APPENDIX 7 - FOLLOW-UP QUESTIONNAIRE – EXPLANATION LETTER - ENGLISH VERSION

January 6, 2003

Dear Madam, dear Sir,

I wish to thank you for your participation in our research project on novice drivers. You answered our questionnaire on the day that you obtained the probationary permit in the summer of 2000. The questionnaire responses from the participants were essential for our study.

In order to better understand our data, I am now asking for your participation in the final phase of the project. Please complete the attached questionnaire (two sheets, one recto-verso) and return it to us in the enclosed postage-paid envelope. I again wish to assure you that the answers will be treated confidentially at the Laboratory of Transportation Research of the Centre for Research on Transportation. Our computer files are anonymized and no individual date will be revealed to anybody.

Congratulations if you have received a 100 dollar cheque, one of the 33 prizes ! Your participation in the final phase will again give you the chance to win a prize of 100 dollars.

We appreciate your collaboration

Urs Maag, Ph.D., Project co-ordinator
Adjunct professor
Department of Mathematics and Statistics
Member of the Laboratory on Transportation Safety

APPENDIX 8 – FOLLOW-UP QUESTIONNAIRE - FRENCH VERSION

Questionnaire sur les expérience de conduite de la première année

Nom de famille: _____. Prénom: _____. Numéro de permis : _____ - _____ - _____.
[Lettre + 4 chiffres - 6 chiffres - 2 chiffres]

S.V.P répondez aux questions suivantes en vous référant à vos expériences. Toutes vos réponses resteront confidentielles et tous les identificateurs seront enlevés du fichier informatique.

1. Quelle réponse décrit le mieux votre opinion sur les énoncés suivants sur les cours pratiques de l'école de conduite?
(Répondre seulement si vous avez suivi un cours. Sinon, passez à la question 2.)

	fortement en accord	modérément en accord	indécis	modérément en désaccord	fortement en désaccord
a) Le cours pratique m'a bien preparé pour être un(e) conducteur (trice) sécuritaire.	☐	☐	☐	☐	☐
b) J'évite des collisions grâce à ma formation à l'école de conduite.	☐	☐	☐	☐	☐
c) Tous les nouveaux conducteurs devraient suivre un cours de conduite pratique.	☐	☐	☐	☐	☐
d) Tous les conducteurs devraient suivre un cours de perfectionnement tous les dix ans.	☐	☐	☐	☐	☐

2. Quelle réponse décrit le mieux votre opinion sur les énoncés suivants sur l'examen sur route de la SAAQ pour l'obtention du permis probatoire?

a) L'examen sur route a bien évalué mes capacités à conduire d'une façon sécuritaire.	☐	☐	☐	☐	☐
b) L'examen sur route devrait durer au moins une heure.	☐	☐	☐	☐	☐
c) L' examen sur route devrait inclure des situations de conduite plus exigeantes, eg. contrôle de dérapage.	☐	☐	☐	☐	☐

3. En conduisant avec votre permis probatoire, dans combien de collisions avez-vous été impliqué: (S.V.P. encerclez la bonne réponse.)

au total ?	0	1	2	3	4 ou plus
avec dommages matériels seulement ?	0	1	2	3	4 ou plus
où au moins une personne a subi des blessures ?	0	1	2	3	4 ou plus

S.V.P répondez aux questions suivantes en vous référant à vos expériences comme conducteur (trice) à partir de la date d'obtention de votre permis probatoire jusqu'au 31 décembre *2001*.

4. Après avoir reçu votre permis probatoire, quand avez-vous commencé à conduire sans supervision d'un adulte :
- ☐ au cours de la première semaine
- ☐ entre un semaine et trois mois
- ☐ après plus de trois mois

5. Quand vous avez conduit, le nombre moyen de passagers dans l'automobile était de : ☐ zèro ☐ 1 ☐ 2 ☐ 3 ou plus

6. Êtes vous : ☐ étudiant(e) plein temps ☐ étudiant(e) temps partiel ☐ travailleur(euse) plein temps ☐ travailleur(euse) temps partiel ☐ autre

7. Raisons et fréquences de conduire :

	4-7 fois par semaine	1-3 fois par semaine	rarement	jamais
a) aller à et revenir de l'école	☐	☐	☐	☐
b) aller au et revenir du travail	☐	☐	☐	☐
c) conduire pour les besoins du travail	☐	☐	☐	☐
d) magasinage/commissions	☐	☐	☐	☐
e) visiter amis ou parents / socialiser	☐	☐	☐	☐
f) sports / loisirs	☐	☐	☐	☐
g) sans raison spécifique	☐	☐	☐	☐

8. La *majorité* des ces déplacements se sont éffectués : ☐ de lundi au jeudi ☐ du vendredi au dimanche ☐ tous les jours

9. La *majorité* des ces déplacements se sont éffectués pendant : ☐ le jour ☐ le soir / nuit ☐ tout le temps

10. La *majorité* des kilomètres parcourus se sont éffectués sur le réseau routier : ☐ de la ville ☐ des autoroutes ☐ de la campagne ☐ partout

11. Jusqu'au 31 décembre *2001*, le nombre total de kilomètres parcourus était : ☐ zéro ☐ 1 à 5 000 km ☐ 5 001 à 15 000 km ☐ plus de 15 000 km

12. Concernant le véhicule que vous avez conduit le plus souvent :

	moi-même et un membre de ma famille	moi-même	un membre de ma famille	autre
a) le véhicule était acheté par	☐	☐	☐	☐
b) les primes d'assurance étaient payées par	☐	☐	☐	☐
c) l'essence était payée par	☐	☐	☐	☐

Page 3 __

15. Une *quasi-collision* est une action ou un évènement qui aurait pu provoquer une collision réelle mais qui ne l'a pas pro[illegible]qué. S.V.P. indiquez combien de fois et à quel moment vous avez vécu des quasi-collisions. Indiquez la probabilité qu'un blessure aurait pu survenir.

Les circonstances de(s) quasi-collision(s)	**S.V.P. Ecrire la fréquence de(s) quasi-collision(s) pendant**		**Risque de blessure pour vous ou pour une autre personne**			
J'ai été presque impliqué(e) dans une collision quand:	**jour**	**soirée / nuit**	**zéro**	**bas**	**moyen**	**élevé**
a) Je suis entré(e) dans la circulation en sortant d'un stationnement						
b) J'ai changé de voie						
c) J'ai effectué un virage à droite à une intersection						
d) J'ai effectué un virage à gauche à une intersection						
e) Je suis entré(e) sur une autoroute						
f) J'ai conduit sur une chaussée glissante						
g) J'ai conduit trop vite dans une courbe						
h) L'autre conducteur (trice) a brulé un feux rouge ou un panneau d'arrêt						
i) L'autre conducteur (trice) a presque frappé l'arrière de ma voiture						
j) L'autre conducteur (trice) m'a coupé						
k) Le (la) conducteur (trice) devant moi a ralenti ou s'est arrêté(e) brusquement						
l) Un cycliste ou un piéton a traversé devant moi						
m) J'ai parlé avec les passagers						
n) J'ai ajusté les rétroviseurs ou les essuie-glaces						
o) J'ai ajusté la radio, cassette ou disque compact						
p) Le pare-brise était sale ou couvert de verglas						
q) La visibilité était diminuée par une tempête de neige ou une pluie torrentielle						
r) J'ai utilisé le téléphone cellulaire en conduisant						
s) J'ai conduit quand j'étais fatigué(e)						
t) J'ai conduit quand j'étais boulversé(e) (fâché(e) / triste)						
Autre circonstances de quasi-collision(s) qui vous est arrivée, s.v.p. la ou les décrire ci-dessous:						

S.V.P. retournez les deux feuilles dans l'enveloppe pré-adressée et pré-affranchie.
Merci pour votre participation.

APPENDIX 9 – FOLLOW-UP QUESTIONNAIRE – ENGLISH VERSION

First Year Driving Experience Questionnaire

Family name: _____. First name: _____. Permit number: _____ - _____ - _____.
[Letter + 4 numbers - 6 numbers - 2 numbers]

Please answer the following questions about your experiences. All responses will remain strictly confidential and all personal identifiers will be removed from the computer files.

1. Which answer best describes your opinion on the following statements about driving school courses?
(If you did not take a driving course, go to question 2.)

	agree strongly	agree moderately	undecided	disagree moderately	disagree strongly
a) The practical courses prepared me to be a safe driver.	☐	☐	☐	☐	☐
b) I avoid collisions thanks to what I learned at my driving school.	☐	☐	☐	☐	☐
c) All new drivers should attend a driving school.	☐	☐	☐	☐	☐
d) All drivers should take refresher courses every ten years.	☐	☐	☐	☐	☐

2. Which answer best describes your opinion on the following statements about the SAAQ road exam that you passed to earn your probationary permit?

a) The road test evaluated my ability to drive safely.	☐	☐	☐	☐	☐
b) The road test should be at least one hour long.	☐	☐	☐	☐	☐
c) The road test should include more challenging driving situations, e.g. skid control.	☐	☐	☐	☐	☐

3. While driving with your probationary permit, in how many collisions were you involved? (Please circle your answer.)

in total?	0	1	2	3	4 or more
with material damage only?	0	1	2	3	4 or more
where someone was injured?	0	1	2	3	4 or more

PLEASE TURN OVER THE PAGE →

Please ver the following questions about your experiences as a er from the day you received your probationary permit December 31, *2001*.

4. After receiving your probationary permit, when did you start driving without adult supervision?
   - ☐ within the first week
   - ☐ between one week and three months
   - ☐ after three months

5. While you were driving, the average number of passengers in the vehicle was: ☐ zero ☐ 1 ☐ 2 ☐ 3 or more

6. Are you a: ☐ full time student ☐ part time student ☐ full time worker ☐ part time worker ☐ other

7. Reasons for and frequency of driving:

	4-7 times a week	1-3 times a week	rarely	never
a) commuting to and from school	☐	☐	☐	☐
b) commuting to and from work	☐	☐	☐	☐
c) driving for work purposes	☐	☐	☐	☐
d) errands / transport	☐	☐	☐	☐
e) socializing	☐	☐	☐	☐
f) sport / recreation	☐	☐	☐	☐
g) no special reason	☐	☐	☐	☐

8. The *majority* of your driving occurred from: ☐ Monday to Thursday ☐ Friday to Sunday ☐ everyday

9. The *majority* of your driving occurred during: ☐ daytime ☐ evening / night ☐ all the time

10. The *majority* of your driving occurred: ☐ in cities ☐ on expressways ☐ on country roads ☐ everywhere

11. Until *December 31, 2001*, the total number of kilometers you drove was: ☐ zero ☐ 1 to 5 000 km ☐ 5 001 to 15 000 km ☐ more than 15 000 km

12. Concerning the vehicle you drove most often:

	myself and a family member	myself	a family member	other
a) the vehicle was purchased by	☐	☐	☐	☐
b) the insurance premiums are paid for by	☐	☐	☐	☐
c) gasoline is paid for by	☐	☐	☐	☐

Page 3 _

13. A *ne* *collision* is an action or event that could have caused an a l collision but did not. Please report how often and when y experienced a near-collision during the first 12 months of your probationary permit. Also indicate how likely it would have been that an ..ury might have occurred.

The circumstances of the near-collision(s)	Please write the number of times the near-collision(s) happened during		Risk of injury to yourself or others			
I almost had a collision when:	**Day**	**Evening/Night**	**Zero**	**Low**	**Medium**	**High**
a) I was entering traffic after being parked						
b) I was changing lanes in traffic						
c) I was turning right at an intersection						
d) I was turning left at an intersection						
e) I was merging onto an expressway						
f) I was driving on a slippery road						
g) I was driving too fast into a curve						
h) Another driver ran a red light or stop sign						
i) Another driver almost failed to stop behind me						
j) Another driver cut me off on the road						
k) The driver in front of me slowed down or stopped suddenly						
l) A cyclist or a pedestrian crossed in front of me						
m) I was talking to passengers						
n) I was adjusting my mirrors or windshield wipers						
o) I was adjusting my radio, cassette or CD						
p) I had a dirty / ice-covered windshield						
q) My visibility was reduced by heavy rain or blowing snow						
r) I was talking on the cell phone						
s) I was driving when I was tired						
t) I was driving when I was emotionally upset (angry / sad)						
Other circumstances of (a) near collision(s) that happened to you: (Please describe below.)						

Please use the enclosed envelope to return this questionnaire.
Thank you for your cooperation.

APPENDIX 10 - Étude comparative des nouveaux conducteurs selon qu'ils ont suivi ou pas un cours de conduite et ce, en accordant un attention particulière à la propension à prendre des risques. RAPPORT FINAL.

Étude comparative des nouveaux conducteurs selon qu'ils ont suivi ou pas un cours de conduite et ce, en accordant une attention particulière à la propension à prendre des risques

RAPPORT FINAL

par

Urs Maag
Claire Laberge-Nadeau
Pierro Hirsch

Novembre 2004

Laboratoire sur la sécurité des transports
Laboratory on Transportation Safety

REMERCIEMENTS

Cette recherche a été financée par la Société de l'assurance automobile du Québec (SAAQ) et le Ministère des transports du Québec dans le cadre du Programme de recherche universitaire en sécurité routière FQRNT (ancien FCAR).

Nous remercions la Direction des études et stratégies en sécurité routière de la SAAQ, spécifiquement M. Robert Simard, responsable et personne ressource pour ce projet. Il nous a aidé et conseillé tout le long, et il a toujours pu trouver les réponses à nos questions techniques concernant les fichiers de la SAAQ. Nous lui sommes aussi reconnaissants pour sa patience concernant le déroulement du projet.

Les volontaires ont pu être recrutés dans les trois centres de service de la SAAQ situés à Longueuil, Henri-Bourassa et Chomedey (Laval). Nous remercions les responsables dans ces centres qui ont facilité pour nous l'accès aux volontaires et des espaces de travail.

Un tel projet a absolument besoin de volontaires; nous tenons à remercier chaleureusement les jeunes gens qui ont participé au projet, ayant pris le temps de remplir les questionnaires. Nous sommes aussi reconnaissants aux parents des mineurs qui ont signé le formulaire de consentement afin que nous puissions obtenir le dossier de conduite de leur enfant.

Nous avons aussi bénéficié des ressources informatiques du GRIS (Département de médecine sociale et préventive) et du Laboratoire de statistique du Département de mathématiques et de statistique.

TABLE DES MATIÈRES

INTRODUCTION

1.1 Le projet

Dans le cadre du "Programme de recherche universitaire en sécurité routière", la SAAQ avait mis de l'avant un projet intitulé "**Étude comparative des nouveaux conducteurs selon qu'ils ont suivi ou pas un cours de conduite et ce, en accordant une attention particulière à la propension à prendre des risques**" (PRUSR-99-02-01).

Les objectifs du projet étaient formulés comme suit:

- Comparer les taux d'accidents des nouveaux conducteurs durant leur période probatoire selon qu'ils aient ou non suivi des cours de conduite;

- Comparer la propension à la prise de risques des nouveaux conducteurs selon qu'ils aient ou non suivi des cours de conduite; notamment sur le plan des infractions et par des mesures à l'aide d'un test psychométrique;

- établir si les différences observées pour les taux d'accidents durant la période probatoire sont essentiellement attribuables ou non aux différences observées quant à la propension à prendre des risques.

Les exigences spécifiques demandaient d'accorder une grande attention aux éléments suivants:

- nombre d'heures d'apprentissage durant la période d'apprenti-conducteur;
- l'exposition au risque (quantité et type de kilométrage) durant la période probatoire;
- le véhicule utilisé (personnel ou parental);
- le statut personnel et familial;
- le fait que le nouveau conducteur ait payé lui-même ou non le coût des ses cours de conduite, de son permis et des ses assurances;
- le motif à l'origine de la décision de prendre ou non des cours de conduite;
- l'opinion des nouveaux conducteurs quant à l'efficacité des cours de conduite (pour eux-mêmes et pour les autres).

Notre soumission fut acceptée en juin 1999.

1.2 Quelques références

Nous commençons avec des citations sur l'entraînement de nouveaux conducteurs.

Lourens (1992):

> "The training of learner drivers is in too many cases insufficient, even to pass the driving test."
> "The passing of the driving test is in too many cases insufficient to safely allow new drivers on our roads."

Brown (1989) est même plus explicite:

> "We concluded that there is no reliable evidence on the benefits of training for road safety."

Williams & Ferguson (2004) citent d'autres auteurs:

> "There is no difference in the crash records of driver education graduates compared with groups of beginners who learned to drive without formal education".
>
> "There is little evidence that pre-license training per se reduces crash rates among novice drivers in the short or longer term."

En effet, cet article indique clairement que présentement les cours de conduite offrent un bon entraînement pour réussir les examens de conduite, mais ne produisent pas de nouveaux conducteurs sécuritaires.

Lynam et Twisk (1995) arrivent aux mêmes conclusions dans un rapport qui décrit les systèmes de formation des conducteurs et les systèmes d'obtention d'un permis de conduire en Europe.

La conclusion de ces articles et bien d'autres est clair: Prendre un cours ne produit pas de nouveaux conducteurs plus sécuritaires que ceux sans cours.

Concernant la prise de risque, il existe déjà des recensions des écrits pertinentes pour ce projet.

L'article "Adolescent driver risk taking and driver education: Evidence of a mobility bias in public policymaking" par Hirsch (2003) contient deux sections sur la prise de risque et plus de 90 références dont un très grand nombre qui sont pertinentes pour ce projet. Nous citons des raisons pour l'échec apparent que des cours de conduite ne réduit pas le risque de collisions des adolescents:

> "(1) DE (driver education) curricula are not based on valid scientific research of driver risk taking. (2) Driver risk taking has multiple, potentially covarying sources that are not treated easily by single-measure, short-term intervention like the current form of DE. (3) Transportation policymakers are not informed fully about the public health risks of the DE time discount within GDL (graduated licensing)."

Dans l'article "Sensation seeking and risky driving: A review and synthesis of the literature", Jonah (1997) résume de la façon suivante:

> "...of the 18 studies relating SS (sensation seeking) to the consequences of risky driving, most reported positive relationships. Of the 11 studies examining traffic violations, six reported significant correlations, and three identified clusters which included drivers with high SS scores and violations."
>
> "High SSs (sensations seeking scores) are more likely to experience collisions and violations than low SSs."

Lam (2003) résume le danger de la prise de risque:

> "...risky driving behaviors, including speeding and risk-taking, have shown to be a risk factor of crash injuries disregarding ages and skills of drivers."

Plus récemment "Injury and risk-taking behavior – a systematic review" a été publié par Turner, McClure & Pirozzo (2004). Nous citons:

> "The evidence presented in this review supports the conclusion that risk-taking behavior is associated with the occurrence of injury."

Les références aux sources que nous avions utilisées dans la construction de la deuxième partie du premier questionnaire (propension à prendre des risques) se trouvent dans la section 1.6.

Ce projet s'est déroulé dans le cadre québécois de l'accès graduel à la conduite qui est en vigueur présentement et qui n'a pas été modifié durant cette étude longitudinale.

1.3 Hypothèse

Selon la littérature (voir la section 1.2), on ne devrait pas trouver des différences entre les taux de collisions selon cours ou non, mais les personnes à propension élevée de prendre des risques devraient avoir plus d'accidents que celles à faible propension.

1.4 Méthode

Cette recherche est une étude longitudinale qui s'adresse aux nouveaux conducteurs et conductrices. Elle comprend plusieurs étapes qui couvrent le cheminement à partir de l'examen théorique à travers la période avec le permis d'apprenti, l'examen pratique et les premiers 15 mois avec le permis probatoire.

Les données personnelles, suite à l'obtention du consentement des répondants et d'un parent pour les moins de 18 ans, proviennent de deux questionnaires et du dossier de conduite de la SAAQ.

Les méthodes statistiques comprennent des tests du chi-deux sur des tableaux de contingences, des analyses en composantes principales, des analyses de variances et des modèles de régression logistique.

1.5 Le déroulement du projet

Afin de répondre aux objectifs et exigences, il a fallu développer deux questionnaires dans les deux langues, recruter des volontaires, constituer une base de données personnelles, obtenir les dossiers de conduite de la SAAQ et incorporer ces fichiers dans la base, le tout en préservant l'anonymat des participants.

Le premier questionnaire (voir Annexe) contient une formule de consentement acceptable à la SAAQ. Il avait été développé et testé fin 1999/début 2000, et il a été utilisé lors du recrutement des candidats durant la période de mai à septembre 2000. À l'aide de la SAAQ, nous avons obtenu la collaboration de trois centres qui administrent les examens et émettent les permis: Longueuil, Henri-Bourassa et Chomedey (Laval). Quatre assistants ont recruté les volontaires en leur demandant de remplir le questionnaire suite à la réussite de l'examen sur route, et donc qualifié pour obtenir le permis probatoire. Les candidats de moins de 18 ans qui n'avaient pas un parent sur place ont pris la page du consentement et une enveloppe pré-adressée et affranchie afin d'obtenir la signature requise d'un parent ou tuteur. À cause des signatures parentales manquantes, nous avons perdu presque 300 personnes de l'échantillon initial de 2091; la base finale contient 1804 personnes.

Comme le questionnaire avait été conçu pour la saisie des données avec un lecteur optique, Pierro Hirsch a consacré beaucoup d'effort d'entrer, de vérifier et de nettoyer les données (marques mal placées, corrections par le répondants, etc.) durant l'hiver 2000/2001. A l'été 2001, nous avions bénéficié d'un stagiaire qui nous à arrangé la base des données en SPSS (étiquettes pour les variables et les modalités, concordance entre la version française et anglaise avec priorité pour la version française, et qui a produit des statistiques descriptives. A l'automne 2001 des explorations et analyses ont commencé et elles se sont poursuivies en 2002.

L'idée d'un journal de bord a dû être abandonné faute de moyens. Cependant, le deuxième questionnaire (3 pages, voir Annexe) sur l'expérience de conduite après 12 mois avec le permis probatoire et des

opinions sur les cours de conduite a été construit et a été prêt pour envoi en janvier 2003. La SAAQ a pu envoyer ce deuxième questionnaire en février 2003 avec une lettre de la part de la SAAQ et une de la part du responsable du projet (voir Annexe) afin d'encourager les personnes à remplir ce deuxième questionnaire. Cette procédure était nécessaire car nous ne pouvions pas obtenir les adresses courantes des participants. Nous avons reçu 503 questionnaires répondus qui furent intégrés dans la base du premier questionnaire (taux de réponse de 27.9%) en mai 2003. Quelques analyses du deuxième questionnaire et des comparaisons avec le premier ont été effectuées durant l'été 2003.

La base a été transférée à la SAAQ qui a ajouté les dossiers de conduite pour la période se terminant le 31 décembre 2001. La SAAQ a enlevé les identificateurs (notre numéro du premier questionnaire et le numéro de permis) et réarrangé les individus dans un ordre aléatoire. L'ensemble des données nous est parvenu vers la fin de septembre 2003 sous forme de 6 fichiers (le nôtre et cinq fichiers de la SAAQ) avec un numéro à quatre chiffres pour chaque individu afin de pouvoir jumeler les fichiers.

1.6 Les questionnaires – quelques remarques

Le **premier questionnaire** comporte une introduction de la part du responsable du projet, la formule de consentement, une feuille d'identification et des instructions ; il comporte les trois parties suivantes :

- Première partie – Apprentissage de la conduite
- Deuxième partie – Attitudes générales (tests psychométriques)
- Troisième partie – Milieu familial et style de vie

Les questions de la première et de la troisième partie servent à pouvoir répondre aux objectifs spécifiques du projet et à explorer les relations entre les infractions et les accidents d'une part et certaines caractéristiques des nouveaux conducteurs d'autre part.

Il est évident qu'il n'existe pas un test psychométrique unique afin de mesurer la propension de prendre des risques. Nous avons construit notre questionnaire et ajouté en les adaptant à des questionnaires ou des parties de questionnaires tirés de la littérature en sécurité routière et en psychologie, donc en partie des questions qui ont déjà montré des associations avec l'insécurité routière. Voici les sources de nos questions de la deuxième partie:

Q18: Disposition envers des infractions concernant la vitesse/Attitudes towards driving violations
West, R. & Hall, J. (1997) The Role of Personality and Attitude in Traffic Accident Risk

Q19 Opinions sur la valeur du temps/Time perspectives
Chebat, J.C. & Chandon, J.L. (1986) Predicting attitudes toward road safety from present and future orientations: An economic approach
Zimbardo, P.G., Keough, K.A. & Boyd, J.N. (1997). Present Time Perspective as a Predictor of Risky Driving

Q20 Motivations sociales/Social Motivations
West, R. French, D., Kemp, R., & Elander, J. (1993). Direct observation of driving, self-reports of driver behavior, and accident involvement

Q21 Perspectives générales de risques/General Risk Perception & Q22 Risques liées à la conduite/Driving-related risk perceptions
Audette, T. & Malette, J. (1993). Profil descriptif de jeunes conductrices et conducteurs québécois impliqués dans les accidents routiers
Perkins, K. Ferrari, N., Rosas, A., Bessette, R., Williams, A. & Omar, H. (1997). You won't know unless you ask: The biopsychosocial interview for adolescents
Zuckerman, M. (1979). *Sensation seeking: beyond the optimum level of arousal*

Q23 à Q26 Questionnaire d'opinions sur les collisions/Collision Belief Questionnaire
(adapté et développé par Pierro Hirsch)
Becker, M. H. E. (1974). The health belief model and personal health behavior
Bandura, A. (1988). Perceived self-efficacy: Exercise of control through self-belief.

Le **deuxième questionnaire** contient des questions sur l'exposition effectif (quantité et type de kilométrage), sur les opinions concernant les cours de conduite, sur les sources de fonds pour payer le véhicule utilisé, les assurances et l'essence, et le nombre d'accidents durant la 1ère année avec le permis probatoire. Certaines questions permettent aussi la comparaison avec les opinions ou attentes exprimées au premier questionnaire. De plus, nous avons ajouté une question concernant des quasi-collisions (une action ou un événement qui aurait pu provoquer une collision réelle mais qui ne l'a pas provoqué).

Le Chapitre 2 (première partie du premier questionnaire) analyse l'apprentissage, donc surtout le cheminement durant la période avec le permis d'apprenti. Le Chapitre 3 (deuxième partie) comprend les résultats des tests psychométriques sur la propension de prendre des risques et des questions d'opinions sur les collisions. Le Chapitre 4 (troisième partie) donne des résultats sur la vie familiale et le style de vie. Le Chapitre 5 couvre le deuxième questionnaire, donc l'expérience vécue durant les premiers 12 mois avec le permis probatoire. Pour les questions pertinentes, ce chapitre contient des comparaisons des réponses avec celles données aux questions du premier questionnaire.

Le Chapitre 6 décrit les cinq fichiers de la SAAQ concernant les informations sur les immatriculations, permis, infractions, accidents et sanctions. Ce chapitre répond aux grands objectifs du projet, c.-à.-d. les comparaisons des taux d'infractions et d'accidents selon cours ou non et selon la propension à prendre des risques. De plus, les accidents et les infractions ont été mis en relation avec les variables des chapitres 2 et 4. Le chapitre 7 contient quelques modèles statistiques pour les infractions et les accidents à l'aide de la régression logistique.

Le Chapitre 8 comprend la discussion et des conclusions. Le Chapitre 9 résume les recommandations qui découlent des conclusions et de la discussion du chapitre précédent.

CHAPITRE 2

RÉSULTATS DE LA PREMIÈRE PARTIE:

APPRENTISSAGE DE LA CONDUITE

Premier questionnaire

L'échantillon

La répartition des 1804 répondants que nous avions recrutés suite à la réussite de l'examen pratique et pour lesquels nous disposions des signatures requises et leur NIP (numéro d'identification personnelle qui correspond au numéro du permis) est présentée dans le Tableau 2.0. Ces 1804 personnes constituent notre échantillon d'étude. Dans des tableaux subséquents, les effectifs vont varier à cause de réponses manquantes. Le Tableau 2.0 montre que 54.7 % des répondants sont des hommes, 45.3 % des femmes, et 34.4 % ont 17 ans révolus au moment de l'obtention du permis probatoire.

Tableau 2.0 : Les effectifs des répondants selon l'âge et le sexe.

Sexe	Age révolu lors de l'examen pratique				Total
	16	17	18	19*	
Femmes	161	277	218	162	818
%	19.7	33.9	26.7	19.8	45.3
Hommes	210	343	264	169	986
%	21.3	34.8	26.8	17.1	54.7
Total	371	620	482	331	1,804
%	20.6	34.4	26.7	18.3	100

*10 personnes (4 hommes et 6 femmes) avaient déjà 20 ans

Le Tableau 2.1 donne la distribution des répondants selon qu'ils aient ou non suivi un cours de conduite. On observe que les pourcentages des femmes qui avaient pris un cours sont plus élevés à tous les âges que ceux des hommes. Tous les 16 ans étaient évidemment obligés de prendre un cours afin de pouvoir bénéficier des 4 mois de rabais sur la période d'apprentissage normale de 12 mois. Les pourcentages des 17 ans qui prenaient un cours sont plus élevés que ceux des 18 et 19 ans qui sont semblables. Il est à remarquer que moins de 15% des répondants n'avaient pas pris un cours.

Tableau 2.1 : Les effectifs selon cours ou non, age et sexe.

Sexe	Cours	Age en année révolues lors de l'examen pratique				Total
		16	17	18	19	
Femmes	oui	161 (100%)	246(88.8%)	180(82.6%)	136(84.0%)	723(88.4%)
	non	-----	31(11.2%)	38)17.4%)	26(16.0%)	95(11.6%)
Hommes	oui	210 (100%)	276(80.5%)	197(74.6%)	131(77.5%)	813(82.5%)
	non	-----	67(19.5%)	67(25.4%)	38(22.5%)	173(17.5%)
Ensemble	oui	371 (100%)	522(84.2%)	377(78.2%)	267(80.7%)	1537(85.1%)

Les pourcentages à l'intérieur des cellules sont en fonction de l'effectif du groupe âge-sexe.

Les raisons pour avoir pris un cours ou non

La question 6 offrait six raisons pour ne pas avoir pris un cours, et la question 7 offrait huit raisons pour en avoir pris un. Les répondants étaient invités à donner une première raison, une deuxième et une troisième.

Malheureusement ces consignes n'ont pas été suivies par tous les répondants. En conséquence, nous avons seulement retenu les réponses consistantes avec les instructions, c.-à.-d. une première, une deuxième et une troisième raison, ou une première et une deuxième, mais rien d'autre, ou une première raison et rien d'autre. La question 6 fournit 227 choix acceptables, 36 inacceptables et 5 non-réponses, la question 7 fournit 1293 choix acceptables, 208 inacceptables et 35 non-réponses.

Tableau 2.2 : Raisons pour ne pas avoir pris un cours de conduite.

Raison	1er choix	2e choix	3e choix	Total	Rang
a) parent ou ami pour m'enseigner	82	61	33	176	2
b) réduction de 4 mois sans importance	10	67	67	144	3
c) rabais d'assurance incitatif insuffisant	6	17	28	51	4
d) cours trop dispendieux	111	44	23	178	1
e) cours pas très accessibles	8	8	12	28	5.5
f) cours inutiles pour moi	5	9	14	28	5.5

Les raisons principales pour ne pas avoir pris un cours sont les coûts du cours de conduite, la disponibilité d'un parent ou d'un ami pour l'enseignement (implique aussi la disponibilité d'une voiture) et de ne pas être pressé pour obtenir le permis.

Tableau 2.3 : Raisons pour avoir pris un cours de conduite.

Raisons	1er choix	2e choix	3e choix	Total	Rang
a) apprendre à conduire	560	274	119	953	2
b) acheter une automobile	8	38	59	105	6
c) être bien préparé pour l'examen pratique	412	465	171	1,048	1
d) sauver les 4 mois d'apprentissage	179	215	294	688	3
e) économiser sur les primes d'assurance	74	185	289	548	4
f) manque d'accès à une automobile	14	26	56	96	7
g) manque d'accès à un accompagnateur	11	24	64	99	8
h) obligation venant des parents	27	39	108	174	5

Les raisons principales pour avoir pris un cours sont la préparation pour l'examen pratique, le désir d'apprendre à conduire, l'incitatif des 4 mois de réduction de la période d'apprentissage et l'économie sur les primes d'assurance. Il se peut que cette dernière raison et la raison de l'obligation par les parents (en 5e position seulement) sont en partie confondues car les jeunes utilisent principalement une voiture appartenant aux parents.

Les raisons pour avoir pris un cours peuvent être regroupées en trois classes de motivations à partir des trois choix exprimés: A) Perspective apprentissage défini par (a et c) mais pas (d ou e); B) Perspective mixte (a ou c) et (d ou e); C) Perspective opportuniste (d et e) mais pas (a ou c). Le Tableau 2.4 montre que le groupe 'Perspective mixte' est le plus nombreux et le groupe 'perspective opportuniste' le moins nombreux; par la suite il sera nécessaire pour certaines analyses de fusionner les groupes B et C.

Tableau 2.4 : Les motivations selon le sexe.

Sexe	Perspective A: apprentissage	B: mixte	C: opportuniste	Total
Femmes	241 (38.7%)	375 (60.2%)	7 (1.1%)	623 (100%)
Hommes	109 (16.4%)	510 (76.6%)	47 (7.1%)	666 (100%)
Total	350 (27.2%)	885 (68.7%)	54 (4.2%)	1289 (100%)

Le Tableau 2.4 montre que les trois groupes de motivations couvrent la presque totalité (1289 sur 1293) des personnes éligibles. Le pourcentage des femmes du groupe 'apprentissage est plus que le double que celui pour les hommes. Il n'y a presque pas de femmes dans le groupe opportuniste.**L'apprentissage pour l'examen théorique**

La première question portait sur les façons employées par les répondants afin de se préparer pour l'examen théorique. Les réponses ont été catégorisées en quatre classes disjointes et exhaustives qui sont présentées dans le Tableau 2.5.

Tableau 2.5 : L'apprentissage pour l'examen théorique selon le sexe.

Type d'apprentissage	Femmes	Hommes	Total
1) Réponses manquantes	25	45	70
2) Pas de cours théorique, pas à l'école de conduite	164	275	439
3) Cours théorique avec prof. ou avec ordinateur à l'école	340	446	786
4) Types 2) et 3)	289	220	509
Total	818	986	1804

On remarque que les femmes se sont plus préparées en terme du type 4 avec 35% (289/8.18) contre 22% (220/9.86) pour les hommes. On verra plus tard l'effet du type de préparation sur la réussite au 1er essai de l'examen théorique.

Les heures d'apprentissage au volant

Le cours standard requis pour pouvoir bénéficier du rabais de 4 mois sur la durée d'apprentissage est de 12 leçons de conduite pratique à 55 minutes chacune. Les apprentis qui avaient choisi d'attendre 12 mois ou plus n'avaient pas besoin d'un certificat d'une école de conduite; pour ces personnes le nombre de leçons n'est pas prescrit. Le Tableau 2.6 montre que 11% des répondants avec des cours de conduite avaient pris moins de 12 leçons.

Tableau 2.6: Nombre de leçons de conduite pratique pour les hommes et les femmes.

Sexe	< 12	12	> 12	Total
Femmes	64 (9.0%)	536 (75.6%)	109 (15.4%)	709 (100%)
Hommes	101 (12.5%)	597 (74.7%)	101 (12.5%)	799 (100%)
Total	165 (10.9%)	1133 (75.1%)	110 (7.3%)	1508 (100%)

La raison pour exiger une période minimale d'apprentissage était de donner plus d'occasions de pratiquer comme apprenti. En effet, presque tous les apprentis avaient pratiqué avec un accompagnateur autre que le moniteur de l'école de conduite (96.0 % des femmes; 90.7% des hommes).

Si on considère l'âge, on observe que les pourcentages des 16 ans sont les plus élevés avec 99.4% pour les femmes et 94.8% pour les hommes; ces pourcentages baissent avec l'âge à 91.2% pour les femmes de 19 ans et a 82.4% pour les hommes de 19 ans. Le Tableau 2.7 montre le nombre d'heures de pratique en dehors des leçons de cours; de toute évidence, les apprentis sans cours ont pratiqué plus que ceux avec cours.

Tableau 2.7 : Nombre d'heures de pratique en dehors des leçons du cours de conduite pour les hommes et les femmes.

Cours	Nombre d'heures de pratique			Total
	moins de 25	25 - 50	plus de 50	
oui	584 (42.0%)	482 (34,7%)	324 (23.3%)	1390 (100%)
non	53 (21.6%)	94 (38.4%)	98 (40.0%)	245 (100%)
Total	637 (39.0%)	576 (35.2%)	422 (25.8%)	1635 (100%)

Pour les apprentis ayant pris un cours de conduite, les Tableaux 2.8 et 2.9 donnent la distribution conjointe des nombres de leçons et des heures de pratique en dehors du cours. Les effectifs sont réduits par rapport au Tableau 2.6 à cause des non-réponses.

Tableau 2.8 : Nombre de leçons et nombre d'heures de pratique pour les femmes.

Nombre de leçons	Nombre d'heures de pratique			Total
	moins de 25	25 - 50	plus de 50	
moins de 12	21	19	19	59 (8.9%)
12	250	162	93	505 (76.1%)
plus de 12	33	48	19	100 (15.1%)
Total	304 (45.8%)	229 (34.5%)	131 (19.7%)	664 (100%)

Tableau 2.9 : Nombre de leçons et nombre d'heures de pratique pour les hommes.

Nombre de leçons	Nombre d'heures de pratique			Total
	moins de 25	25 - 50	plus de 50	
moins de 12	32	33	25	90 (12.8%)
12	210	182	137	529 (75.5%)
plus de 12	34	27	21	82 (11.7%)
Total	276 (39.4%)	242 (34.5%)	183 (26.1%)	701 (100%)

Les Tableaux 2.8 et 2.9 montrent que les femmes ont la tendance de prendre plus de cours que les hommes tandis que les hommes tendent à pratiquer plus que les femmes. Si on regarde la ligne correspondant au cours standard de 12 leçons, on observe que presque la moitié des femmes (250/505) avaient pratiqué moins de 25 heures et 18.4% (93/505) plus de 50 heures; pour les hommes les pourcentages correspondants sont de 39.7% (210/529) et de 25.9% (137/529). On verra plus loin que les hommes on nettement plus de collisions que les femmes malgré cette pratique additionnelle.

Les accompagnateurs

La question 13 porte sur les personnes qui accompagnaient lors de la pratique autre que le moniteur de l'école de conduite. Les réponses ont été catégorisées en quatre classes disjointes et exhaustives qui sont présentées dans le Tableau 2.10. Parent a été spécifié dans le questionnaire comme mère, père ou les deux ensembles. Comme les réponses possibles pouvaient varier de toujours à jamais (5 modalités), nous n'avons considéré que les modalités 'toujours' et 'souvent', les autres choix étant considérés comme 'sans réponses'.

Tableau 2.10 : Les accompagnateurs autre que le moniteur de l'école de conduite par sexe.

Accompagnateurs	Répondants Femmes	Répondants Hommes	Total
Amis, mais pas de parents	81 (11.0%)	66 (8.4%)	147
Parents, mais pas d'amis	520 (70.7%)	610 (77.3%)	1130
Amis et parents	134 (18.2%)	113 (14.3%)	247
Sous-total	735 (100 %)	789 (100 %)	1524
Sans réponses	83	197	280
Total	818	986	1804

Le Tableau 2.10 montre donc que ce sont principalement les parents qui servent comme accompagnateurs, plus pour les hommes que pour les femmes.

Les opinions sur les cours

La question 12 porte sur les opinions des répondants concernant le cours pratique de l'école de conduite. Les réponses, en cinq classes de "fortement en accord' à 'fortement en désaccord' ont été regroupées en trois classes: 'en accord',' indécis' et 'en désaccord'.

Tableau 2.11 : Les opinions des femmes concernant le cours pratique.

Le cours pratique	n	en accord (%)	indécis (%)	en désaccord (%)
m'a bien préparé pour passer l'examen de la SAAQ	708	93.6	2.7	3.7
m'a bien préparé pour être une conductrice sécuritaire	704	94.7	2.4	2.8
devrait être suivi par tous les nouveaux conducteurs	704	91.2	5.8	3.0
Un cours de perfectionnement devrait être suivi tous les 10 ans par tous les conducteurs	702	49.1	32.8	18.1

Le Tableau 2.11 montre que les femmes sont en accord à plus de 90% sur les trois premiers énoncés. Sur les cours de perfectionnement à tous les 10 ans, moins de 50% sont en accord et une fraction non négligeable de 18% est en désaccord. Le Tableau 2.12 montre que les hommes sont aussi en accord avec les trois premiers énoncés (87.9 à 94.7%), mais même moins en accord avec le cours de perfectionnement que les femmes avec 28.5% en désaccord. Les opinions des hommes sont significativement ($p<.001$) différentes des femmes sur cette dernière question.

Tableau 2.12 : Les opinions des hommes concernant le cours pratique.

Le cours pratique	n	en accord en %	indécis en %	en désaccord en %
m'a bien préparé pour passer l'examen de la SAAQ	792	94.7	3.3	2.0
m'a bien préparé pour être un conducteur sécuritaire	789	92.6	5.1	2.3
devrait être suivi par tous les nouveaux conducteurs	785	87.9	8.4	3.7
Un cours de perfectionnement devrait être suivi tous les 10 ans par tous les conducteurs	785	40.5	31.0	28.5

Paiement des dépenses associées au cours de conduite et au permis

La question 55 comprend trois items sur les frais des permis et les coûts du cours de conduite:
a) frais du permis d'apprenti, b) frais du permis probatoire et c) coûts du cours de conduite. Évidemment a) et b) s'appliquent à toutes les personnes, mais c) seulement pour ceux ayant pris un cours de conduite.

Tableau 2.13: Qui a payé les dépenses pour les hommes.

Frais pour	moi-même seul		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total
	n	%	n	%	n	%	n	%	
le permis d'apprenti	575	59.4	335	34.6	58	6.0	----------		968
le permis probatoire	583	60.1	311	32.1	76	7.8	----------		970
l'école de conduite	412	42.6	369	38.2	71	7.3	115	11.9	967

Tableau 2.14: Qui a payé les dépenses pour les femmes.

Frais pour	moi-même seule		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total
	n	%	n	%	n	%	n	%	
le permis d'apprenti	395	49.0	350	43.4	61	7.6	----------		806
le permis probatoire	406	50.4	324	40.2	76	9.4	----------		806
l'école de conduite	272	34.0	369	46.1	85	10.6	75	9.4	801

Les Tableaux 2.13 et 2.14 montrent très clairement que les femmes obtiennent significativement ($p<.001$) plus de support financier de leurs familles que les hommes.

Paiement des dépenses associées au véhicule que les répondants vont conduire

Tableau 2.15 : Qui va payer les dépenses pour le véhicule que tu vas conduire; cas des femmes

Frais pour	moi-même seule		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total 100%
	n	%	n	%	n	%	n	%	
les primes d'assurance	296	36.7	357	44.3	126	15.6	27	3.3	806
l'essence	494	61.2	74	9.2	224	27.8	15	1.9	807
le coût d'achat	316	39.5	214	26.8	139	17.4	130	16.3	799
l'entretien et les réparations	294	36.4	270	33.4	213	26.4	31	3.8	808

Les femmes prévoient principalement de payer pour l'essence. Le fait que la famille paie pour l'assurance dans 44% des cas reflète que ces femmes vont conduire une automobile familiale. Si on exclut les réponses "ne s'applique pas à moi" pour les coûts d'achat, on trouve que 47.2% des femmes prévoient pouvoir payer elles-mêmes!

Tableau 2.16 : Qui va payer les dépenses pour le véhicule que tu vas conduire; cas des hommes

Frais pour	moi-même seul		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total 100%
	n	%	n	%	n	%	n	%	
les primes d'assurance	524	54.1	308	31.8	119	12.3	17	1.8	968
l'essence	682	70.3	103	10.6	172	17.7	13	1.3	970
le coût d'achat	549	56.8	210	21.7	125	12.9	82	8.5	966
l'entretien et les réparations	524	54.1	246	25.4	174	18.0	24	2.5	968

Les hommes prévoient aussi de payer pour l'essence; mais ils pensent à plus de 50% de pouvoir aussi

payer pour les autres dépenses. Si on exclut les réponses "ne s'applique pas à moi" pour les coûts d'achat, on trouve que 62.1% des hommes prévoient de pouvoir payer eux-mêmes!

Les réponses des femmes diffèrent significativement de celles des hommes. Les pourcentages dans la colonne "moi-même seul" sont tous supérieures chez les hommes.

Expériences avant le permis d'apprenti

Q3 demandait si la personne avait de l'expérience avant l'obtention du permis d'apprenti sur bicyclette, planche à roulettes ou patin à roues alignées, conduisait une mobylette ou une motocyclette, ou une automobile sur chemin privé. Si l'activité s'applique, la question demandait le niveau de confiance. Le Tableau 2.17 indique que les activités sur bicyclette, planche à roulettes ou patin à roues alignées, conduite accompagnée sur chemin privé sont des expériences habituelles, tandis que la conduite d'une mobylette ou motocyclette se font peu fréquemment, surtout par les femmes.
Tableau 2.17 : Expériences avant le permis d'apprenti selon le sexe.

Expériences avant le permis d'apprenti	Sexe			
	Femmes (% des femmes)	Sans réponse	Hommes (% des hommes)	Sans réponse
Bicyclette en circulation **	96.3	3	98.4	5
Planche à roulette ou patin à roues alignées*	72.0	11	76.9	15
Mobylette ou motocyclette***	15.5	45	32.3	35
Conduite accompagnée sur chemin privé ***	69.0	11	77.7	22
Conduite non-accompagnée sur chemin privé ***	25.5	29	41.1	29

χ 2 avec 1 dl; * p<.05; ** p<.01; *** p<.001

On peut se demander si les activités de conduite, accompagnées ou non, sur chemin privé, ne sont pas un aveu involontaire de conduite sur routes publiques. On remarque aussi que ces activités de conduite d'une automobile se pratiquent plus fréquemment par les personnes sans cours comparées aux personnes avec cours: conduite accompagnée 78.5% versus 72.9% (p<.05); conduite non-accompagnée 44.5% versus 32.2% (p<.001).

Le niveau de confiance pour ces activités est plus élevé pour les hommes que pour les femmes à l'exception de la conduite accompagnée (voir Tableau 2.18).

Tableau 2.18: Niveau de confiance personnelle en exerçant des activités sur route avant le permis d'apprenti selon le sexe

Activité	Sexe	n	Très confiant (% selon le sexe)	Un peu confiant (% selon le sexe)	Pas vraiment confiant (% selon le sexe)
Bicyclette en circulation ***	F	785	68.3	26.2	5.5
	M	965	82.7	14.9	2.4
Planche à roulette ou patin à roues ***	F	582	35.6	43.6	20.8
	M	748	64.1	27.7	8.2
Mobylette ou motocyclette ***	F	120	33.3	50.0	16.7
	M	307	52.8	34.5	12.7
Conduite accompagnée sur route privée	F	557	48.8	42.7	8.4
	M	749	54.9	37.7	7.5
Conduite non-accomp. sur route privée ***	F	201	35.8	39.8	24.4
	M	393	50.4	34.9	14.8

χ 2 with 2 df, *** p< .001

Auto-évaluation

La question 4 demande un jugement du participant sur la facilité d'apprentissage de la conduite, s'il est un conducteur prudent, s'il est un bon conducteur, et si la probabilité d'être impliqué dans un accident dans la prochaine année est faible. Le Tableau 2.19 montre que les hommes trouvent l'apprentissage de la conduite était facile, et ils se jugent plus prudents et meilleurs conducteurs que les femmes. Le nombre de femmes et d'hommes qui ne jugent pas qu'il est tout à fait vrai que la probabilité d'un accident dans l'année prochaine soit faible est plutôt grand (60.7% pour les femmes, 58.9% pour les hommes). Nous verrons plus loin l'association entre ces jugements et les infractions et collisions.

Tableau 2.19 : Auto-évaluation de la conduite selon le sexe

Habilité de conduite	Sexe	n	Auto-évaluation	
			Tout à fait vrai (% selon le sexe)	Assez ou pas du tout vrai (% selon le sexe)
Facile d'apprendre à conduire ***	F	814	28.5	71.5
	M	981	50.5	49.5
Conductrice prudente Conducteur prudent ***	F	817	72.1	27.9
	M	975	60.8	39.2
Bonne conductrice Bon conducteur ***	F	809	47.7	52.3
	M	967	55.8	44.2
Faible probabilité d'un accident dans l'année prochaine	F	816	39.3	60.7
	M	977	41.1	58.9

χ 2 avec 1 dl; *** p<.001

En combinant ces catégories, on trouve des associations intéressantes. La combinaison 'prudent' avec 'bon' donne lieu à quatre groupes donnés au Tableau 2.20

Tableau 2.20 : La combinaison des auto-évaluations 'prudent' et 'bon conducteur' pour les femmes et les hommes

Groupe	Femmes		Hommes		Total	
	n	%	n	%	n	%
Prudent et bon	343	42.5	403	41.9	746	42.1
Prudent et pas bon	239	29.6	182	18.9	421	23.8
Pas prudent et bon	43	5.3	135	14.0	178	10.1
pas prudent et pas bon	183	22.6	242	25.2	425	24.0
Total	808	100.0	962	100.0	1770	100.0

On verra par la suite que c'est le troisième groupe (43 femmes et 135 hommes) dont les individus s'évaluent comme être un conducteur 'bon et pas prudent' qui sont moins sécuritaires que les autres.

CHAPITRE 3

RÉSULTATS DE LA DEUXIÈME PARTIE:

ATTITUDES GÉNÉRALES

Les questions 18 à 22 sont constituées de groupes de sous-questions afin d'obtenir des mesures sur la propension à prendre des risques. Les questions 23 à 26 cherchent à obtenir les attitudes, opinions et réactions face à quatre situations rencontrées fréquemment par des automobilistes. Les réponses à ces questions sont sur des échelles de type Lykert.

Les résultats sur les questions 18 à 22 se résument très facilement: a) Les femmes sont systématiquement plus prudentes, moins agressives et moins preneurs de risque que les hommes; b) Il n'y a pas de différences selon la prise ou non d'un cours de conduite, aussi bien chez les femmes que chez les hommes. Pour quelques questions on observe des effets d'âge; les jeunes deviennent plus matures entre 16 et 19 ans ce qui se reflète par des réponses à tendance plus prudente, moins agressive et moins risquée. Des tableaux détaillés se trouvent en annexe. Voici quelques observations et commentaires spécifiques.

Q18: "Les pénalités pour les excès de vitesse devraient être plus sévères"
64.7 % des femmes mais seulement 49.2 % des hommes sont en faveur.

Q19: Il n'y a des différences entre les opinions des hommes et des femmes que pour deux sous-questions:
"Il faut se préparer longtemps à l'avance pour les choix de vie"
70.4 % des hommes, mais 63.1 % des femmes sont en accord.
" Les succès de demain sont les fruits des efforts d'hier"
86.6 % des hommes, mais 91.8 % des femmes sont en accord.

Q20: Ces questions concernent l'honnêteté des gens et montrent des phénomènes sociologiques.
"Quelles est la probabilité que tu fasses l'une des actions suivantes si tu étais tout à fait certain de t'en sortir sans pénalité?" (très probable, assez probable, pas du tout probable)
"Recevoir un salaire en argent comptant sans payer les impôts"
Seulement 36.7 % des femmes et 35.7 % des hommes ont répondu 'pas du tout probable'.
"Garder un billet de $50 que tu as trouvé dans la rue"
90.5 % des femmes et 92 % des hommes ont répondu 'très ou assez probable'.
"Appeler et te déclarer malade si tu as quelques chose d'intéressant à faire"
57.4 % des femmes et 58.5 % des hommes ont répondu 'très ou assez probable'.

Q21: Situations considérées entre 'très sécuritaire' et 'très dangereuse' (échelle à cinq niveaux).
"Faire du vélo sans porter de casque protecteur"
'très sécuritaire ou sécuritaire' pour 14.2% des femmes et 28.4 % des hommes, mais 'dangereuse ou très dangereuse' pour 40.4 % des femmes et 25.8 % des hommes; les autres ayant l'opinion 'neutre'.

"Sauter d'un pont en bungie" montre l'effet d'âge: chez les femmes l'opinion 'très dangereuse ou dangereuse' monte de 42.4 % chez les 16 ans à 57.9 % chez les 19 ans; chez les hommes de 34.5 % à 47.3 % respectivement.

Q22: Opinions sur des situations de conduite (échelle à cinq niveaux comme Q21).
Presque toutes les sous-questions montrent une différence nette entre les hommes et les femmes. De plus, les perceptions de la dangerosité des situations augmentent avec l'âge pour les deux sexes. Toutes ces réponses indiquent que les hommes considèrent ces situations

comme moins dangereuses, donc plus sécuritaires que les femmes; par exemple:
"Accepter d'être passager d'un véhicule lorsque le conducteur va trop vite"
'dangereuse ou très dangereuse' pour 82.4 % des femmes, mais seulement 61.4 % des hommes.
"Conduire sur des routes enneigées"
'dangereuse ou très dangereuse' pour 38 % des femmes (36.4 % pour les 16 et 17 ans, 39.9 % pour les 18 et 19 ans), mais seulement 29.1 % des hommes (25 % pour les 16 et 17 ans, 34.4 % pour les 18 et 19 ans).
"Conduire après avoir pris quelques bières"
'dangereuse ou très dangereuse' pour 96.1 % des femmes, mais seulement 90.1 % des hommes.

Ces cinq questions (Q18 à Q22) contiennent 41 sous-questions. À l'aide des analyses en composantes principales, nous tentons d'établir des indices comme mesures de la propension à prendre des risques. Ces analyses ont abouti avec 8 ensembles de sous-questions, chaque ensemble donnant lieu à une première composante principale. Afin de pouvoir extraire les scores pour tous les individus, la substitution par la moyenne a été utilisée pour les réponses manquantes. Toutes les 1804 personnes de l'échantillon font donc partie de ces analyses. Les scores sont normés avec une moyenne de 0 et une variance de 1. Les signes ont été choisis afin de faire correspondre une propension plus à risque aux valeurs élevées.

Voici les 8 sous-ensembles:

I: Toutes les 7 sous-questions de Q18 portant principalement sur la vitesse
II: Q19a, b, c sur le présent
III: Q19d,e,f sur la valeur du présent pour le futur
IV: Q20a, b, c, i des actions illégales, mais acceptables dans certains milieux
V: Q20d, e, f, h des actions illégales, mais considérées plus sérieuses
La sous-question Q20g "garder un billet de $50 que tu as trouvé dans la rue" a été laissée de côté car elle est la moins corrélée avec les autres sous-questions de Q20, et sa moyenne est plus petite que les autres; i.e. la plupart des personnes disent 'très probable'.

VI: Les 5 premières sous-questions de Q21.
La sous-question Q21f "ne pas faire de l'exercice régulièrement" n'est que très peu corrélée avec les autres sous-questions de Q21; elle a été laissée de côté.
VII: Q22a, b, c, j, k portant sur l'alcool, la ceinture et la vitesse imprudente
VIII: Q22d, e, f, g, h, i, l, m portant sur des situations qui ne sont pas nécessairement dangereuses pour un conducteur averti.

En faisant l'addition des 8 scores, on obtient un indice global de propensions à prendre des risques pour chaque individu, appelé par la suite simplement Indice. Voici quelques statistiques descriptives:

Tous Moyenne = 0.000, écat-type = 4.258, minimum = -13.167, maximum = + 17.317
Femmes: Moyenne = -1.164, écat-type = 3.710, minimum = -13.167, maximum = + 14.419
Hommes: Moyenne = +0.965, écat-type = 4.440, minimum = -12.285, maximum = + 17.317

Il faut prendre note que les variations sont fortes chez les femmes et chez les hommes; il y a donc des femmes et des hommes dans les deux extrêmes, même si les moyennes sont significativement différentes ($p<.001$). L'Indice diminue avec l'âge: +0.630 pour les 16 ans, +0.176 pour les 17 ans, -0.370 pour les 18 ans et –0.496 pour les 19 ans; ceci confirme la maturation mentionnée précédemment. Il n'y a pas d'interaction entre les facteurs âge et sexe.

La distribution de la variable Indice est proche d'une distribution normale, mais on constate une légère asymétrie vers les valeurs positives surtout due à des valeurs aberrantes dans la queue supérieure de la distribution.

Il n'y a pas de différence significative des moyennes selon la prise ou non d'un cours de conduite; les moyennes (écart-type) sont de –0.014 (4.256) pour ceux et celles avec cours et de +0.082 (4.274) pour ceux et celles sans cours.

Nous verrons par la suite que les moyennes de l'Indice correspondent aux différents facteurs étudiés, comme par exemple la motivation, le nombre de collisions et d'infractions, mais étant données les variations importantes, l'Indice devient un faible prédicteur.

Q23 à Q26: Certaines situations d'accidents typiques (Crash beliefs questionnaire):

Q23: "J'arrête ma voiture à un feu rouge et le conducteur du véhicule qui me suit ne freine pas à temps et frappe l'arrière de ma voiture."

Q24: "Je conduis sur l'autoroute. Le conducteur du véhicule devant moi s'arrête brusquement et je frappe l'arrière de son véhicule."

Q25: "Je suis arrêté à un feu rouge à une intersection achalandée. La lumière devient verte et j'appuie sur l'accélérateur. Un autre véhicule brûle la lumière rouge et frappe le côté de ma voiture."

Q26: "Je conduis sur une route de campagne qui est en bonne condition et il n'y a pas de circulation. Alors que je tente de négocier une courbe, ma voiture se dirige en ligne droite et sort de la route."

Pour chacune de ces quatre situations, les quatre jugements suivants étaient demandés:

a) Susceptibilité: "Le risque que ceci m'arrive pendant que je conduis dans les prochaines années est ..."
extrêmement élevé à extrêmement bas (6 niveaux)

b) Confiance en l'apprentissage: "Tous les conducteurs peuvent apprendre comment réduire le risque associé à ce type de collisions ..."
définitivement à définitivement pas (5 niveaux)

c) Auto-confiance: "Compte tenu de mes habilités comme conducteur, les chances que je sois en mesure d'éviter ce type de collision sont ..."
extrêmement élevées à extrêmement basses (6 niveaux)

d) Risque de blessures: "Les chances que quelqu'un soit blessé dans ce type de collision sont ..."
extrêmement élevées à extrêmement basses (6 niveaux)

Pour la présentation des statistiques descriptives, les deux niveaux extrêmes ont été mis ensemble. Voici quelques résultats:

a) Susceptibilité: Les pourcentages des hommes dans les deux groupes extrêmes sont plus forts que chez les femmes, donc celles-ci ont des pourcentages plus élevés que les hommes pour les niveaux du milieu.

b) Confiance que tout conducteur puisse apprendre à réduire le risque de ce type de collision: Il n'y pas de différence entre les hommes et les femmes pour les quatre situations.

c) Auto-confiance de pouvoir éviter ce type de collision: Les hommes expriment plus de confiance que les femmes, spécifiquement pour la question 26: 48.8 % des hommes versus 39.8 % des femmes répondent 'extrêmement ou très élevées'.

d) Les chances que quelqu'un soit blessé: Pour les questions 23 à 25, les hommes jugent ces chances plus élevées que les femmes; il n'y a pas de différence pour Q26.

Des analyses en composantes principales ont données lieu à quatre indices en regroupant les 16 sous-questions de la façon suivante:

L'indice de susceptibilité: Q23a, Q24a, Q25a et Q26a
L'indice de confiance en l'apprentissage : Q23b, Q24b, Q25b et Q26b
L'indice d'auto-confiance: Q23c, Q24c, Q25c et Q26c
L'indice de chance de blessures; Q23d, Q24d, Q25d et Q26d
Ces indices sont de nouveau standardisés avec des moyennes=0 et des variances=1.

Afin d'analyses ces indices, il faut comparer des moyennes de groupes. Des analyses de variance des 8 scores, de l'Indice et des quatre indices des questions Q23 à Q26 donnent souvent des résultats qui sont statistiquement significatifs, mais qui n'expliquent qu'une petite fraction de la variation totale. Ces modèles ne sont donc pas utiles. Voici un exemple pour l'Indice selon les facteurs motivation et sexe.

Tableau 3.1 : L'indice de propension de prendre des risques selon la motivation pour les femmes et pour les hommes.

	Motivation								
	opportuniste			mixte			apprentissage		
	n	moy.	s	n	moy.	s	n	moy.	s
Femmes	7	+2.72	3.79	375	-0.47	3.45	241	-1.84	3.68
Hommes	47	+4.68	4.40	510	+1.25	4.20	109	-0.85	3.82
Tous	54	+4.42	4.34	885	+0.52	3.99	350	-1.53	3.75

Pour les femmes et les hommes, les personnes avec motivation 'opportuniste' ont l'Indice le plus fort et celles avec motivation 'apprentissage' ont l'Indice le plus faible. De plus, pour chaque modalité de motivation la moyenne des hommes est plus grande que celle des femmes. Les hommes ont donc une propension de prendre des risques qui est plus élevée que pour les femmes. Le groupe de "motivation opportuniste" a une propension de prendre des risques qui est supérieure à celle des autres groupes, et cela chez les femmes et chez les hommes.

L'analyse de variance montre qu'il n'y a pas d'interaction entre les deux facteurs et que chacun des facteurs est significatif au niveau 0.001, mais seulement 12.7 % de la variation totale est expliquée par le modèle.

CHAPITRE 4

RÉSULTATS DE LA TROISIÈME PARTIE:

MILIEU FAMILIAL ET STYLE DE VIE

Le Tableau 4.1 montre que la moitié des répondants habitent le plus longtemps en banlieue, et très peu de gens à la campagne. La résidence en banlieue s'explique par la source principale des répondants étant le Centre Longueuil.

Tableau 4.1 : 'Où as-tu habité le plus longtemps' selon le sexe.

	Résidence			
Sexe	en ville	en banlieue	à la campagne	Total
Femmes	332 (40.9%)	420 (51.7%)	60 (7.4%)	812 (100%)
Hommes	433 (44.5%)	467 (48.0%)	72 (7.4%)	972 (100%)
Total	765 (42.9%)	887 (49.7%)	132 (7.4%)	1784 (100%)

Si on examine le lieu de résidence selon l'âge, on observe que 50% des 16 ans habitent en banlieue, mais que ce pourcentage diminue avec l'âge à 41.6% pour les femmes de 19 ans et à 36.1% pour les hommes de 19 ans. Il n'y a aucune différence du lieu de résidence selon la prise ou non d'un cours de conduite.

Q28: Les participants ont des parents bien éduqués. En définissant la variable SCOLMAX comme le plus haut niveau de scolarité complété par n'importe quel parent, on trouve que 43.5% des femmes et 39.3% des hommes ont au moins un parent avec une éducation universitaire; 28.5% des femmes et 33.7% des hommes ont des parents où le plus haut niveau de scolarité est le secondaire. Il n'y a pas de différence selon cours ou non; ni chez les femmes ni chez les hommes.

Q30 et Q31: La grande majorité (70%) habitent avec leurs deux parents, même plus si on considère des secondes unions. Seulement 3.1% des femmes et 6.6% des hommes vivent seuls.

Q32: De nombreux jeunes sont ou pensent devenir propriétaire d'une automobile au cours de l'année prochaine (34.5% des femmes, 48.0% des hommes). Les personnes avec cours tendent plus vers la propriété d'une automobile que celles sans cours.

Q33: Comme les répondants habitent principalement en banlieue, il n'est pas surprenant de voir que 66% des femmes et des hommes habitent dans des ménages avec deux voitures ou plus. Pour les 16 ans, on trouve même 78% dans des ménages avec deux voitures ou plus, ce pourcentage tombe à 52% pour les personnes de 19 ans. Il n'y a pas de différence selon la prise ou non d'un cours de conduite.

Q34: La possibilité d'accès à un véhicule durant l'année après la réussite de l'examen pratique ne semble pas poser beaucoup de problèmes. Seulement 3.8% des femmes et 5.1% des hommes ont répondu jamais ou rarement, tandis que la réponse toujours tient pour 20% des femmes (25% pour les 16ans; 18% pour les 19 ans) et pour 39% des hommes (35% pour les 16 ans; 26% pour les 17 ans; 29% pour les 18 ans et 34% pour les 19 ans). De nouveau, il n'y a pas de différence en terme d'accès selon la prise ou non d'un cours de conduite.

Q39: Avoir fumé des cigarettes durant les deux derniers mois tient pour 39.5% des femmes et 32.0% des hommes.

Q44: Avoir consommé une boisson alcoolisée durant les deux derniers mois tient pour 79.6% des

femmes et 80.8% des hommes.

Q47: La plupart des répondants sont inscrits à l'école (89.4% des femmes, 83.0% des hommes). Ces pourcentages sont les plus élevés à 16 ans (97.5 % pour les femmes et 94.8 % pour les hommes); ils diminuent pour les 19 ans à 77.2% pour les femmes et 69.2 % pour les hommes. Il y a une différence selon cours de conduite (87.1 %) ou non (79.0 %) ce qui ne surprend pas étant donné que les 16 ans ont dû prendre un cours.

Q49 à Q51: Les femmes comparées aux hommes ont des résultats plus forts; elles ont plus d'ambitions concernant le plus haut niveau d'études envisagé, et elles passent plus d'heures pour faire les travaux scolaires à la maison.

Q52: Travaille ou cherche du travail à temps partiel: 75.9% des femmes et 70.0% des hommes; ces pourcentages diminuent avec l'âge. Il n'y a pas de différence ($p > .05$) selon cours (73.5%) ou non (67.8%).

Q53: Travaille ou cherche du travail à temps plein: 25.0% des femmes et 38.6% des hommes; ces pourcentages augmentent avec l'âge. Il y a une différence ($p < .001$) selon cours (30.7%) ou non (42.9%).

Q55: Qui paie les coûts associés à l'automobile que tu vas conduire? Les trois sous-questions concernant les coûts du permis d'apprenti, du permis probatoire, de l'école de conduite ont été traité au Chapitre 3. Voici maintenant les coûts associés au véhicule.

Paiement des dépenses associées au véhicule que les répondants vont conduire

Tableau 4.2 : Qui va payer les dépenses pour le véhicule que tu vas conduire; cas des femmes

Frais pour	moi-même seule		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total
	n	%	n	%	n	%	n	%	100%
les primes d'assurance	296	36.7	357	44.3	126	15.6	27	3.3	806
l'essence	494	61.2	74	9.2	224	27.8	15	1.9	807
le coût d'achat	316	39.5	214	26.8	139	17.4	130	16.3	799
l'entretien et les réparations	294	36.4	270	33.4	213	26.4	31	3.8	808

Les femmes prévoient principalement de payer pour l'essence. Le fait que la famille paie pour l'assurance dans 44% des cas reflète que ces femmes vont conduire une automobile familiale. Si on exclut les réponses "ne s'applique pas à moi" pour les coûts d'achat, on trouve que 47.2% (100 x 316/(799-130)) des femmes prévoient pouvoir payer elles-mêmes!

Tableau 4.3 : Qui va payer les dépenses pour le véhicule que tu vas conduire; cas des hommes

Frais pour	moi-même seul		la famille ou le tuteur		moi-même et la famille		ne s'applique pas à moi		total
	n	%	n	%	n	%	n	%	100%
les primes d'assurance	524	54.1	308	31.8	119	12.3	17	1.8	968
l'essence	682	70.3	103	10.6	172	17.7	13	1.3	970
le coût d'achat	549	56.8	210	21.7	125	12.9	82	8.5	966
l'entretien et les réparations	524	54.1	246	25.4	174	18.0	24	2.5	968

Les hommes prévoient aussi de payer pour l'essence; mais ils pensent à plus de 50% de pouvoir aussi payer pour les autres dépenses. Si on exclut les réponses "ne s'applique pas à moi" pour les coûts d'achat, on trouve que 62.1% (100 x 524/(966-82)) des hommes prévoient pouvoir payer eux-mêmes!

Les réponses des femmes diffèrent significativement de celles des hommes. Les pourcentages dans la colonne "moi-même seul" sont tous supérieurs chez les hommes.

CHAPITRE 5

RÉSULTATS DU DEUXIÈME QUESTIONNAIRE

Le but du deuxième questionnaire était de connaître l'expérience de conduite vécue des répondants au premier questionnaire et d'obtenir les opinions sur les cours de conduite et l'examen pratique de la SAAQ. Ce deuxième questionnaire qui contient 13 questions (48 sous-questions) a été envoyé en février 2003 par la SAAQ à la dernière adresse dans ses fichiers. En date du 15 avril, 503 questionnaires éligibles ont été reçus au Laboratoire sur la sécurité des transports.

5.1 Le sous-échantillon et des comparaisons avec l'échantillon initial

La distribution des répondants au deuxième questionnaire selon l'âge et le sexe est présentée au Tableau 5.1.1. La comparaison avec le Tableau 3.0 montre que la proportion des femmes a augmenté de 45.3 % à 55.3 % avec une diminution correspondante chez les hommes, et la proportion des 16 et 17 ans a augmentée de 55.0 % à 60.7 % et donc un pourcentage plus bas de répondants de 18 et 19 ans.

Tableau 5.1.1 : Les effectifs des répondants au deuxième questionnaire selon l'âge et le sexe

Sexe	Age révolu lors de l'examen pratique				Total
	16	17	18	19	
Femmes	60	102	67	49	278
%	21.6	36.7	24.1	17.6	(55.3)
Hommes	55	88	46	36	225
%	24.4	39.1	20.4	16.0	(44.7)
Total	115	190	113	85	503
%	22.9	37.8	22.5	16.9	100%

Chez les répondants au deuxième questionnaire, le pourcentage des hommes avec cours a augmenté de 82.5% à 89.3 %, mais il est resté stable pour les femmes (88.4% versus 89.2%). Ces résultats s'expliquent par les pourcentages plus élevés des hommes de 16 et 17 ans qui fréquentent les cours plus que les 18 et 19 ans, tandis que chez des femmes les pourcentages avec cours varient moins à travers les âges (voir Tableau 3.1).

Une analyse comparative entre les répondants et les non-répondants du deuxième questionnaire montre que les non-répondants ont tendance à être 'moins sages' que les répondants. Par exemple, les premiers ont des taux de réussite au 1er essai de l'examen théorique plus bas (hommes et femmes), ont répondu 'tout à fait vrai' à 'J'ai trouvé que c'est facile d'apprendre à conduire' (42.1% versus 36.5%), ont des résultats scolaires plus bas et fument plus souvent. Spécifiquement chez les hommes non-répondants, on observe des pourcentages plus élevés pour 'conduite d'une automobile avec accompagnateur sur chemin privé' (79.5% versus 71.7%), 'pas sécuritaire mais bon' (26.9% versus 19.5%), et des pourcentage moins élevés pour 'sauter d'un pont en bungie' est 'dangereuse ou très dangereuse' (37.9% versus 49.6%).

En résumé, il faut donc constater qu'il a un certain biais dans ce sous-échantillon des répondants du deuxième questionnaire vers des personnes plus jeunes et surtout chez les hommes avec une tendance moindre à prendre des risques.

5.2 Résultats du deuxième questionnaire et comparaisons avec le premier

La première question a demandé des opinions concernant le cours de conduite comme la question Q12 du 1er questionnaire. Les résultats du Tableau 5.2.1 sont semblable aux réponses à Q12 de tous les répondants (Tableaux 2.11 et 2.12), mais le pourcentage des personnes en désaccord avec un cours de perfectionnement tous les dix ans a augmenté chez les femmes de 18.1 % à 30.6 % et chez les hommes de 28.5 % à 44.9 %.

Tableau 5.2.1 : Opinions sur le cours de conduite selon le sexe

Les cours pratiques de l'école de conduite	Sexe	n	en accord %	indécis %	en désaccord %
m'a bien préparé pour être un conducteur sécuritaire	F	241	94.6	2.5	2.9
	M	197	89.3	3.6	7.1
j'évite des collision grâce à ma formation à l'école de conduite **	F	241	72.6	16.6	10.8
	M	193	57.7	20.4	21.9
devraient être requis de tous les nouveaux conducteurs	F	241	92.9	3.3	3.7
	M	196	86.7	7.1	6.1
devrait être suivi par tous à tous les dix ans **	F	242	41.3	28.1	30.6
	M	196	35.2	19.9	44.9

χ 2 avec 2 dl; ** $p < .01$

Il est surprenant de constater que les répondants jugent très différemment les questions 'être un conducteur sécuritaire' et 'éviter des accidents'. Chez les femmes le pourcentage de celles en accord tombe de 94.6% à 72.5%, chez les hommes de 89.3% à 57.7%; et le pourcentage des femmes en désaccord remonte de 2.9% à 10.8%, et de 7.1% à 21.9% pour les hommes.

Le Tableau 5.2.2 montre que l'opinion quant à la question "m'a bien préparé pour être un bon conducteur" a changé pour un bon nombre de femmes et d'hommes de 'fortement en accord' (1) à 'modérément en accord' (2), c.-à.-d. les chiffres au dessus de la diagonale du tableau sont plus grands que les correspondants en dessous.

Tableau 5.2.2 : Opinions sur la question " Le cours de conduite pratique m'a bien préparé pour être un bon conducteur" selon les deux questionnaires (questions Q12 et S1) pour les femmes et pour les hommes

	Femmes selon S1 (2e questionnaire)				Hommes selon S1 (2e questionnaire)			
Q12	1	2	3	Total	1	2	3	Total
1	114	64	5	183	82	52	11	145
2	15	29	7	51	12	23	8	43
3	2	3	1	6	1	4	2	7
Total	131	96	13	240	95	79	21	195

La question S2 a demandé les opinions sur l'examen sur route de la SAAQ. On note qu'un tiers des répondants pense que l'examen devrait être plus long que la durée actuelle de moins de 30 minutes et la

moitié juge que l'examen devrait être plus exigeant (voir Tableau 5.2.3).

Tableau 5.2.3 : Opinions sur l'examen sur route selon le sexe

L'examen sur route	Sexe	n	Fortement ou modérément en accord (%)	Indécis ou en désaccord (%)
a bien évalué mes capacités à conduire d'une façon sécuritaire *	F	278	86.0	14.0
	M	225	77.8	22.2
devrait durer au moins une heure	F	275	31.6	68.4
	M	220	38.2	61.8
devrait inclure des situations de conduite plus exigeantes, ex. contrôle de dérapage	F	278	45.3	54.7
	M	225	52.9	47.1

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* $p<0.05$

La question S3 a demandé le nombre d'accidents dans lesquels le répondant était impliqué en conduisant avec le permis probatoire. Deux observations s'imposent: Le nombre total ne correspond pas toujours à la somme des accidents DMS et des accidents avec blessés. Ces derniers sont très rares: 7 pour les femmes et 4 pour les hommes. Quelques résultats suivront sur les accidents au total qui correspond donc essentiellement aux accidents DMS. Les taux d'accidents sont de 30.3 % pour les femmes et de 42.9 % pour les hommes. En terme des personnes avec au moins un accident, les taux sont de 25.2 (70/278) par 100 femmes et de 30.8 (69/225) par 100 hommes. Ces taux sont nettement au dessus des taux dans les fichiers de la SAAQ pour ces répondants du deuxième questionnaire (5.4 par 100 femmes et 9.8 par 100 hommes) car les accidents rapportés au deuxième questionnaire comprennent aussi les accidents réglés par un constat à l'amiable; ces derniers ne se trouvent pas dans les dossiers de conduite de la SAAQ n'ayant pas donné lieu à un rapport de police.

Tableau 5.2.4 : Nombre d'individus selon le nombre d'accidents (S3) et le sexe

Sexe	Individus	Aucun		Un		Deux ou plus		Nombre d'accidents *
	n	n	%	n	%	n	%	
F	278	208	74.8	57	20.5	13	4.7	84
M	224	155	69.2	47	21.0	22	9.8	96
Total	502	363	72.3	104	20.7	35	7.0	180

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* On a tenu compte du nombre exact des accidents rapportés (une femme avec 3; 3 hommes avec 3 et un avec 4)

Comme les durées couvrant les accidents rapportés sont variables, on ne s'attardera pas longtemps sur ces données. Dans le Chapitre 6, les accidents selon le dossier de conduite fourni par la SAAQ seront analysés en détails sur le même nombre de jours pour tous les individus.

La question S4 a demandé quand les individus ont commencé à conduire sans supervision. Le Tableau 5.2.5 montre que les 16 et 17 ans ont débuté un peu plus rapidement que les 18 et 19 ans. D'autres analyses font ressortir que les individus sans cours commencent un peu plus rapidement à conduire sans supervision que ceux avec cours (chaque groupe d'âge).

Tableau 5.2.5 : Début de la conduite sans supervision selon l'âge et le sexe

Sexe	Age	n	Après avoir reçu le permis probatoire, j'ai commencé à conduire sans supervision (en pourcentage selon le groupe âge-sexe)		
			la première semaine	entre une semaine et trois mois	après trois mois
F	16 & 17	162	77.2	17.6	4.9
F	18 & 19	116	68.1	19.0	12.9
M	16 & 17	143	79.7	14.7	5.6
M	18 & 19	82	67.1	19.5	13.4

S5: Le nombre moyen de passagers est de deux et plus pour 30.2% des femmes et pour 38.2% des hommes. Les femmes et les hommes sans cours ont tendance a avoir plus de passagers que les individus avec cours.

Les statuts d'occupation selon la question S6 (étudiant ou travailleur) sont résumés dans le Tableau 5.2.6. Plus de 80 % des répondants sont aux études; 16.5% des femmes et 19% des hommes ont indiqué 'travailleur', donc ne sont plus aux études.
Tableau 5.2.6 : Statut d'occupation selon le sexe

Sexe	n	Statut		
		étudiant	travailleur	étudiant et travailleur
F	273	63.4	16.5	20.1
M	216	68.1	19.0	13.0

Tableau 5.2.7 : Le kilométrage entre l'obtention du permis probatoire et le 31 décembre 2001 selon le sexe

Sexe ***	n	Kilomètres rapportés		
		1 – 5000	5,001 - 15,000	> 15,000
F	277	155 (56.1%)	91 (32.8%)	31 (11.1%)
M	225	87 (38.8%)	84 (37.1%)	54 (24.1%)

Il est évident que les hommes conduisent plus de kilomètres que les femmes (χ 2 avec 2 dl; *** $p < .001$). On observe que durant cette période initiale avec le permis probatoire, les nouveaux conducteurs conduisent peu, 56.1 % des femmes et 38.8 % des hommes conduisent moins de 5000 km.

La question S7 demandait les types et les fréquences d'exposition au risque. Les répondants pouvaient cocher autant de raisons qui étaient applicables dans leur cas. Comme la catégorie 'jamais' n'est que peu utilisée, nous l'avons fusionnée avec la catégorie 'rarement'. Le Tableau 5.2.8 donne les résultats pour les femmes et le Tableau 5.2.9 pour les hommes.

Le pourcentage des hommes dans la catégorie '4 -7 fois par semaine' est plus élevé que celui des femmes pour toutes les raisons de conduire. Ce résultat correspond au fait que les hommes conduisent plus de kilomètres par an que les femmes. Il n'y a aucune différence selon cours ou non.

Tableau 5.2.8 : Les raisons et les fréquences de la conduite pour les 278 femmes

Raison	Fréquence par semaine							
	4 - 7		1 – 3		rarement ou jamais		NA ou manquant	
	n	%	n	%	n	%	n	%
Aller et revenir de l'école	71	25.5	35	12.6	159	57.2	13	4.7
Aller et revenir du travail	84	30.2	92	33.1	98	35.2	4	1.4
Conduire pour les besoins du travail	14	5.0	25	9.0	218	78.4	21	7.6
Magasinage / commissions	54	19.4	162	58.3	58	20.9	4	1.4
Visiter amis ou parents / socialiser	62	22.3	156	56.1	58	20.9	2	0.7
Sports / loisir	23	8.3	116	41.7	131	47.1	8	2.9
Sans raison spécifique	13	4.7	53	19.1	198	71.2	14	5.0

Tableau 5.2.9 : Les raisons et les fréquences de la conduite pour les 225 hommes

Raison	Fréquence par semaine							
	4 - 7		1 – 3		rarement ou jamais		NA ou manquant	
	n	%	n	%	n	%	n	%
Aller et revenir de l'école	87	38.7	33	14.7	97	43.1	8	3.6
Aller et revenir du travail	82	36.4	75	33.3	59	26.2	9	4.0
Conduire pour les besoins du travail	34	15.1	32	14.2	141	62.7	18	8.0
Magasinage / commissions	36	16.0	124	55.1	63	28.0	2	0.9
Visiter amis ou parents / socialiser	74	32.9	111	49.3	38	16.9	2	0.9
Sports / loisir	18	16.9	113	50.2	73	32.4	1	0.4
Sans raison spécifique	30	13.3	50	22.2	138	61.3	7	3.1

Les activités le plus souvent mentionnées par les femmes et par les hommes avec une fréquence de 4 – 7 fois par semaine sont 'aller et revenir de l'école', 'aller et revenir du travail' et 'visiter amis ou parents / socialiser'.

Le plus grand nombre de personnes fait des déplacements tous les jours, et ce groupe effectue aussi le plus de kilomètres (voir Tableau 5.2.10).

Tableau 5.2.10 : Le kilométrage annuel selon les jours des déplacements

Majorité des déplacements ***	n	Kilomètres rapportés		
		1 - 5000	5,001 - 15,000	> 15,000
Lundi à jeudi	35	21 (60.0%)	11 (31.4%)	3 (8.6%)
Vendredi à dimanche	136	108 (79.4%)	27 (19.9%)	1 (0.7%)
Tous les jours	323	109 (33.7%)	134 (41.5%)	80 (24.8%)

χ 2 avec 4 dl; *** p< .001

Les personnes qui conduisent majoritairement seulement le jour ou seulement le soir font moins de kilomètres que les individus qui conduisent en tout temps; ces derniers constituent plus de 64% des répondants dont 21.4 % conduisent plus de 15 000 km par année (voir Tableau 5.2.11).

Tableau 5.2.11 : Le kilométrage selon la période de la journée de la conduite

Majorité des déplacements **	n	Kilomètres rapportés 1 - 5000	5,001 - 15,000	> 15,000
Le jour	99	53 (53.5%)	35 (35.4%)	11 (11.1%)
Le soir ou la nuit	78	49 (62.8%)	24 (30.8%)	5 (6.4%)
Tout le temps	318	137 (43.1%)	113 (35.5%)	68 (21.4%)

χ 2 avec 4 dl; ** p< .01

Une question d'intérêt est la source des fonds pour payer le véhicule conduit le plus souvent, soit pour les primes d'assurance, l'essence et l'achat du véhicule. Les Tableau 5.2.12 à 5.2.17 donnent les sources des fonds conjointement selon les questions Q55d, e, f et S12a, b, c. On observe que les répondants ont payé moins eux-mêmes que prévu au moment de l'obtention du permis probatoire, mais que la famille a payé plus que prévu surtout pour les femmes.

Tableau 5.2.12 : Source des fonds pour les primes d'assurance du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les femmes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	49	28	9	4	90 (32.4 %)
2) Famille	21	95	8	1	125 (45.0 %)
1) et 2)	9	29	8	2	48 (17.3 %)
Ne s'applique pas	3	10	1	1	15 (5.4 %)
Total	82 (29.5 %)	162 (58.3 %)	26 (9.4 %)	8 (2.9 %)	278 (100 %)

Tableau 5.2.13 : Source des fonds pour les primes d'assurance du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les hommes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	80	18	11	5	114 (50.9 %)
2) Famille	16	46	9	0	71 (31.7 %)
1) et 2)	16	12	5	1	34 (15.2 %)
Ne s'applique pas	1	2	1	1	5 (2.2 %)
Total	113 (50.4 %)	78 (34.8 %)	26 (11.6 %)	7 (3.1 %)	224 (100 %)

Les réponses des hommes sur la source des fonds pour les primes d'assurances concordent assez bien entre les deux questionnaires.

Tableau 5.2.14 : Source des fonds pour l'essence du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les femmes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	85	26	44	5	160 (57.6 %)
2) Famille	4	9	11	0	24 (8.6 %)
1) et 2)	21	20	44	1	86 (30.9 %)
Ne s'applique pas	2	1	5	0	8 (2.9 %)
Total	112 (40.3 %)	56 (20.1 %)	104 (37.4 %)	6 (2.2 %)	278 (100 %)

Le fait que la famille contribue dans plus de 50 % pour l'essence semble indiquer que les femmes conduisent en effet une voiture appartenant aux parents.

Tableau 5.2.15 : Source des fonds pour l'essence du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les hommes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	102	8	33	3	146 (65.8 %)
2) Famille	7	11	3	0	21 (9.5 %)
1) et 2)	26	7	18	1	52 (23.4 %)
Ne s'applique pas	2	0	1	0	3 (1.4 %)
Total	137 (61.7 %)	26 (11.7 %)	55 (24.8 %)	4 (1.8 %)	222 (100 %)

Tableau 5.2.16 : Source des fonds pour l'achat du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les femmes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	32	66	11	3	112 (40.9 %)
2) Famille	4	55	4	0	63 (23.0 %)
1) et 2)	6	31	5	2	44 (16.1 %)
Ne s'applique pas	2	50	1	2	55 (20.1 %)
Total	44 (16.1 %)	202 (73.7 %)	21 (7.7 %)	7 (2.6 %)	274 (100 %)

Tableau 5.2.17 : Source des fonds pour l'achat du véhicule conduit le plus souvent selon les réponses dans les deux questionnaires pour les hommes

Premier questionnaire	Deuxième questionnaire (S12) 1) Moi-même	2) Famille	1) et 2)	Autre	Total
1) Moi-même	45	57	13	5	120 (54.1 %)
2) Famille	11	27	5	1	44 (19.8 %)
1) et 2)	6	15	12	0	33 (14.9 %)
Ne s'applique pas	5	15	2	3	25 (11.3 %)
Total	67 (30.2 %)	114 (51.4 %)	32 (14.4 %)	9 (4.1 %)	222 (100 %)

En ce qui concerne l'achat du véhicule (Tableaux 5.2.16 et 5.2.17), on observe que les femmes et les hommes étaient trop optimistes quant à la capacité de payer eux-mêmes. C'est donc principalement la famille qui a payé.

CHAPITRE 6

LES FICHIERS DE LA SAAQ

Afin de compléter l'étude longitudinale et de répondre aux objectifs principaux de ce projet, il fallait obtenir les données objectives des dossiers de conduite des répondants. La SAAQ a les données sur l'insécurité des conducteurs (infractions, accidents et sanctions) ainsi que le cheminement concernant l'accès au permis probatoire (performances aux examens, dates et âges aux moments de l'obtentions des permis, etc.).

La SAAQ nous a fourni cinq fichiers en plus du nôtre; la première variable dans tous les fichiers s'appelle 'NUMERO' afin de pouvoir jumeler les fichiers.

IMMATRIC: 4 variables pour chaque individu donnant l'information (oui ou non) sur la propriété d'une automobile au 31 décembre des années 1999, 2000, 2001.

PERMIS: 15 variables pour chaque individu sur le cheminement à travers les examens (nombres d'essais pour réussir, dates, âges, etc.)

INFRACT: 5 variables pour chaque individu donnant les dates de commission et de condamnation, les points d'inaptitude et le type d'infraction.

ACCIDENT: 31 variables avec les détails sur les accidents des 210 individus ayant eu un (188) ou deux (22) accidents.

REVOSUSP: 4 variables avec l'information sur la date d'entrée en vigueur, la durée et la nature de la sanctions. Comme les sanctions autres que 'Amende non payée' sont rares, nous n'avons pas effectué beaucoup d'analyses avec ce dernier fichier.

Dans les sections suivantes nous présenterons des statistiques descriptives de ces fichiers et des associations avec les variables des deux questionnaires et des fichiers de la SAAQ.

6.1 Le fichier IMMATRIC

Le nombre de propriétaires de notre cohorte de 1804 nouveaux conducteurs et conductrices s'accroît de 9 en 1999 à 269 (14.9%) en 2000 et à 472 (26.2%) en 2001.

En 2001, chez les femmes, il n'y a aucune différence quant au statut de propriétaire selon cours (20.5%) ou non (20.0%). En 2001, chez les hommes on trouve pour ceux avec cours 29.5% de propriétaires et 37.6% chez ceux sans cours.

6.2 Le fichier PERMIS

Voici d'abord quelques statistiques sur l'âge. Il n'y a pas de différences ni selon le sexe ni selon cours ou non pour l'âge moyen au moment de l'obtention du permis d'apprenti; cette moyenne est de 17.0 ans. L'âge au moment de l'obtention du permis probatoire diffère selon cours (17.9 ans) ou non (18.4 ans). Cette différence d'une demie-année s'explique en bonne partie par les 4 mois que le cours retranche de la durée minimale pour le permis d'apprenti (12 mois sans cours). De plus, les hommes obtiennent le permis probatoire à un âge légèrement plus jeunes que les femmes (17.9 versus 18.0 ans).

Il y a des différences significatives entre les moyennes de la durée en jours de la date du permis d'apprenti à la date du permis probatoire selon cours ou non; la différence entre les deux moyennes est de 157 jours, un peu plus que cinq mois. Les hommes obtiennent le permis probatoire un peu plus rapidement que les femmes (différence de 16 jours). Il n'y a pas d'interaction entre les deux facteurs cours et sexe.

Tableau 6.2.1 : Durée moyenne (arrondie en jours) pour la durée du permis d'apprenti au permis probatoire selon le sexe

	Femmes		Hommes		Tous	
	moy.	n	moy.	n	moy.	n
Avec cours	352	723	325	813	338	1536
Sans cours	506	95	489	173	495	268
Total	370	818	354	986	361	1804

Si on considère les personnes qui ont détenu le permis d'apprenti moins d'une année (<360 jours), ont trouve que 62.2 % des femmes et 64.7 % des hommes tombent dans cette catégorie.

Regardons maintenant conjointement la durée du permis d'apprenti et le nombre de leçons prises selon la question Q10. Comme la réglementation stipule au moins 12 leçons pour pouvoir se présenter à l'examen pratique en moins de 12 mois (360 jours) avec le permis d'apprenti, le Tableau 6.2.2 indique que 103 personnes (9.1 %; 35 femmes et 68 hommes) sur 1134 ont obtenu le permis probatoire avant 360 jours sans avoir suivi les 12 leçons requises.

Tableau 6.2.2 : Nombre de leçons et durée du permis d'apprenti avant la réussite de l'examen pratique pour les femmes et les hommes.

	Femmes			Hommes			Ensemble	
Nombre de leçons	< 360 jours	360 jours ou plus	Total	< 360 jours	360 jours ou plus	Total	< 360 jours	360 jours ou plus
< 12	35	30	65	68	33	101	103	131
12	393	143	536	488	110	598	881	253
> 12	75	34	109	75	26	101	150	60
Total	503	207	710	631	169	800	1134	376

Est-ce que toutes ces 103 personnes ont présenté un faux certificat ou y a-t-il d'autres raisons que nous n'avons pas pu explorer dans le cadre de cette recherche? Cependant, il est connu qu'il y a des écoles de conduite qui fournissent de tels certificats pour un prix moindre que celui d'un cours complet de 12 leçons. Chez les femmes le taux d'obtention prématuré du permis probatoire est donc de 7 % et chez les hommes de 10.8%. De toute évidence, il y a un problème avec ces certificats quand 9.1 % des personnes qui avaient réussi l'examen sur route n'avaient pas vraiment le droit de le prendre. Nous verrons plus loin les taux d'infractions et d'accidents de ces personnes.

La majorité des répondants ont réussi les examens au premier essai, mais il y a des cas spéciaux comme

on les voit dans les Tableaux 6.2.3 et 6.2.4. La partie de l'examen théorique sur la signalisation est la mieux réussie chez les femmes (92.3 %) et chez les hommes (90 %).

Tableau 6.2.3 : Le nombre d'essais afin de réussir les examens pour les 818 femmes

Examen	Nombre d'essais afin de réussir			
	1	2	3 et plus	maximum
Code le la sécurité routière	666	113	39	11
Signalisation	755	56	7	4
Spécialisation classe 5	686	96	36	13
Théorie (les 3 parties)	580 (70.9%)	131 (16.0%)	107 (13.1%)	23
Examen pratique	632 (77.3%)	152 (18.6%)	34 (4.1%)	6

Tableau 6.2.4 : Le nombre d'essais afin de réussir les examens pour les 986 hommes

Examen	Nombre d'essais afin de réussir			
	1	2	3 et plus	maximum
Code le la sécurité routière	781	155	50	8
Signalisation	887	82	17	8
Spécialisation classe 5	787	136	63	9
Théorie (les 3 parties)	637 (64.6%)	199 (20.2%)	150 (15.2%)	22
Examen pratique	775 (78.6%)	166 (16.8%)	45 (4.6%)	5

Parmi les 107 femmes ayant eu besoin de 3 essais ou plus afin de réussir les trois parties de l'examen théorique, il y en a 59 (7.2 % des femmes) qui ont eu besoin de 6 essais ou plus. Parmi les 150 hommes ayant eu besoin de 3 essais ou plus afin de réussir les trois parties de l'examen théorique, il y en a 81 (8.2 % des hommes) qui ont eu besoin de 6 essais ou plus. Il faut se demander pour ce groupe de personnes : pourquoi laisse-t-on répéter ces examens autant de fois sans faire une intervention? Des recherches antérieures (Laberge-Nadeau et al., 1999) ont montré que les nouveaux conducteurs avec plus d'une tentative pour réussir l'examen théorique ont des taux d'accidents plus élevés que ceux et celles qui réussissent à la première tentative.

6.3 Le fichier INFRACT

Ce fichier contient les variables NUMÉRO, DINF (date de commission de l'infraction), DCON (la date de condamnation de l'infraction), PDDOBT (le nombre de points d'inaptitude pour cette infraction) et TYPINF (le type d'infraction).

Le fichier contient 498 individus avec au moins une infraction (maximum = 5) pour un total de 726 infractions. Dans nos analyses, nous traiterons les infractions selon la date de commission de l'infraction. En effet le délai entre la date de commission et la date de condamnation (par paiement ou par jugement) peut être très long (plus d'une année!): moyenne=63 jours, écart-type=75 jours, minimum=0, maximum=452 jours. Voici des centiles de la distribution du nombre de jours entre la date de commission et la date de condamnation:

Centile:	10	25	50	75	90
Valeur en jours:	10	24	34	67	168.3

La moitié des personnes paient donc l'amende durant les 34 jours suivant la date de commission, mais

25 % des personnes prennent 67 jours ou plus, et 10 % des personnes entament des procédures qui font reculer la date de condamnation à plus de 168 jours (5 mois et demi) de la date de commission.

Ces délais dus au système de l'appareil judiciaire repoussent donc la date d'entrée en vigueur d'une suspension du permis; de plus, environ un autre mois passe jusqu'à l'entrée en vigueur d'une suspension après la date de condamnation par jugement (délai administratif). Ces délais se reflètent dans le fichier REVOSUSP (voir la section 6.5).

Afin de rendre les données comparables entre les individus, nous avons choisi la période maximale disponible avec le permis probatoire pour tous; elle est 450 jours. De plus, nous avons mis de côté les infractions durant la période d'apprentissage; le fichier contient 18 individus (une femme et 17 hommes) avec une telle infraction chacun. Ce choix réduit le nombre d'individus avec au moins une infraction commise dans la période des premiers 450 jours avec un permis probatoire à 441 pour un total de 613 infractions.

Tableau 6.3.1 : Nombre d'infractions par personne durant les premiers 450 jours suivant l'obtention du permis probatoire pour les femmes et pour les hommes

Sexe	Nombre d'infractions par personne						Total
	0	1	2	3	4	5	
Femmes	714 (87.3%)	92 (11.2%)	12	0	0	0	818
Hommes	649 (65.8%)	222 (22.5%)	81	26	5	3	986

Le Tableau 6.3.1 montre que 12.7% des femmes et 34.2% des hommes ont au moins une infraction. Il y a nettement plus d'hommes avec des infractions: 337 pour 497 infractions dont 34 hommes avec trois infractions et plus comptant pour 113 infractions.

Tableau 6.3.2 : Les infractions selon le type pour les femmes

Code	Signification	Infraction		Total
		1ère	2e	
1	Excès de vitesse de 11 à 20 km/h	11		13
2	Excès de vitesse de 21 à 30 km/h	37	2	43
3	Excès de vitesse de 31 à 45 km/h	16	6	20
4	Excès de vitesse de plus de 45 km/h	4	4	4
12	Feu rouge	13		13
13	Panneau d'arrêt	18	1	19
20	Franchissement prohibé d'une ligne de démarcation de voie	1		1
29	Omission de porter la ceinture de sécurité	2		2
31	Manquement devoir de conducteur	1		1
Total des nombres d'infractions		103	13	116

Le nombre de femmes avec infractions est de 104 pour 116 infractions. On y trouve 80 infractions pour des 'Excès de vitesse' et 32 infractions pour 'Feu rouge' et 'Panneau d'arrêt' (voir Tableau 6.3.2). Le taux d'infractions pour les femmes est de 14.2%. Chez les hommes les taux d'infractions sont plus élevés, soit de 50.4%. On y trouve 344 infractions pour 'Excès de vitesse' et 102 infractions pour 'Feu rouge' et 'Panneau d'arrêt' (voir Tableau 6.3.3). Ces taux montrent un manque flagrant de respect pour le Code de la sécurité routière par les jeunes hommes.

Tableau 6.3.3 : Les infractions selon le type pour les hommes

Code	Signification	Infraction 1ère	2e	3e	4e	5e	Total
1	Excès de vitesse de 11 à 20 km/h	19	10	4			33
2	Excès de vitesse de 21 à 30 km/h	108	33	17	2		161
3	Excès de vitesse de 31 à 45 km/h	85	30	8	4	1	127
4	Excès de vitesse de plus de 45 km/h	23	8	1	1		33
7	Dépassement prohibé par la droite			1			1
11	Effectuer des dépassements successifs en zigzag		1				1
12	Feu rouge	19	1	1		1	21
13	Panneau d'arrêt	56	21	3			81
16	Dépassement d'un autobus scolaire	1	1				2
20	Franchissement prohibé d'une ligne de démarcation	3	3		1		7
21	Vitesse ou action imprudente	1					1
22	Conduite pour un pari	2					2
29	Omission de porter la ceinture	9	5	3	1		18
31	Manquement devoir de conducteur		2				2
32	Zéro alcool pour les nouveau conducteurs	4	2			1	7
	Total des nombres d'infractions	330	117	38	9	3	497

La comparaison selon cours ou non montre qu'il n'y a pas de différence significative (voir Tableau 6.3.4) ni chez les femmes (tendance vers une prise de risque pour celles sans cours), ni chez les hommes.

Tableau 6.3.4 : Taux d'infractions selon cours ou non pour les femmes et les hommes

Infractions par individu	Femmes avec cours n	%	Femmes sans cours n	%	Femmes total n	%	Hommes avec cours n	%	Hommes sans cours n	%	Hommes total n	%
0	637	88.1	77	81.1	714	87.3	534	65.7	115	66.5	649	65.8
1	76	10.5	16	16.8	92	11.2	191	23.5	31	17.9	222	22.5
2 et plus	10	1.4	2	2.1	12	1.5	88	10.8	27	15.6	115	11.7
Total	723		95		818	100	813		173		986	100

Comme le nombre de femmes avec plus d'une infraction est très petit, les analyses suivantes utiliseront la variable infraction de façon binaire, c.-à.-d. personnes avec au moins une infraction versus personnes sans infractions.

Étant donné qu'il n'y a pas de différence selon la variable cours ou non, on examinera d'autres variables qui pourraient caractériser les individus avec infractions.

Regardons d'abord des variables disponibles dans les fichiers de la SAAQ comme l'âge révolu à l'obtention du permis probatoire, les performances aux examens et la durée du permis d'apprenti.

Chez les femmes l'âge, la performance à l'examen théorique (les trois parties ensemble) et celle à l'examen pratique, et la durée du permis d'apprenti ne montrent pas de relations significatives avec les taux d'infractions. Il faut quand même mentionner que les femmes avec une durée du permis d'apprenti de 245 jours ou moins ont un taux d'infractions de 20 % tandis que ce taux est de 11.9 % pour les autres avec plus de 245 jours comme apprenti. Chez les hommes, la situation est très différente comme les tableaux suivants la démontrent.

Tableau 6.3.5 : Le nombre (les taux) d'hommes avec au moins une infraction et leur âge révolu à l'obtention du permis probatoire

Infractions	Age révolu				Tous
	16	17	18	19	
0	118	225	180	126	648
au moins une	92 (43.8 %)	118 (34.4 %)	84 (31.8 %)	43 (25.4%)	337 (34.2 %)
N du groupe âge	210	343	264	169	986

Le Tableau 6.3.5 ($p<0.001$) indique très clairement que les plus jeunes sont les moins respectueux des règles du CSR, et selon le Tableau 6.3.2 les infractions les plus fréquentes sont la vitesse excessive et le non respect du signe d'arrêt et du feu rouge.

La performance globale pour les examens théoriques indique une petite différence: un taux d'infractions de 32.3 % pour ceux qui ont réussi au premier essai et 37.5 % pour ceux qui ont eu besoin de plus d'un essai ($p<0.10$). La réussite au premier essai de l'examen pratique est une bon prédicteur pour des infractions subséquentes avec un taux de 36.6 % contre 25.1 % ($p<0.01$) pour ceux qui avaient besoin de plus d'un essai pour réussir. Si on regarde conjointement la performance à l'examen théorique et celle à l'examen pratique, on trouve des différences significatives ($p<0.01$) à travers les quatre possibilités (voir Figure 6.3.1).

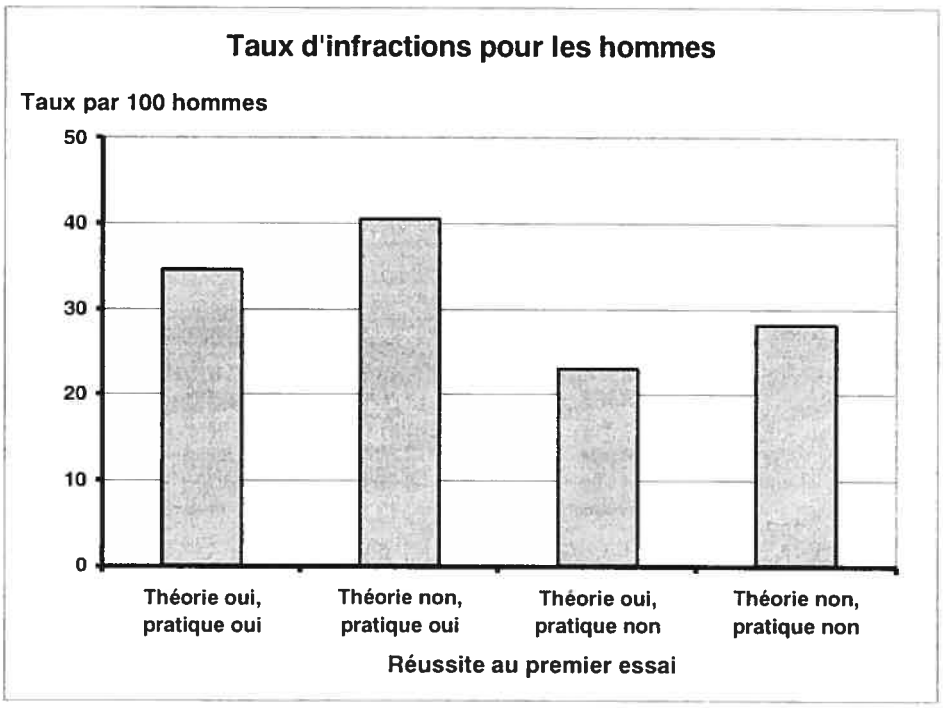

Figure 6.3.1 : Les taux d'infractions par 100 hommes et la performance aux examens

La vitesse d'accès au permis probatoire est aussi un indicateur pour les infractions; plus les hommes sont rapides à l'obtenir le permis probatoire, plus le taux est élevé ($p<0.01$; voir Tableau 6.3.6).

Tableau 6.3.6 : Les nombres (les taux) d'hommes avec permis probatoire ayant eu au moins une infraction selon la durée du permis d'apprenti

Infractions	Durée du permis d'apprenti en jours			Tous
	240 – 245	246 -359	360 et plus	
0	90	316	243	649
au moins une	75 (45.5 %)	157 (33.2 %)	105 (30.2 %)	337 (34.4 %)
N selon durée	165	473	348	986

En regardant la vitesse d'accès au permis probatoire (moins d'un an avec le permis d'apprenti), concentrons-nous sur les personnes ayant pris moins de 12 leçons de 55 minutes. Le taux d'infraction pour les 35 femmes est de 20 %, celui des 68 hommes de 45.6 %, des taux nettement au dessus des taux moyens des femmes (12.7 %) et des hommes (34.2 %).

Une autre série de variables concernent l'exposition au risque: le kilométrage selon le deuxième questionnaire et des proxies comme le nombre d'heures de pratique en dehors de l'école de à la conduite (Q17), l'accès attendu à un véhicule routier (Q34), et être propriétaire d'une automobile fin de l'an 2001.

Tableau 6.3.7 : Taux d'infraction pour 100 personnes selon le kilométrage annuel déclaré pour les femmes et pour les hommes

Sexe	Kilomètres jusqu'au 31 décembre 2001						Total	
	1 - 5000		5001 – 15 000		> 15 000			taux
	n	taux	n	taux	n	taux	n	d'infraction
Femmes	150	7.3	89	10.1	30	23.3	270	10.0
Hommes	87	13.8	83	31.3	54	35.2	224	25.4

Les taux d'infractions par 100 personnes montent avec le kilométrage pour les femmes ($p<0.05$) et les hommes ($p<0.01$). Nous avons mentionné au Chapitre 5 que les répondants au 2e questionnaire, surtout les hommes, semblent être plus 'sages' que les non-répondants; il n'est donc pas surprenant que le taux de 25.4 pour les hommes du Tableau 6.3.7 est inférieur au taux de 34.2 mentionné plus haut pour l'ensemble des 986 hommes de l'échantillon de base.

Tableau 6.3.8 : Taux d'infractions pour 100 personnes selon le nombre d'heures de pratique pour les femmes et pour les hommes avec permis probatoire.

Sexe	Nombre d'heures de pratique (Q17)						Total	
	< 25		25 - 50		> 50			taux
	n	taux	n	taux	n	taux	n	d'infraction
Femmes	320	11.3	268	10.8	177	19.2	765	12.7
Hommes	317	27.4	308	34.1	245	43.7	870	34.4

Chez les femmes et les hommes on trouve le taux le plus élevé chez ceux et celles avec le plus grand nombre d'heures de pratique ce qui va à l'encontre des recommandations que plus d'expérience fait des conducteurs plus sécuritaires. Chez les hommes les taux montent linéairement avec le nombre d'heures de pratique. Cependant on ne tient pas compte de l'exposition au risque dans ce calcul.

Le Tableau 6.3.9 montre que les hommes et les femmes qui s'attendaient d'avoir accès à un véhicule routier souvent ou toujours ont les taux d'infractions les plus élevés.

Tableau 6.3.9 : Taux d'infractions pour 100 personnes selon la fréquence de l'accès attendu à un véhicule routier pour les femmes et pour les hommes

Sexe	Fréquence d'accès attendu (Q34)						Total	
	jamais ou rarement		quelquefois		souvent ou toujours			
	n	taux	n	taux	n	taux	n	taux d'infraction
Femmes	31	3.2%	617	10.0%	161	24.8%	809	12.7%
Hommes	49	14.3%	626	28.4%	293	48.5%	968	33.8%

Un autre substitut pour l'exposition au risque future est le nombre de véhicules à la maison. Le Tableau 6.3.10 montre que les taux d'infractions sont les plus élevés dans les ménages avec le plus grand nombre de véhicules. Ces tableaux ne tiennent pas compte des kilomètres parcourus de ceux et celles avec permis probatoire.

Tableau 6.3.10 : Taux d'infractions selon le nombre de véhicules à la maison pour les femmes et les hommes

Sexe	Nombre de véhicule à la maison						Total	
	0 ou 1		2		3 et plus			
	n	taux	n	taux	n	taux	n	taux d'infraction
Femmes	276	10.9%	373	9.9%	160	22.5%	809	12.7%
Hommes	328	28.7%	426	30.8%	218	47.7%	972	33.8%

Tableau 6.3.11 : Taux d'infractions pour 100 personnes selon la propriété ou non d'un automobile à la fin de l'an 2001 pour les femmes et pour les hommes

Sexe	Propriétaire d'une auto au 31 décembre 2001			
	oui		non	
	n	taux	n	taux
Femmes	167	20.4	651	10.8
Hommes	305	42.0	681	30.7

Les propriétaires ont des taux nettement plus élevés que les non-propriétaires pour les femmes ($p<0.01$) et pour les hommes ($p<0.001$).

Que peut-on dire sur les infractions et la propension à prendre des risques?

Comme la question Q18 porte sur l'attitude envers les règlements de la vitesse et comme la majorité des infractions concernent la vitesse, on recherche s'il y a des relations entre les infractions et Q18. Toutes les sous-questions de Q18 ont été dichotomisées 'en accord' versus en 'désaccord'.

La sous-question Q18g "Les pénalités pour les excès de vitesse devraient être plus sévères" fait un bon prédicteur pour les infractions futures. Le taux d'infractions des femmes étant 'en désaccord' est de 16.7 % versus 10.6 % pour celles étant 'en accord' ($p<0.05$); pour les hommes les taux sont de 37.9 % et de 30.0 % respectivement ($p<0.05$). Si on n'examine que les infractions de vitesse, la différence devient même plus frappante pour les hommes avec des taux de 34.8 % et 25.7 % ($p<0.001$).

La seule autre sous-question reliée directement au taux d'infractions des hommes est Q18a 'Réduire les vitesses sur les autoroutes est une bonne idée' où le taux de ceux 'en désaccord' est de 36.0 % et celui de ceux 'en accord' est de 29.1 % ($p<0.05$).

Une analyse de variance des scores construits avec l'analyse en composantes principales sur les 8 sous-questions de Q18 (plus le score est élevé, plus le nouveau conducteur est en désaccord avec des mesures pénalisantes pour des excès de vitesse) montre des différences significatives pour les facteurs 'sexe' et 'infractions oui ou non'. Rappelons que les grandes valeurs indiquent une propension élevée à prendre des risques. Les moyennes sont de 0.22 pour les personnes avec des infractions et de –0.07 pour celles sans infractions; les moyennes correspondantes pour les femmes sont de 0.06 et de –0.26 et pour les hommes de 0.27 et de 0.14.

Malheureusement, la fraction de variation expliquée dans cette analyse de variance et des analyses semblables sur les autres scores n'expliquent qu'une fraction négligeable (< 5 %) de la variation totale. En conséquence, ces scores ne sont pas de bon prédicteurs pour les infractions.

Il est intéressant de vérifier s'il y a des associations entre les infractions et le style de vie comme la consommation de tabac et d'alcool, et la performance scolaire.

Le Tableau 6.3.12 montre que les femmes et les hommes qui fument ou qui boivent de l'alcool ont des taux d'infraction supérieurs aux taux de celles et ceux qui ne le font pas. On observe que le pourcentage des femmes qui ont fumé durant les deux derniers mois est de 39.5 et de 32.0 pour les hommes. Le pourcentage des femmes qui ont bu une boisson alcoolisée durant les deux derniers mois est de 79.6 et de 80.8 pour les hommes. Il faut se demander si la loi concernant l'âge de 18 ans pour l'achat de cigarettes et de boissons alcoolisées est vraiment appliquée ou si cette consommation se fait à domicile?

Il n'est pas surprenant de voir que les femmes prennent nettement plus de temps pour les travaux scolaires que les hommes. La relation avec les infractions est une de dose-réponse: moins de temps que les personnes dévouent aux travaux scolaires plus leurs taux d'infractions sont élevés. On peut aussi interpréter la variable 'temps pour les travaux scolaires' comme un proxy pour l'exposition future derrière le volant: les personnes qui passent leur temps avec des travaux scolaires conduiront moins que celles et ceux qui ne font qu'un effort minimal pour les travaux scolaires.

Tableau 6.3.12 : Taux d'infractions pour 100 personnes selon quelques variables sur le style de vie pour les femmes et pour les hommes

Question	Femmes		Hommes	
	n	taux	n	taux
Q39: As-tu fumé une cigarette au cours des deux derniers mois?				
Oui	320	19.4	312	41.3
Non	490	8.6	662	19.0
Q44: As-tu bu une boisson alcoolisée au cours de deux derniers mois?				
Oui	632	13.9	784	35.3
Non	162	8.0	186	28.5
Q51: Combien de temps passes-tu chaque jour pour faire tes travaux scolaires à la maison?				
Moins d'une demi-heure	65	21.5	207	39.1
Entre une demi-heure et une heure complète	185	14.6	231	33.3
Une à deux heures	227	11.2	270	30.4
Plus de deux heures	190	8.9	93	16.1

Au Chapitre 2 la variable ' motivation' a été introduite afin de former trois sous-groupes pour les

personnes avec cours qui avaient répondu selon les instructions à la question sur les raisons d'avoir pris un cours. Le Tableau 6.3.13 montre que les personnes avec la motivation mixte ont un taux plus élevé d'infractions que celles avec la motivation apprentissage et celles avec la motivation opportuniste un taux qui est même 2.9 fois plus élevé par rapport à la motivation apprentissage ($p<0.001$).

Tableau 6.3.13 : Taux d'infractions selon la motivation (femmes et hommes ensemble)

Motivation	n	Taux par 100 personnes
apprentissage	374	14.4
mixte	1065	25.6
opportuniste	58	41.4
Total	1497	23.4

La question Q46 porte sur la connaissance d'une victime de la route:'Est-ce qu'un membre de ta famille ou un ami a déjà été blessé dans un accident de la route?' Les taux d'infraction pour celles qui ont répondu 'oui' est de 14.7 (n=374) par 100 conductrices versus 11.1 (n=431) pour les 'non' ($p>0.10$), mais pour les hommes on trouve une différence significative ($p<0.01$) avec des taux de 39.2 (n=390) versus 30.1 (n=582) par 100 conducteurs. Il faut se demander si les personnes ayant répondu 'oui' appartiennent à une culture où l'automobile fait partie active de la vie quotidienne impliquant des infractions, des collisions et les conséquences.

En utilisant les auto-évaluations selon les Tableaux 2.19 et 2.20, on trouve des taux d'infraction élevés pour certains groupes (voir Tableau 6.3.14). Ceux et celle qui ont trouvé que c'est facile d'apprendre à conduire ont un taux d'infractions de 32 par 100 qui est nettement au dessus des deux autres groupes. Ce résultat est plus prononcé chez les femmes. Les individus du groupe 'Pas prudent est bon' ont aussi un taux surélevé de 34.8 par 100 comparé avec les trois autres groupes qui sont dessous de 26 par 100 (plus prononcé chez les hommes).

Tableau 6.3.14 : Taux d'infractions selon les auto-évaluations (femmes et hommes ensemble)

Habilité	Infractions		Taille du groupe
	n	%	
Facile d'apprendre à conduire: Tout à fait vrai	233	32.0	727
Facile d'apprendre à conduire: Assez vrai	195	20.4	957
Facile d'apprendre à conduire: Pas du tout vrai	12	10.8	111
Prudent et bon	183	24.5	746
Prudent et pas bon	75	17.8	421
Pas prudent et bon	62	34.8	178
Pas prudent et pas bon	110	25.9	425

Finalement, il y a 18 personnes avec une infraction chacune avec le permis d'apprenti. De ces 18 personnes 10 (55.6 %) n'avaient aucune infraction subséquente, 3 avaient une et 5 avaient 2; donc un taux d'infraction de 44.4 par 100 personnes (8/18). Rappelons que le taux pour les autres est de 24.2 (433/1786) par 100 personnes. Même si c'est un petit groupe, il contient des individus très peu sécuritaires comme on le verra aussi pour les accidents.

Une autre variable d'intérêt est le lapse de temps entre l'obtention du permis probatoire et la 1ère infraction. Cette variable ne s'applique qu'aux individus avec au moins une infraction durant les premiers 450 jours suivant l'obtention du permis probatoire. La moyenne, pour les femmes et les hommes ensemble, est de 230 jours avec un écart-type de 133 jours. Comme la variance est grande, on ne trouve que peu de facteurs qui différencient les moyennes. Les hommes arrivent plus rapidement à la première infraction avec une moyenne de 221 jours contre 256 jours pour les femmes ($p<0.05$). La moyenne de

ceux et celles du groupe 'bon et pas prudent' est de 183 jours contre 237 jours pour les autres ($p<0.01$). Avoir suivi un cours ou non ne fait aucune différence.

6.4 Le fichier ACCIDENT

Ce fichier contient les variables NUMÉRO, DA (date de l'accident), GR (gravité de l'accident), NT (nombre total de victimes) et 28 autres variables qui décrivent l'accident selon le rapport de police.

Le fichier contient 210 individus avec au moins un accident (maximum = 2) pour un total de 232 accidents. Afin de rendre les données comparables entre les individus, nous avons choisi la période maximale disponible avec le permis probatoire pour tous; elle est 450 jours comme pour les infractions. De plus, nous avons mis de côté les accidents durant la période d'apprentissage; le fichier contient 14 individus (2 femmes et 12 hommes) avec un tel accident chacun. Ce choix réduit le nombre d'individus avec au moins un accident survenu dans la période des premiers 450 jours avec un permis probatoire à 174 pour un total de 185 accidents.

Tableau 6.4.1 : Le nombre d'accidents selon cours ou non pour les femmes et pour les hommes

Sexe et cours	Nombre de personnes avec accidents			
	0	1	2	Total
Femmes avec cours	681 (94.2%)	42	0	723
Femmes sans cours	90 (94.7%)	5	0	95
Femmes total	771 (94.3%)	47	0	818
Hommes avec cours	712 (87.6%)	93	8	813
Hommes sans cours	147 (85.0%)	23	3	173
Hommes total	859 (87.1%)	116	11	986
Grand total	1630 (90.4%)	163	11	1804

Il n'y a aucune femme avec plus d'un accident, leur taux est de 0.057, et les hommes ont un taux d'accidents de 0.140, plus que le double du taux des femmes. Comme le nombre de personnes avec plus d'un accident est petit, nous traiterons cette variable de façon dichotomisée par la suite – aucun accident versus au moins un accident. Le taux d'accidents par 100 femmes est donc de 5.7% (47/818) et celui des hommes de 12.9% (127/986).

Il n'y a aucune différence des taux selon cours ou non, 5.8 % versus 5.3 % chez les femmes et 12.4 % versus 15.0 % chez les hommes. Comme il n'y a pas de différence selon la variable cours ou non, on examinera d'autres variables qui pourraient caractériser les individus avec accidents.

Regardons d'abord des variables facilement disponibles comme l'âge révolu à l'obtention du permis probatoire, les performances aux examens et la durée du permis d'apprenti.

Il n'y a pas de différences significatives d'accidents selon l'âge révolu, ni chez les femmes ni chez les hommes.

Chez les femmes, il n'y a pas d'association entre les taux d'accidents et la réussite au 1er essai de l'examen théorique, mais une tendance ($p<0.10$) pour l'examen pratique: 4.9 % pour celles ayant réussi au premier essai et 8.6 % pour celles avec plus d'un essai. Chez les hommes, la même constatation tient pour l'examen théorique comme chez les femmes. Pour l'examen pratique, on trouve l'inverse ($p<0.10$): 13.9 % pour ceux ayant réussi au 1er essai et 9.0 % pour ceux avec plus d'un essai. Le pattern pour les taux d'accidents selon les deux examens est semblable à celui pour les infractions avec $p<0.10$ (voir Figure 6.4.1).

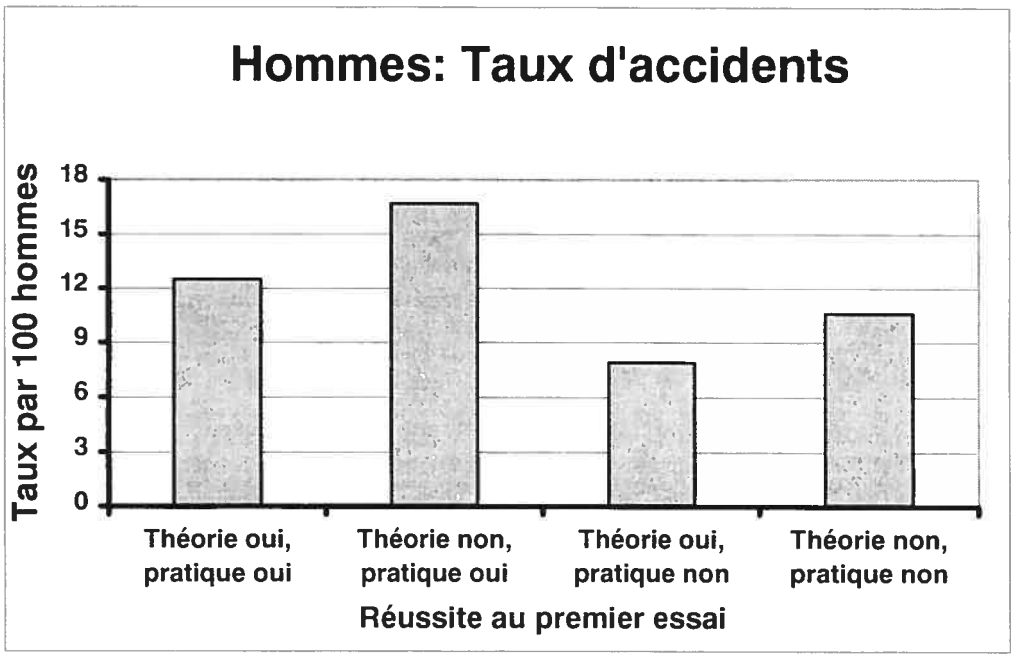

Figure 6.4.1 : Les taux d'accidents par 100 hommes et la performance aux examens

Si on considère la rapidité d'accès au permis, donc la durée du permis d'apprenti, on ne trouve aucune différence des taux d'accidents, ni chez les femmes ni chez les hommes. Mais si on considère les personnes ayant pris moins de 12 leçons de 55 minutes mais avec moins d'un an avec le permis d'apprenti, le taux d'accidents pour les 35 femmes est de 8.6 %, celui des 68 hommes de 19.1 %, des taux nettement au dessus du taux moyen des femmes (5.7 %) et des hommes (12.9 %).

Une autre série de variables concerne l'exposition au risque: le kilométrage selon le deuxième questionnaire et des proxies pour l'exposition future comme le nombre d'heures de pratique en dehors de l'école de conduite (Q17), l'accès attendu à un véhicule routier (Q34), propriétaire d'une automobile à la fin de l'an 2001.

Tableau 6.4.2 : Taux d'accidents pour 100 personnes selon le kilométrage pour les femmes et pour les hommes

Sexe	Kilomètres jusqu'au 31 décembre 2001						Total	
	1 - 5000		5001 – 15 000		> 15 000			
	n	taux	n	taux	n	taux	n	taux
Femmes	150	5.3	89	5.6	30	6.7	269	5.6
Hommes	87	2.3	83	12.0	54	18.5	224	9.8

Les taux d'accidents par 100 personnes montent avec le kilométrage pour les hommes ($p<0.05$), mais pas pour les femmes. Nous avons mentionné au Chapitre 5 que les répondants au deuxième questionnaire, surtout les hommes, semblent être plus 'sages' que les non-répondants; il n'est donc pas surprenant que le taux de 9.8 pour les hommes du Tableau 6.4.2 est inférieur au taux de 12.9 mentionné plus haut.

Tableau 6.4.3 : Taux d'accidents pour 100 personnes selon le nombre d'heures de pratique pour les femmes et pour les hommes

Sexe	Nombre d'heures de pratique (Q17)						Total	
	< 25		25 - 50		> 50			
	n	taux	n	taux	n	taux	n	taux
Femmes	320	3.8	268	6.0	177	10.2	765	6.0
Hommes	317	8.5	308	13.6	245	15.9	870	12.4

Les taux montent clairement avec le nombre d'heures de pratique ce qui contredit la recommandation très répandue que plus d'expérience fait des conducteurs plus sécuritaires.

Tableau 6.4.4 : Taux d'accidents pour 100 personnes selon la fréquence de l'accès attendu à un véhicule routier pour les femmes et pour les hommes

Sexe	Fréquence d'accès attendu (Q34)						Total	
	jamais ou rarement		quelquefois		souvent ou toujours			
	n	taux	n	taux	n	taux	n	taux
Femmes	31	0.0 %	617	5.0 %	161	9.9 %	809	5.8 %
Hommes	49	12.2 %	626	9.9 %	293	18.4 %	968	12.6 %

Les hommes et les femmes qui s'attendaient d'avoir accès à un véhicule routier souvent ou toujours ont les taux d'accidents les plus élevés.

Un autre proxy pour l'exposition au risque future est le nombre de véhicules à la maison. Le Tableau 6.4.5 montre que les taux d'accidents sont les plus bas dans les ménages avec le plus petit nombre de véhicules, et chez les hommes le taux le plus élevé se trouve dans les ménages avec 3 véhicules et plus.

Tableau 6.4.5 : Taux d'accidents pour 100 personnes selon le nombre de véhicules à la maison pour les femmes et pour les hommes

Sexe	Nombre de véhicules à la maison (Q33)						Total	
	0 ou 1		2		3 et plus			
	n	taux	n	taux	n	taux	n	taux
Femmes	276	4.3 %	373	6.4 %	160	6.3 %	809	5.7 %
Hommes	328	11.0 %	426	12.7 %	218	16.1 %	972	12.9 %

Tableau 6.4.6 : Taux d'accidents pour 100 personnes selon la propriété ou non d'un automobile à la fin de l'an 2001 pour les femmes et pour les hommes

Sexe	Propriétaire d'une auto au 31 décembre 2001			
	oui		non	
	n	taux	n	taux
Femmes	167	9.0	651	4.9
Hommes	305	13.4	681	12.6

Les propriétaires féminins ont des taux plus élevés que les non-propriétaires (9% versus 4.9 %; $p<0.05$), mais il n'y pas de différence des taux d'accidents chez les hommes selon propriétaire ou non; mais le taux reste élevé à 12.6 % pour les non-propriétaires.

Il est intéressant de constater des associations entre les accidents et le style de vie comme la consommation de tabac et d'alcool, et la performance scolaire.

Le Tableau 6.4.7 montre que chez les femmes il n'y a pas d'association prononcée entre les taux

d'accidents et le style de vie. Chez les hommes qui fument le taux d'accidents est supérieur au taux de ceux qui ne le font pas ($p < 0.05$). On observe que le pourcentage des femmes qui ont fumé durant les deux derniers mois est de 39.5 et de 32.0 pour les hommes. Le pourcentage des femmes qui ont bu une boisson alcoolisée durant les deux derniers mois est de 79.6 et de 80.8 pour les hommes.

Tableau 6.4.7 : Taux d'accidents pour 100 personnes selon quelques variables sur le style de vie pour les femmes et pour les hommes

Question	Femmes		Hommes	
	n	taux	n	taux
Q39: As-tu fumé une cigarette au cours des deux derniers mois?				
Oui	320	5.0	312	15.4
Non	490	6.3	662	11.6
Q44: As-tu bu une boisson alcoolisée au cours de deux derniers mois?				
Oui	632	5.9	784	13.0
Non	162	4.9	186	11.8
Q51: Combien de temps passes-tu chaque jour pour faire tes travaux scolaires à la maison?				
Moins d'une demi-heure	65	7.7	207	11.6
Entre une demi-heure et une heure complète	185	5.4	231	16.5
Une à deux heures	277	7.9	270	9.6
Plus de deux heures	190	2.6	93	5.4

Il n'est pas surprenant de voir que les femmes prennent nettement plus de temps pour les travaux scolaires que les hommes. Il n'y a pas de relations fortes avec les accidents pour les femmes, mais celle pour les hommes montre des différences ($p<0.05$): Les hommes passant une heure ou moins pour les travaux scolaires ont des taux d'accidents supérieurs aux taux de ceux qui passent plus d'une heure. On peut aussi interpréter la variable 'temps pour les travaux scolaires' comme un proxy pour l'exposition future derrière le volant: les personnes qui passent leur temps avec des travaux scolaires conduiront moins que celles et ceux qui ne font qu'un effort minimal pour les travaux scolaires.

Au Chapitre 2 la variable 'Motif" a été introduite afin de former trois sous-groupes pour les personnes avec cours qui avaient répondu selon les instructions à la question sur les raisons d'avoir pris un cours. Le Tableau 6.4.8 montre que les personnes avec la motivation mixte ont un taux plus élevé que celles avec la motivation apprentissage et celles avec la motivation opportuniste un taux qui est même 2.5 fois plus élevé par rapport à la motivation apprentissage ($p<0.05$).

Tableau 6.4.8 : Taux d'accidents selon la motivation (femmes et hommes ensemble)

Motivation	n	Taux par 100 personnes
apprentissage	374	5.6
mixte	1065	10.2
opportuniste	58	13.8
Total	1497	9.2

En utilisant les auto-évaluations selon le groupement du Tableau 3.20, on trouve un taux d'accidents de 17 % pour le groupe "bon et pas prudent', mais des taux en dessous de 10 % pour les autres groupes.

La question Q46 porte sur la connaissance d'une victime de la route:'Est-ce qu'un membre de ta famille

ou un ami a déjà été blessé dans un accident de la route?' Les taux d'accidents pour celles qui ont répondu 'oui' est de 7.0 (n=374) par 100 conductrices versus 4.9 (n=431) pour les 'non', et pour les hommes on trouve des taux de14.9 (n=390) pour les 'oui' versus 11.3 (n=582) pour les 'non' par 100 conducteurs. Même si ces différences ne sont pas significatives (p>0.10), elles vont dans la même direction comme pour les infractions. Il faut se demander si les personnes ayant répondu 'oui' appartiennent à une culture où l'automobile fait partie active de la vie quotidienne impliquant des infractions, des collisions et les conséquences.

Finalement, on examinera des relations entre les infractions et les accidents. Le Tableau 6.4.9 montre que les femmes et les hommes avec au moins une infraction durant les 450 jours suivant l'obtention du permis probatoire ont des taux d'accidents durant la même période qui sont plus élevés que les taux de ceux et celles sans infraction (p<0.001).

Le Tableau 6.4.9 montre donc que la propension à prendre des risques, mesurée par les infractions, est associée aux collisions.
Tableau 6.4.9 : Le nombre et le taux d'accidents par 100 personnes selon le nombre d'infractions pour les 818 femmes et les 986 hommes durant les 450 jours suivant l'obtention du permis probatoire

	Femmes (n=818) Accidents			Hommes (n=986) Accidents		
Infractions	0	1	Ensemble	0	1 ou 2	Ensemble
0	681	33 (4.6 %)	714	584	65 (10.0 %)	649
1 ou plus	90	14 (13.5 %)	104	275	62 (18.4 %)	337

Les tests psychométriques montrent des associations faibles avec les accidents. Spécifiquement la moyenne de la variable Indice (voir Chapitre 4) est significativement plus élevée pour les hommes avec au moins un accident (2.48) que pour ceux sans accidents (0.97). Chez les femmes les moyennes vont dans la même direction (- 0.097 versus – 1.00), mais ne sont pas significativement différents. En effet, des analyses de variances sur les scores selon des facteurs à risque ne sont pas performantes car les facteurs n'expliquent qu'une petite fraction (< 5%) de la variation totale.

Les auto-évaluations sous forme de la question Q4 donnent des résultats plus intéressants (voir Tableau 6.4.10). Ceux et celles qui ont trouvé que c'est facile d'apprendre à conduire ont un taux d'accidents de 12.2 % qui est nettement au dessus des deux autres groupes. Ce résultat est plus prononcé chez les hommes. Les individus du groupe 'Pas prudent et bon' ont aussi un taux surélevé de 16.9 % comparé avec les trois autres groupes qui ont des taux entre 7.4 et 10.1 % (plus prononcé chez les hommes).

Tableau 6.4.10 : Taux d'accidents selon les auto-évaluations (femmes et hommes ensemble)

Habilité	Accidents n	Accidents %	Taille du groupe
Facile d'apprendre à conduire: Tout à fait vrai	89	12.2	727
Facile d'apprendre à conduire: Assez vrai	79	8.3	957
Facile d'apprendre à conduire: Pas du tout vrai	6	5.4	111
Prudent et bon	67	9.0	746
Prudent et pas bon	31	7.4	421
Pas prudent et bon	30	16.9	178
Pas prudent et pas bon	43	10.1	425

Il y a donc des nouveaux conducteurs, plus chez les hommes que chez les femmes, qui semblent être surconfiants (facile à apprendre de conduire et bon conducteur), mais qui réalisent qu'ils ne sont pas

prudents avec le résultats qu'ils ont trop d'accidents.

Une autre variable d'intérêt est le lapse de temps entre obtention du permis probatoire et le premier accident. Cette variable ne s'applique qu'aux individus avec au moins un accident durant les premiers 450 jours suivant l'obtention du permis probatoire. La moyenne pour les femmes est de 231 jours avec un écart-type de 136 jours; pour les hommes la moyenne est de 173 jours avec un écart-type de 135 jours. Comme la variance est grande et le nombre d'individus avec des accidents est petit, nous n'avons pas trouvé de facteurs qui différencient les moyennes.

En terme d'interventions potentielles, on peut aussi se demander si le dossier de conduite comme apprenti prédit le dossier avec le permis probatoire? Il y a 18 personnes avec des infractions (une femme et 17 hommes) et 14 avec un accident (2 femmes et 12 hommes) avec leur permis d'apprenti.

Les 17 hommes avec une infraction comme apprenti ont eu 5 accidents par la suite, un taux de 29.4% (5/17); le taux global des hommes de notre échantillon est 12.6 %.

Parmi les 14 personnes avec un accident comme apprenti, on trouve par la suite 4 avec une infraction et 4 avec deux infractions, un taux de 57.1 par 100 personnes (8/14); le taux global est de 24.2 par 100 personnes.

Les 14 personnes avec un accident comme apprenti ont eu 4 accidents par la suite, un taux de 28.6% (4/14).

En mettant ensemble toutes les personnes avec un dossier non vierge comme apprenti, on y trouve 29 personnes (3 femmes et 36 hommes) dont trois hommes avec une infraction et un accident. Durant les 450 jours suivant l'obtention du permis probatoire, il n'y a que 12 dossiers vierges (2 femmes et 10 hommes), donc seulement 41.4 % de ces personnes sans infractions et sans accident. On y trouve 4 hommes avec 2 infractions et une collision, un homme avec une infraction et un accident, les autres soit avec des infractions (1 ou 2), soit avec un accident.

Il est évident que le dossier de l'apprenti qui n'est pas vierge prédit des problèmes après l'obtention du permis probatoire. Étant donné les petits effectifs et l'absence de publications à ce sujet, il serait bon de vérifier avec d'autres effectifs et noter si cette tendance se répète.

6.5 Le fichier REVOSUSP

Ce fichier contient 63 suspensions de durée 0 jours pour des amendes non payées, 163 suspensions de 3 mois pour 'accumulation de points d'inaptitude en période probatoire', dont 8 avec une 2e concurrente, une personne avec suspension de 12 mois pour 'infraction au Code criminel reliée à l'alcool' et de façon concurrente 12 mois par 'Interdiction de conduire imposée par un juge', et 4 individus avec une suspension de 15 jours et 5 individus avec deux suspensions de 15 jours par 'Suspension administrative pour alcool (>0 pour le permis d'apprenti et le permis probatoire)'. On arrive donc à un total de 236 personnes avec des suspensions dont 3 personnes ayant été suspendues avant le permis probatoire.

Étant donnée la fermeture de nos fichiers en date du 31 décembre 2001 et les délais entre la date de commission et la date de condamnation d'une infraction, le fichier REVOSUSP n'est pas utilisable pour des analyses valables car trop de suspensions méritées ne s'y trouvent pas encore (voir les remarques au début de la section 6.3).

CHAPITRE 7

QUELQUES MODÈLES

Dans le chapitre précédant, plusieurs variables ont été trouvées qui sont associées aux taux d'infractions et aux taux d'accidents. Dans ce chapitre nous présenterons quelques modèles logistiques pour l'événement 'au moins une infraction' contre 'aucune' et pour l'événement 'au moins un accident' contre 'aucun' durant les premiers 450 jours avec le permis probatoire.

Les résultats du Chapitre 3 et plusieurs tentatives de modélisation ont montré que les variables sur la propension de prendre des risques, issues de la deuxième partie du premier questionnaire, sont fortement associées aux variables de la première partie sur l'apprentissage de la conduite, c.-à.-d. dans les modèles pour les infractions ou les accidents les variables de la partie sur l'apprentissage sont en compétition avec les variables sur la propension à prendre des risques. En d'autres mots, les variables de la première partie du premier questionnaire peuvent jouer un rôle de substitut pour la propension à prendre des risques.

Pour tous ces modèles le pouvoir explicatif est faible, c.-à.-d. le modèle n'absorbe qu'une petite partie de la log-vraisemblance. Nous ne présenterons donc qu'une petite sélection de modèles.

7.1 Modèles pour les infractions

Un premier modèle n'utilise pas les questions de la deuxième partie du premier questionnaire (mesures sur la propension à prendre des risques). Le Tableau 7.1.1 montre qu'il n'y a que peu de facteurs explicatifs pour les infractions. Le facteur avec le rapport des cotes (RC) le plus élevé, pour les femmes et pour les hommes, est de prévoir d'acheter une auto. Ce résultat concorde avec les taux d'infractions selon la propriété d'un véhicule en 2001: les propriétaires ont des taux qui sont plus que le double des taux des non-propriétaires (Tableau 6.3.11). L'autre facteur significatif pour les femmes et les hommes est 'prévoir l'auto pour travailler'.

Pour les femmes, il y a un facteur protecteur sous forme des parents comme accompagnateurs. Chez les hommes, on trouve les facteurs suivants qui font augmenter les risques: la confiance dans la circulation 'très confiant sur bicyclette'; plus de 50 heures de pratique (taux de 43.9 %), et la performance aux examens 'réussite de l'examen pratique au premier essai, mais réussite de l'examen théorique après plus d'un essai' (taux de 40.8 %). Enfin, ceux avec la performance 'réussite de l'examen théorique au premier essai, mais réussite de l'examen pratique après plus d'un essai' ont un risque diminué de 23.6 %; le risque pour le groupe 'réussite de tous les examens au premier essai' est de 35.3 %. Ces résultats correspondent aux tableaux dans la section 6.3.

Tableau 7.1.1 : Estimation des rapports des cotes (RC) pour l'événement d'infractions durant les premiers 450 jours avec un permis probatoire avec des modèles de régression logistique pour les femmes et les hommes

Variable explicative	Femmes			Hommes		
	RC	IC 95%	Taux (%)	RC	IC 95%	Taux (%)
Âge: 16 – 17	1.08	0.85 - 1.38	12.5	1.24*	1.05 - 1.46	38.1
18 – 19	Groupe de référence		12.8	Groupe de référence		30.0
Confiance sur bicyclette						
très confiant	0.99	0.77 - 1.27	13.0	1.30*	1.04 - 1.62	37.0
peu ou pas confiant	Groupe de référence		11.8	Groupe de référence		23.4
Facile d'apprendre conduire						
tout à fait vrai	1.54✞	1.22 - 1.94	20.6	1.01	0.86 - 1.18	37.7
assez ou pas du tout vrai	Groupe de référence		9.5	Groupe de référence		31.6
Préparation pour les examens						
sans cours	Groupe de référence		15.5	Groupe de référence		32.9
cours pratique seulement	0.95	0.64 - 1.40	12.6	1.02	0.80 - 1.29	34.6
cours théorie et pratique	1.06	0.75 - 1.50	12.2	1.05	0.85 - 1.30	35.3
Heures de pratique						
moins de 25	0.80	0.57 - 1.11	10.6	0.71**	0.57 - 0.89	27.8
25 - 50	0.82	0.59 - 1.14	11.0	0.98	0.79 - 1.21	34.3
plus de 50	Reference group		18.8	Reference group		43.9
Accompagnateurs						
principalement parents	0.78 *	0.61 - 0.99	9.5	0.97	0.83 - 1.14	33.9
parents et amis	Groupe de référence		15.2	Groupe de référence		35.3
Prévoit acheter une auto						
oui	1.43**	1.13 - 1.80	20.2	1.48 ✞	1.27 - 1.73	44.0
pas mentionné	Groupe de référence		8.9	Groupe de référence		26.0
Prévoit l'auto pour travailler						
oui	1.38**	1.08 - 1.75	16.6	1.18*	1.01 - 1.38	38.3
pas mentionné	Groupe de référence		8.8	Groupe de référence		30.1
Réussite 1er essai (examens)						
théorie et pratique	Groupe de référence		15.6	Groupe de référence		35.3
théorie, pas pratique	1.00	0.61 - 1.64	12.3	0.62*	0.42 - 0.92	23.6
pas théorie, pratique	1.17	0.76 - 1.80	15.8	1.47**	1.10 - 1.95	40.8
ni théorie ni pratique	0.95	0.48 - 1.87	11.1	1.00	0.62 - 1.48	28.6

* $p<0.05$ ** $p<0.01$ ✞$p<0.001$

Les modèles qui n'utilisent que les scores construits via les analyses en composantes principales sur les questions Q18 à Q26 ne révèlent rien d'intéressant.

Voici un modèle pour les femmes et les hommes ensemble. Les facteurs suivants sont associés ($p<0.01$) à des risques d'infractions plus élevés avec les rapports des cotes:

Hommes versus femmes	1.72
Accès attendu à un véhicule: souvent/toujours versus quelquefois/rarement/jamais	1.59
Heures de pratique: plus de 50 versus moins de 25	1.39
Vitesse d'accès au permis probatoire: 240-245 jours versus plus de 360 jours	1.35
Propriétaire d'une auto en 2001: oui versus non	1.30
Index de propension à prendre des risques: par unité additionnelle ,	1.04
et donc par unité moindre (1/1.04)	0.96

Les variables âge (16/17 versus 18/19 et 'bon et pas prudent' versus les autres n'entrent pas dans le modèle. Ce modèle confirme les facteurs déjà vus dans la section 6.3.

7.2 Modèles pour les accidents

Un premier modèle n'utilise pas les questions de la deuxième partie du premier questionnaire (mesures sur la propension à prendre des risques).

Deux facteurs sont significatifs pour les femmes et les hommes (Tableau 7.2.1):

(i) Les personnes avec moins de 25 heures de pratiques, en dehors du cours de conduite pour les personnes avec cours, ont moins d'accidents que celles avec plus de 50 heures. Ce résultat semble aller à l'encontre des pratiques exigées dans plusieurs juridictions aux États-unis. Cependant, il ne faut pas oublier que les heures de pratiques sont un prédicteur pour l'exposition au risque future.

(ii) Les personnes avec au moins deux infractions ont des taux d'accidents extrêmement élevés par rapport à celles avec aucune infraction, même par rapport à celles sans infractions.

Chez les femmes où les parents paieront pour les réparations du véhicule il n'y a que très peu d'accidents; les femmes qui utilisent la voiture parentale sont donc prudentes. Les hommes avec de l'expérience sur une mobylette ou une motocyclette ont des taux d'accidents élevés. De plus, ceux qui avaient besoin de plus d'un essai afin de réussir les examens théoriques, mais qui avaient réussi l'examen pratique au premier essai, ont un rapport de cotes de 1.50 par rapport à ceux qui avaient réussi les deux examens sans reprise.

Tableau 7.2.1 : Estimation des rapports de cotes (RC) pour l'événement d'accidents durant les premiers 450 jours avec un permis probatoire avec des modèles de régression logistique pour les femmes et les hommes

Variable explicative	Femmes (n=730)			Hommes (n=836)		
	RC	IC 95%	Taux (%)	RC	IC 95%	Taux (%)
Âge: 16 – 17	1.29	0.92-1.81	7.2	0.96	0.77-1.20	12.2
18 – 19	Groupe de référence		5.2	Groupe de référence		12.7
Expérience sur motocyclette:						
oui	0.88	0.57-1.40	6.3	1.43✞	1.15-1.77	20.0
non	Groupe de référence		6.3	Groupe de référence		9.1
Préparation des examens:						
sans cours	Groupe de référence		6.0	Groupe de référence		14.7
cours pratique	1.09	0.63-1.91	6.0	1.03	0.75-1.43	13.3
cours théorie et pratique	1.19	0.73-1.94	6.5	0.93	0.69-1.26	11.3
Heures de pratique:						
< 25	0.61*	0.38-0.98	4.0	0.69*	0.50-0.96	8.5
25 – 50	1.08	0.70-1.69	6.2	1.22	0.91-1.64	14.0
> 50	Groupe de référence		10.3	Groupe de référence		15.5
Accompagnateurs:						
principalement parents	0.99	0.71-1.36	5.8	0.87	0.70-1.09	10.8
parents et amis	Groupe de référence		6.7	Groupe de référence		13.7
Qui paiera pour réparations:						
parents	0.50**	0.32-0.78	2.3	0.87	0.67-1.13	9.7
moi ou avec parents	Groupe de référence		8.5	Groupe de référence		13.4
Infractions:						
aucune	Groupe de référence		5.1	Groupe de référence		9.6
une	0.80	0.41-1.55	11.6	0.89	0.64-1.24	14.0
deux ou plus	3.63**	1.42-9.31	36.4	1.64**	1.14-2.36	25.8
Réussite 1er essai (examens):						
théorie et pratique	Groupe de référence		4.7	Groupe de référence		11.2
théorie, pas pratique	1.45	0.80-2.62	9.2	0.74	0.42-1.30	8.3
pas théorie, pratique	1.01	0.57-1.80	7.4	1.50*	1.02-2.20	17.3
ni théorie ni pratique	1.18	0.51-2.75	8.7	0.89	0.48-1.65	11.3

* $p<0.05$ ** $p<0.01$ ✞$p<0.001$

Voici un modèle pour les femmes et les hommes ensemble. Les facteurs suivants sont associés ($p<0.01$) à des risques d'accidents plus élevé avec les rapports de cotes:

Hommes versus femmes	1.34
Heures de pratique: plus de 50 versus moins de 25	1.50
Performances aux examens:	
Pratique au premier essai et théorie avec reprise(s) versus aucun échec	1.39
Index de propension à prendre des risques:	
par unité additionnelle ,	1.055
et donc par unité moindre (1/1.055)	0.948

Les variables 'facile d'apprendre à conduire', 'bon/pas bon et prudent/pas prudent' et 'fumé dans les deux derniers mois' n'entrent pas dans le modèle. Ce modèle confirme les facteurs déjà vus dans la section 6.4.

Le fait qu'on n'a pas trouvé de très bons modèles ne surprend pas trop. Il y a beaucoup de variations parmi les nouveaux conducteurs, c'est un groupe hétérogène, et des événements comme une infraction observée par un policier et des accidents avec un rapport de police sont relativement rares. En effet, les statistiques officielles ne montrent qu'une fraction des infractions commises et des accidents. Malgré ces constatations, le Chapitre 6 a démontré qu'on peut décrire des groupes à risque élevé.

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CHAPITRE 8

DISCUSSION ET CONCLUSIONS

Rappelons les résultats selon les objectifs du projet énoncés au chapitre 1.

Les taux des nouveaux conducteurs avec au moins un accidents durant les premiers 450 jours suivant l'obtention du permis probatoire ne diffèrent pas selon qu'ils ont pris un cours ou non; ce résultat tient pour les femmes et pour les hommes. Le taux d'accidents des hommes (12.9 par 100) est plus que le double de celui des femmes (5.7 par 100).

Les taux des nouveaux conducteurs avec au moins une infraction durant les premiers 450 jours suivant l'obtention du permis probatoire ne diffèrent pas selon qu'ils ont pris un cours ou non; ce résultat tient pour les femmes et pour les hommes. Le taux d'infractions des hommes est de 34.2 par 100, celui des femmes de 12.7 par 100.

Pour les mesures psychométriques, les questions Q18 à Q26, il n'y a pas de différences selon la prise ou non d'un cours de conduite, aussi bien chez les femmes que chez les hommes.

La variable Indice, une mesure de la propension à prendre des risques, construite en utilisant des analyses en composantes principales, ne montre pas de différence significative des moyennes selon la prise ou non d'un cours de conduite; les moyennes (écart-type) sont de –0.014 (4.256) pour ceux et celles avec cours et de +0.082 (4.274) pour ceux et celles sans cours.

Comme il n'y a pas de différence entre les taux d'accidents selon cours ou non, et qu'il n'y a pas de différence entre les mesures de la propension à prendre des risques, le dernier objectif tel que formulé (voir chapitre 1) devient caduc. Cependant, nous avons pu établir d'autres groupes de nouveaux conducteurs avec des taux d'accidents différents. Ces groupes sont aussi caractérisés par des propensions à la prise de risques différentes; les groupes avec des taux d'accidents plus élevés ont aussi une propension à prendre des risques plus élevée. Nous y reviendrons plus loin.

On peut conclure que les personnes qui prennent un cours ne sont pas fondamentalement différentes de celles qui n'en prennent pas: Il n'y a pas de différence des taux d'accidents et pas de différences dans les mesures de propension à prendre des risques (infractions et mesures psychométriques). Les cours ne produisent donc pas de nouveaux conducteurs et conductrices plus sécuritaires que l'apprentissage sans cours, donc avec des parents ou des amis (Tableau 6.4.1).

Les cours donnent cependant le bénéfice de mieux préparer les candidats à réussir les examens (théorique et pratique); mais ce bénéfice est associé au danger de laisser conduire ces personnes sans accompagnateurs à un âge plus jeunes (5 mois en moyenne) que celles sans cours.

Les deux paragraphes précédents correspondent exactement aux citations du Chapitre 1 tirées de Lourens (1992), Brown (1989), Mayhew et al. (1998) et Williams & Ferguson (2004).

Voici le résumé selon les exigences spécifiques:

Les heures d'apprentissage

selon cours: 75% des femmes et des hommes ont pris un cours standard de 12 leçons (voir Tableau 2.6);

en dehors d'un cours: Les apprentis sans cours ont pratiqué plus que ceux avec cours (voir Tableau 2.7).

Il faut prendre note que 35 femmes sur 503 qui avaient obtenu le permis probatoire en moins de 360 jours avec le permis d'apprenti avaient pris moins de 12 leçons de cours; parmi les hommes

on trouve 68 sur 631 dans cette situation.

L'exposition au risque (selon le deuxième questionnaire avec 503 répondants)

Les nouveaux conducteurs parcourent relativement peu de kilomètres durant la première année; 56.1% des femmes et 38.8% des hommes font moins de 5 000 kms, et seulement 11.1 % des femmes et 24.1 % des hommes font plus de 15 000 kms (voir Tableau 5.2.7).

Le plus grand nombre de personnes fait des déplacements tous les jours et ce groupe effectue aussi le plus de kilomètres (voir Tableau 5.2.10). Les personnes qui conduisent majoritairement seulement le jour ou seulement le soir font moins de kilomètres que les individus qui conduisent en tout temps; ces derniers constituent plus de 64% des répondants (voir Tableau 5.2.11).

Le véhicule utilisé

Le nombre de propriétaires monte de 269 (14.9%) en 2000 à 472 (26.2%) en 2001.

En 2001, chez les femmes, il n'y a aucune différence quant au statut de propriétaire selon cours (20.5%) ou non (20.0%). En 2001, chez les hommes on trouve pour ceux avec cours 29.5% de propriétaires et 37.6% chez ceux sans cours.

Selon le deuxième questionnaire, 44 sur 272 femmes et 67 sur 222 hommes ont payé pour l'achat du véhicule conduit le plus souvent; pour les autres c'est principalement la famille et dans une mesure moindre les nouveaux et la famille qui ont payé. En comparant les réponses des deux questionnaire, on observe que les femmes et les hommes étaient trop optimistes quant à la capacité de payer eux-mêmes (voir les tableaux 5.16 et 5.17).

Le statut personnel et familial

La grande majorité (70%) habite avec leurs deux parents, même plus si on considère des secondes unions. Seulement 3.1% des femmes et 6.6% des hommes vivent seul.

Comme les répondants habitent principalement en banlieue (52 % des femmes et 48 % des hommes), il n'est pas surprenant de voir que 66% des femmes et des hommes habitent dans des ménages avec deux voitures ou plus. Pour les 16 ans, on trouve même 78% dans des ménages avec deux voitures ou plus, ce pourcentage tombe à 52% pour les personnes de 19 ans. Il n'y a pas de différence selon la prise ou non d'un cours de conduite.

La plupart des répondants sont inscrits à l'école (89.4% des femmes, 83.0% des hommes). Ces pourcentages sont les plus élevés à 16 ans (97.5 % pour les femmes et 94.8 % pour les hommes); ils diminuent pour les 19 ans à 77.2% pour les femmes et 69.2 % pour les hommes. Il y a une différence selon cours de conduite (87.1 %) ou non (79.0 %) ce qui ne surprend pas étant donné que les 16 ans ont dû prendre un cours.

Il y a un pourcentage élevé des nouveaux conducteurs qui travaillent ou cherchent du travail à temps partiel: 75.9% des femmes et 70.0% des hommes; ces pourcentages diminuent avec l'âge. Il n'y a pas de différence ($p > .05$) selon cours (73.5%) ou non (67.8%).

Les pourcentages des nouveaux conducteurs qui travaillent ou cherchent du travail à temps plein sont de 25.0% pour les femmes et de 38.6% pour les hommes; ces pourcentages augmentent avec l'âge. Il y a une différence ($p < .001$) selon cours (30.7%) ou non (42.9%).

Les participants ont des parents bien éduqués: 43.5% des femmes et 39.3% des hommes ont au moins un parent avec une éducation universitaire. Il n'y a pas de différence selon cours ou non; ni chez les femmes ni chez les hommes.

Paiements des cours, des permis et des assurances

Presque la moitié des hommes paient les frais du cours eux-mêmes; chez les femmes 37.5% paient les frais du cours elles-mêmes. Pour les permis les pourcentages des personnes qui paient elles-mêmes sont de 60 % pour les hommes et de 50 % pour les femmes. Les femmes

obtiennent significativement (p<.001) plus de support financier de leurs familles que les hommes.

Motifs pour prendre un cours ou non

Motifs pour: Les raisons principales pour avoir pris un cours sont la préparation pour l'examen pratique, le désir d'apprendre à conduire, l'incitatif des 4 mois de réduction de la période d'apprentissage et l'économie sur les primes d'assurance. En effet, le regroupement de ces motifs fait sortir un petit groupe appelé 'opportuniste' (54/1289 personnes dont 47 hommes) avec des taux d'accidents et d'infractions plus élevés que les autres.

Motifs contre: Les raisons principales pour ne pas avoir pris un cours sont les coûts du cours de conduite, la disponibilité d'un parent ou d'un ami pour l'enseignement (implique aussi la disponibilité d'une voiture) et de ne pas être pressé pour obtenir le permis.

Opinions sur les cours

Les nouveaux conducteurs pensent que le cours les a bien préparé pour passer l'examen de la SAAQ et pour être un conducteur sécuritaire, et qu'un cours devrait être suivi par tous les nouveaux conducteurs (pourcentage 'en accord' de 88 à 95). Il n'y a pas de surprise étant donné qu'ils viennent de réussir l'examen pratique!

Concernant un cours de perfectionnement à tous les dix ans pour tous les conducteurs, seulement 49 % des femmes et 40 % des hommes sont 'en accord' et 18 % des femmes et 28 % des hommes sont 'en désaccord' (différence significative entre les femmes et les hommes).

Opinions sur l'examen pratique

La question S2 a demandé les opinions sur l'examen sur route de la SAAQ. Les femmes et les hommes pensent que l'examen devrait durer au moins une heure; 31.6 % des femmes et 38.2 % des hommes sont 'fortement ou modérément en accord' avec cette proposition. Quant à des exigences plus sévères, on trouve que 45.3 % des femmes et 52.9 % des hommes sont 'fortement ou modérément en accord' avec la proposition "L'examen sur route devrait inclure des situations de conduite plus exigeantes, exemple contrôle de dérapage" (voir Tableau 5.2.3).

L'objectif principal du projet est de comparer des taux d'accidents. Voici donc un résumé des caractéristiques des nouveaux conducteurs avec des taux d'accidents au dessus de la moyenne.

Il est déjà connu que les infractions peuvent être considérées comme des proxies pour les accidents. En effet, les infractions sont un indice de propension à prendre des risques. Chez les femmes, il y a 13.5 % de celles avec des infractions qui ont aussi un accident comparées à 4.6 % de celles sans infractions; chez les hommes les taux correspondants sont de 18.4 % et 10.0 % respectivement (voir Tableau 6.4.9). Dans la même ligne de pensée, on trouve que 58.6 % des personnes avec un accident ou une infraction comme apprenti, ont un accident ou au moins une infraction durant les premiers 450 jours avec le permis probatoire.

Pour les hommes, le taux d'infractions le plus élevé de 45.5 % appartient aux individus qui ont obtenu le permis probatoire le plus rapidement possible (240-245 jours avec le permis d'apprenti) et qui ont pris un cours (voir Tableau 6.3.6). Le bonus des quatre mois sanctionne donc le permis probatoire pour les hommes avec la plus grande propension à prendre des risques sur les routes.

La motivation est un facteur important: les taux d'accidents et d'infractions du groupe avec la motivation 'opportuniste' sont 13.8 % et 41.4 %, ceux du groupe avec la motivation 'mixte' sont 10.2% et 25.6 % et ceux du groupe avec la motivation 'apprentissage' sont 5.6 % et 14.4 % (voir les tableaux 6.4.8 et 6.3.14. En éliminant le bonus de 4 mois pour avoir pris un cours, on pourra potentiellement réduire la motivation 'opportuniste'. Rappelons-nous de la remarque de Mayhew et al. (1998) citée dans la section 1.2.

Un autre facteur important est clairement l'exposition au risque ou même des proxies de l'exposition au risque comme le nombre d'heures de pratique en dehors de l'école de conduite (Q17), l'accès attendu à un véhicule routier (Q34), et être propriétaire d'une automobile à la fin de l'an 2001 qui sont associés à des taux d'accidents plus élevés (plus d'exposition entraîne des taux d'accidents plus élevés).

Le style de vie différencie aussi des groupes avec des taux d'accidents différents, par exemple l'effort à l'école et la consommation d'alcool et du tabac. Les différences suivantes s'avèrent significatives chez les hommes:

Ceux qui passent une heure ou moins pour les travaux scolaires ont un taux d'accidents supérieurs au taux de ceux qui passent plus d'une heure.

Ceux qui fument ont un taux d'accidents supérieur au taux de ceux qui ne le font pas.

Les résultats pour les infractions sont plus prononcés: les femmes et les hommes qui, durant les deux derniers mois, ont fumé ou qui ont bu de l'alcool ont des taux d'infraction supérieurs aux taux de celles et ceux qui ne le font pas.

En résumé nos résultats confirment les hypothèses énoncées dans l'introduction:

On ne devrait pas trouver des différences entre les taux de collisions selon cours ou non, mais les personnes à propension élevée de prendre des risques devraient avoir plus d'accidents que celles à faible propension.

Dans le Chapitre 9, nous énoncerons des recommandations ayant pour but de réduire les taux d'infractions et d'accidents des nouveaux conducteurs et conductrices.

Travaux futurs:

Toute recherche de cette envergure ouvre la porte à d'autres projets. Il nous semble que la SAAQ a en main les données pour des analyses sur l'ensemble des jeunes nouveaux conducteurs. Voici quelques idées:

(i) Suivre sur quelques années les infractions et les accidents des conducteurs ayant eu des infractions ou des accidents avec le permis d'apprenti.

(ii) Analyser les séquences temporelles des infractions et des accidents à partir de l'obtention du permis probatoire.

(iii) Suivre les infractions et les accidents des conducteurs selon leurs performances aux examens, spécifiquement les hommes qui ont réussi l'examen pratique au premier essai, mais qui ont eu besoin de plus d'une tentative pour réussir l'examen théorique.

CHAPITRE 9

RECOMMANDATIONS

Ces recommandations constituent une suite logique à la discussion du chapitre précédant. Elles sont aussi basées sur les considérations suivantes:

a - Toute action doit entraîner une réaction; en d'autres mots chaque personne doit accepter les conséquences de ses actes et subir une punition ou des exigences rectificatives appropriées.

b - Les jeunes conducteurs et conductrices sans permis probatoire ne peuvent pas conduire sans supervision; ils demeureront donc des apprentis qui ont des taux d'accidents et d'infractions nettement plus bas que les taux de ceux et celles avec le permis probatoire.

c - La SAAQ a le mandat de sécurité routière. Elle est en charge des règlements pour l'accès aux permis de conduire.

Nous sommes conscients que certaines de ces recommandations poseront potentiellement des problèmes juridiques, administratifs ou pratiques.

Recommandation 1:

Exiger un minimum de 12 mois avec le permis d'apprenti pour tous les nouveaux conducteurs et conductrices; donc abolir le bénéfice de raccourcir la période exigée avec le permis d'apprenti de 12 à 8 mois (240 jours) pour avoir pris un cours.

Justification: L'existence d'attestations fausses, c.-à.-d. pour 12 leçons mêmes si la personne en a pris nettement moins, est bien connue dans le milieu des écoles de conduite. En effet, notre échantillon contient 103 participants avec moins de 12 leçons qui ont obtenu le permis probatoire dans moins de 360 jours avec un permis d'apprenti. De plus, ces femmes et ces hommes ont des taux d'infractions et des taux d'accidents au dessus des taux moyens. Les hommes qui accèdent au permis probatoire le plus rapidement possible (240–245 jours avec le permis d'apprenti) ont le taux d'infractions le plus élevé.

Cette recommandation rendra inutiles les attestations d'avoir pris un cours et réduira l'administration de l'examen pratique. En plus, tous les nouveaux conducteurs et conductrices auront au moins 17 ans.

Dans un rapport de ICBC (Insurance Corporation of British Columbia, 2004) la recommandation est faite d'abolir le bénéfice de raccourcir la période d'apprentissage pour avoir pris un cours.

Recommandation 2:

Allonger les délais avant la reprise d'un examen échoué, pour les parties de l'examen théorique et pour l'examen pratique.

Justification: Les hommes avec des reprises d'une ou de plusieurs parties de l'examen théorique ont des taux d'accidents plus élevés que ceux qui passent au premier essai. En allongeant les délais, les candidats demeureront plus longtemps avec le permis d'apprenti et ne pourront conduire que sous supervision. De plus, ces personnes seront un peu plus âgées au moment de l'obtention du permis probatoire, et on espère qu'elles gagneront aussi un peu plus de maturité et plus de sens de responsabilité. Les raisons pour des échecs aux examens méritent d'être explorées plus à fond. Il s'agit d'un résultat original corroboré par deux de nos recherches antérieures.

Recommandation 3:

Exiger un dossier de conduite vierge, donc sans infractions et sans accidents, pour une période de six mois avant de pouvoir se présenter à l'examen pratique.

Justification: Nous avons trouvé des taux très hauts pour les personnes avec des infractions ou des accidents durant leur période d'apprenti conducteur. Comme le nombre de telles personnes dans notre échantillon est petit, nous suggérons que la SAAQ entreprenne des analyses sur l'ensemble des apprentis conducteurs avec un dossier non vierge avant de procéder avec cette recommandation.

Recommandation 4:

Ne plus permettre des suspensions d'un permis qui courent en parallèle. Une personne avec un permis probatoire qui a accumulé 8 points d'inaptitude ou plus devrait être suspendue pour 6 mois et pas seulement pour 2 fois 3 mois concurrents.

Recommandation 5:

Développer un test sur route (examen pratique) valide en terme de sécurité routière.

Justification: Les écoles de conduite sont des établissements à but lucratif. Elles taillent leur enseignement de façon à optimiser les chances pour leurs clients de réussir les examens. Comme nous l'avons démontré, et comme la littérature en témoigne, suivre un cours et réussir l'examen pratique n'a pas produit de nouveaux conducteurs sécuritaires jusqu'à maintenant. L'enseignement dans les écoles de conduite ne changera que si les exigences de l'examen changent!

En effet, l'examen de la SAAQ ne couvre qu'une partie des situations de conduite autorisées par le permis probatoire. On peut conduire sur des voies rapides, des routes de campagne sinueuses, des autoroutes, durant la nuit et dans tous les mauvais temps et conditions de routes possibles, mais l'examen se fait principalement le jour sur des rues avec une limite de vitesse de 50 kms/h. De plus, s'il fait mauvais temps le candidat peut simplement reporter son rendez-vous pour l'examen.
Même les nouveaux conducteurs sont de l'opinion que l'examen sur route devrait durer plus d'une heure et inclure des situations plus exigeantes.

Nous comprenons bien qu'on ne peut pas commander des orages ou des tempêtes de neiges sur mesure, et nous sommes conscients qu'allonger la durée des examens afin de couvrir des situations plus exigeantes nécessitent plus de ressources pour la SAAQ, mais les coûts et les séquelles des accidents constituent un fardeau énorme pour l'économie, et pour la santé publique dans le cas d'accidents avec blessés.

De plus, il existe des tests sur ordinateur, par exemple le "Hazard perception test" (test sur la perceptions des risques) qui est utilisé en Australie (Congdon, 1999) et en Angleterre (Driving Standards Agency). Cependant, nous n'avons pas encore vu des évaluations définitives de ces tests.

Un examen pratique valide et plus long, combiné avec des tests sur ordinateurs, devrait être exploré et évalué afin d'accorder le permis probatoire à des nouveaux conducteurs plus sécuritaires, et devrait donc diminuer les taux d'accidents même à long terme.

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APPENDIX 11 - HIRSCH, P. (1999). RECENSION DES ÉCRITS (LITERATURE REVIEW). IN C. LABERGE-NADEAU, U. MAAG, R. BOURBEAU, D. DESJARDINS, & S. MESSIER (EDS.) LE LIEN ENTRE PERFORMANCE AUX EXAMENS (THÉORIQUE ET PRATIQUE) POUR L'OBTENTION D'UN PERMIS ET LE TAUX D'IMPLICATION DANS LES ACCIDENTS. ANNEXE AU RAPPORT FINAL. LABORATOIRE SUR LA SÉCURITÉ DES TRANSPORTS DU ENTRE DE RECHERCHE SUR LES TRANSPORTS. UNIVERSITÉ DE MONTRÉAL.

THE RELATIONSHIP BETWEEN PERFORMANCE ON THE DRIVER'S PERMIT EXAMS (THEORY AND PRACTICAL) AND CRASH RATES: A LITERATURE REVIEW

LE LIEN ENTRE LA PERFORMANCE AUX EXAMEN (THÉORIQUE ET PRATIQUE) POUR L'OBTENTION D'UNPERMIS ET LE TAUX D'IMPLICATION DANS LES ACCIDENTS : RECENSION DES ÉCRITS

Pierro Hirsch

edited by

Claire Laberge-Nadeau
Urs Maag
Robert Bourbeau
Denise Desjardins
Stephan Messier

Laboratoire sur la sécurité des transports du Centre de recherche sur les transports.

Université de Montréal.

July 1999.

Note to the Reader

- The terms "examination" and "test" are synonymous and are replaced by the term "exam", when possible, for the sake of brevity.
- "Written exam" and "theory exam" are synonymous. "Theory" will be preferred for the sake of consistency.
- The terms "practical exam", "drive exam", "driving exam" and "road exam" are synonymous. "Practical exam" will be used for the sake of consistency.
- "Candidate" refers to anyone applying for a driver's permit.
- "Performance" is defined by the SAAQ as: a) the number of attempts required to pass an exam (theory or practical), and; b) the duration of the process. However, most other researchers define the term differently.
- "License" and "permit" are synonymous. "Permit" will be used for the sake of consistency.
- Unfamiliar or undefined terms from secondary sources will be enclosed in single quotation marks.

Introduction

This literature review is part of a research project that attempts to discover the nature of the relationship between two variables, performance on driver's permit exams (theoretical and practical) and collision involvement rates. The specific objectives of this research project are to:

- Establish a relationship between theory exam performance and collision involvement rates;
- Establish a relationship between practical exam performance and collision involvement rates;
- Establish a relationship between global exam performance (theory and practical) and collision involvement rates, and;
- Identify the actual elements (or other potential elements) of exams that can best predict future collision involvement.

The research project follows the results of the study, *Effects of the reform on access to a first driver's permit*, which was carried out by our group at the Laboratory on Transportation Safety. We found that candidates who passed the theory exam on the first attempt had lower collision risks during the first year after licensing than those who needed several attempts (see Dionne *et al.*, 1996).

It is well known that driver's permit exams only test the minimal knowledge and skill necessary to drive a car (Waller, 1975; MacDonald, 1987; Mayhew and Simpson; 1990). It is also well known that young drivers (16 to 19 year of age), particularly males, are significantly overrepresented in collision related injury and fatality statistics (Mayhew, 1990) and that this age group also has higher success rates on the theory and practical exams than older candidates (SAAQ 1994). Both variables of interest, permit exam performance and collision involvement, are influenced by a wide variety of other known, unknown and possibly unpredictable variables, some of which may be correlative and not easily disentangled, i.e. age, maturity, experience, and exposure. Therefore, it should be acknowledged at the outset that the appearance of any relationships between driver's permit exam performance and collision records might easily reflect the influence of confounding variables. Conversely, the apparent lack of relationship between permit exam performance and collision records might reflect limitations in the available study data and/or inadequate research designs. As a result, it may be very difficult to establish any clear relationships between exam performance and collision rates.

Despite these difficulties, improving our understanding of the relationship between driver's permit exams and collision rates is of considerable importance for at least two reasons:

1) Passing the government driver's permit exam is generally perceived by both novice drivers and their families as proof of the achievement of the knowledge and skill necessary to operate a motor vehicle "safely" in traffic (Plato, 1983);

2) Obtaining the driver's permit usually marks the end of formal and even informal driver training and the start of unsupervised and generally unrestricted driving exposure.

Section one will contain a detailed discussion of the requirements of standardized testing in relation to the construction of driver's permit exams. Section two will discuss potential effects of a few select confounding variables, such as age, gender, family background, etc., on our ability to interpret evaluation findings. The third and last section will review the literature findings that relate directly to our research question.

Section 1

Standardized testing and driver's exams

Societies view the acquisition of a driver's permit more as a citizen's right than as a privilege (Gregersen and Bjurulf, 1996; Waller *et al.*, 1978). As a result, permit exams have traditionally been standardized in order to be administered in a manner that appears to be explicitly fair to every candidate. It is important to recognize the implications of standardized exams in relation to the present research question. If the criteria of driving safety knowledge and skill selected for the exam are too demanding, the failure rate for first time exam takers may be high. A high failure rate will increase administrative costs, complaints to politicians and, according to Waller *et al.* (1978), legal challenges to the licensing authorities. On the other hand, if the permit exam is not sufficiently thorough, the granting of driver's permits to certain individuals might actually increase their collision risk by increasing both their confidence and their exposure. These very practical considerations may have influenced the manner in which driver's permit exams have been constructed over the years. Therefore, let us briefly look at the established educational criteria for exam standardization. If it appears that driver's permit exams do not adequately meet these criteria, then we must consider this inadequacy in relation to our research questions.

Criteria for exam standardization

According to Biehler and Snowman (1990) several of the criteria for the standardization of educational exams are: reliability; validity; normed excellence; examinee appropriateness; teaching feedback; usability, and; retest potential. We will look at each of these in turn, with special attention to the first two.

1. Reliability

This term arose from the field of psychometrics, in which exams are used to measure basic human traits, such as intelligence and achievement, which are assumed to be relatively stable over time. These traits are purely hypothetical variables; they do not exist independently of the exams themselves. The only way to determine whether the exams are reliable or consistent indicators of the variables of interest is to compare repeated measures of these traits to see whether they agree. When the testing instrument is an objective measure of driving knowledge, such as a multiple choice exam, exam reliability can be assessed by measuring different sets or forms of exam items (alternate form reliability), different halves of the exam (split half reliability), or administration of the entire exam on different occasions (test-retest reliability). The degree of reliability is expressed as a correlation coefficient that ranges from zero to one. Well-constructed standardized exams in education have correlation coefficients of about .85 for alternate form reliability, .95 for split half reliability, and .90 for test-retest reliability (Kubiszyn and Borich, 1987 in Biehler and Snow, 1990). It is difficult to determine how the reliability coefficients of driver's permit

exams compare with these educational standards because these figures are not readily available in published reports.

Practical driving skill or achievement is usually measured by performance under controlled conditions in closed circuits or under realistic conditions during on-road exams in traffic. Differences in exam routes are measured by inter-route reliability scores. The subjectivity of different evaluator's judgements is measured by the inter-rater reliability coefficient. MacDonald (1987) reports that McGlade (1963) found high scores for the inter-rater correlations of his exam but Jones (1978) found "pronounced instructor bias" and inadequate rating criteria in the same exam. Schumaker (1994) found that exam scores and reliabilities differed significantly from one testing office to another in California and by using total scores found that inter-rater reliability was .69 and net reliability (including interroute reliability) was .60. It is difficult to determine whether these coefficients are adequate or whether all exam centres maintain the same standards because this information is not readily available in published reports.

If the driving skills measured by the permit exam are relatively stable, it would be logical that performance exams should also have some measure of test re-test reliability. However, Wittink and Twisk (1990, in OECD, 1994) found that when young male drivers submitted to a driving performance evaluation three months after passing their driver's permit exam they seemed to have forgotten most of what they had learned. Forsyth (1992b, in Forsyth, 1993) found that a group of 400 novice drivers who were retested between three months and two years after passing their permit exams had an overall pass rate of only 53% on a practical exam of the same duration using the same assessment criteria as the original practical exam which each of them had already passed. The overall pass rate dropped to 44% when the length of the assessment drive was doubled. An analysis of the serious and dangerous errors made by these newly qualified drivers revealed that they were less likely than learner drivers to fail due to poor use of the vehicle's controls and driving too slowly for the conditions. However, a higher proportion of qualified than learner drivers failed their post-permit assessments because of driving too fast for conditions and due to lack of anticipation of the actions of other road users.

It appears, therefore, that the driving skills measured by the permit exam are not stable. More significantly, perhaps, it appears that with increases in experience that follow licensing new drivers improve their vehicle control skills and begin to drive at faster speeds without necessarily acquiring better anticipation skills. Do these findings imply that the practical permit exam itself is not reliable? That is, that the practical permit exam cannot measure a stable trait known as "driving skill" because novice drivers are still developing these skills and appear to be doing so for at least several months after licensing. Is it also possible that the driving skills tested during a practical exam are not consistent with the driving behaviours actually practiced by the majority of licensed drivers? McKnight and McPherson (1981, in Mayhew and Simpson, 1995) found that there was little correlation between the safety practices of candidates during a practical exam and those evidenced by the same candidates immediately after obtaining their permits.

2. Validity

This term refers to how well a test appropriately measures what its users intend to measure. Three forms of validity are directly pertinent to driver's permit exams, construct validity, content validity and predictive validity. We will examine each in turn.

Construct validity

This term relates to how accurately the test measures a particular attribute or psychological construct. Knowledge, skills, attitudes and behaviours related to the safe operation of a motor vehicle in traffic would obviously be the attributes and constructs of the greatest interest in the construction of a driver's permit exam. However, traffic safety researchers admit that the actual behaviour of safe driving has not yet been defined (Gregersen and Bjurulf, 1996; Mayhew and Simpson, 1990). This is not to say that traffic safety researchers and other drivers do not know how to drive safely. Safe driving is obviously practiced effectively by many drivers, but the rules and strategies underlying their behaviour may not always be validated by the traffic laws (Hirsch, 1994), traffic safety science or social norms.

The fundamental gap in traffic safety science represented by a lack of a definition of safe driving complicates the training of new drivers because the criteria of driver permit testing effectively determine the standards for novice driver training (MacDonald, 1987; Waller, 1978). If "safety" cannot be defined, it cannot be measured or directly tested by the driver's permit exams. As a result, driving schools will inevitably teach their students how to pass the permit exam regardless of the relationship or lack of relationship between exam criteria and unrecognized but potentially valid safety standards.

Content validity

This term relates to how well the items that make up an exam measure a particular type of ability or understanding or learning. In relation to theory testing, driver's permit exams have traditionally tested only signs and laws under the rationale that a "...new driver should at least know the law... even though parents, friends, relatives may not exhibit safe driving practices" (Coppin, 1977). Efforts have been made to include items on the driver's permit exams that relate more directly to safer driving practices that are not emphasized in traditional law-based permit exams (Ratz, 1978a; Schuster, 1968, reviewed in Section Three).

In terms of practical driving skills, MacDonald (1987) noted that young and inexperienced drivers rate poorly in (1) perceptual skills, (scanning, moving eyes), (2) cognitive skills, (risk assessment, informed decision making) and (3) vehicle control, (less smooth, fast and abrupt responses) and that

driver's permit practical exams tended to measure only (3) vehicle control skills. Forbes *et al.* (1975) used a content validity approach combined with systems psychology to develop the Michigan Drive Test, a method of driver performance measurement based on the concept of behavioural-environmental-traffic-situational sequences. The exam places greater importance on when and where braking and speed changes are made in relation to traffic conditions rather than on the smoothness of the braking and steering. MacDonald (1987) doubts this criteria because experience effects were only significant in one of six anova's carried out during the development of exam, and then the result was that inexperienced drivers scored better than experienced.

However, in the previous discussion of test reliability we have already reviewed evidence that discrepancies exist between driver performance on a practical exam and the unsupervised behaviour of licensed drivers. Therefore, it is possible that the measures developed by Forbes *et al.* (1975) actually do correspond to a more rational and scientific approach to safe driving which might be practiced more effectively by recently trained novice drivers rather than by experienced drivers who have not yet adjusted to less rational, riskier social norms. An analogy might be found in the difference between prescriptive grammar that dictates how someone should speak a language and descriptive grammar that records how people actually do speak. Newly trained speakers of a language are often more explicitly aware of the correct rules than native speakers. McKnight (1997) believes that content validity is the only appropriate form of validity for driver's permit exams and that the purpose of driver's permit exams is to provide the incentive to acquire the knowledge that would enable and motivate candidates to drive safely.

Predictive validity

This measures how well performance on the exam correlates with performance in the future. Certain scholastic aptitude tests have been found to correlate with future academic success. In terms of a driver's permit exam, predictive validity would attempt to correlate exam scores and performance with some criterion of driving performance in the future. Ideally, the ultimate criterion for the validity of a driving exam is the one specified by this present research project, driving collision records. However, researchers have noted several problems with this paradigm:

a) Prediction of future collisions is not the purpose of the driver's permit exam (McKnight, 1997: NHSTA, 1975).

b) A demonstration of knowledge in health related human activities does not necessarily predict self-protective behaviour (i.e. knowledge of the riskof aids and the use of condoms).

c) Performance during a driver's permit exam does not necessarily represent behaviour after the exam (McKnight and MacPherson, 1981; Waller *et al.*, 1978). In addition, post-test driving skills will change differently for each driver (MacDonald, 1987).

d) Practical exams are not necessarily of sufficient duration (10 to 30 minutes in North America, longer in Europe) to afford an adequate sample of behaviour upon which to make a valid judgement of driver performance (Waller *et al.*, 1978).

e) There are unresolved questions concerning both the individual reliability over time and the comparative reliability of different permit exam forms, scoring systems, examiner evaluations, exam routes etc..

f) The practical exam is not representative of real world conditions. Permit exam centres in large cities may not test highway driving. Busy traffic situations may not be tested in small towns. For obvious reasons, dangerous situations that are most likely to lead to a collision are never tested (Waller *et al.* 1978).

g) Political and legal constraints require only that a minimal amount of driving skill be demonstrated (Waller *et al.*, 1978).

h) Those who fail the exam are not licensed, removing the so-called unsafe drivers from the range of evaluations (MacDonald, 1987; NHSTA, 1978).

i) The relative scores or rankings of knowledge and performance levels of those so-called safe drivers who do pass the permit exam do not necessarily remain constant over the time period following the permit exam during which their collision records are established (MacDonald, 1987).

j) Collisions are relatively rare events (MacDonald, 1987).

k) Reported collision rates do not necessarily reflect actual collision rates. Not all collisions are reported and not all reported collisions are attributed to the correct driver. Also, discrepancies have been noted between collision rates reported by different agencies, i.e. police, hospitals, insurance sources.

l) Collisions follow a Poisson distribution which severely limits the predictive validity of even well developed exams (Waller *et al.*, 1978).

m) Collision rates are usually calculated either in absolute numbers per driver or collisions per kilometer, each method reflecting either a public health or a traffic safety research priority and (Mayhew

and Simpson, 1990). Each method presents a different profile of the collision criterion being validated by the permit exam.

n) The duration of the time period selected for collecting collision rates will influence the result of the validation process, but there is no agreement as to the correct period. Hakkinen (1958) concluded that collision records must be used for a minimum of an eight year period in order to properly validate performance tests. Waller *et al.* (1978) state that longer collection periods may decrease predictive power. Atkins (1984) believes that at least four years are needed to establish a correlation between knowledge test scores and collision records and performance tests. On the other hand, research constraints may necessitate collection periods of only six months.

o) In multi-vehicle collisions, each driver contributes a different degree of responsibility or fault yet the collision will appear on each driver's record equally. The use of only "at-fault" collisions introduces additional biases due to the way collisions are recorded and processed (Waller *et al.*, 1978).

p) Collisions are multi-factorial events and their occurrence or non-occurrence cannot necessarily be attributed to levels of knowledge or skill presently tested on driver's permit exams (MacDonald, 1987; Waller *et al.*, 1978).

q) If collision rates do not distinguish between fatal, injury causing and material damage only collisions, a driver involved in three low speed collisions with no injuries will appear to be more dangerous than a driver whose first and only reported collision is fatal. Failure to separate these cases may therefore produce misleading associations when permit exam performance and collision rates are compared.

r) Chapanis (1977, in Waller *et al.*, 1978) concludes that attitudinal and personality variables are far more important than collision experience and override the role of the type of skills measured in driver's permit performance testing.

s) The inclusion of criteria related to attitudinal and personality variables in the driver's permit exam that might be predictive of future collision involvement is not necessarily politically or legally feasible (Mayhew and Simpson, 1990; Waller, 1978).

3. Normed excellence or concurrent validity

For a standardized test to have meaning, it has to be compared to some measure of performance. This approach relies on "post-diction" rather than prediction, and is potentially problematic in terms of permit testing where the norm group would *appear* to be experienced drivers with safe driving records.

We emphasize the word "appear" because it is not clear to what degree a safe driving record can be attributed to measurable factors like skill or to other less easily measurable factors, e.g exposure, personality. Even an experienced driver and traffic safety expert like Leonard Evans admits that he does not know how much his own long-standing collision free record is influenced by factors completely outside his control (Evans, 1991).

The concurrent validity of a testing instrument is established by measuring the degree to which scores on an exam discriminate between persons known to be skilled drivers, (e.g. experienced drivers with safe records), and persons known to be less skilled drivers, (e.g. novice, inexperienced drivers). Romanowicz and Hagge (1995, in Peck, 1995) used this procedure to validate the Driver Performance Evaluation (DPE test) in California. They found that novice drivers had a failure rate on the DPE of almost 53% compared to only 14.9% for renewees with good records (p=.001). Peck (1995) claims that this data supports the validity of the DPE "*if* one accepts the premise that a valid road test should discriminate between novice and experienced drivers..." From a scientific point of view, it is critical not to overlook the use of the qualifying word "if".

Engel and Townsend (1997, in Ontario Ministry of Transportation, 1993) used concurrent measures to validate the G2 exit exam for the Graduated Licensing System in Ontario. During the validation trials, experienced drivers did better than novice drivers only *on average*. There was significant overlap between novice and experienced driver scores and some experienced drivers scores were actually worse than those of some novice drivers. Therefore, it is not evident that measures of concurrent validity are sufficient to corroborate the content or construct validity of practical permit exams in relation to driving safety.

4. Examinee appropriateness

Standardized exams are designed for use across entire states, provinces and countries. Therefore, it is important to estimate how appropriate a given exam is in terms of level of difficulty and in relation to the language skills and psychomotor abilities of all the driver's permit candidates. McKnight (1997) recommends that theory exams use language appropriate for the sixth grade level. However, even this level may still represent difficulties for some. Alternatives have been available in the form of oral exams with translators but these options are currently being limited. In terms of the practical exam, even relatively simple skills indirectly related to safety, such as parallel parking, still may require some candidates, especially older ones, several hours of practice to achieve smooth and confident performance. Moreover, not every candidate has equal access to driving practice with family and friends, equal financial means to pay for professional instruction, or equal time to devote to permit exam preparation.

5. Teaching feedback

Biehler and Snowman (1990) observe that "an [standardized] achievement test ... will provide meaningful feedback only if the scores tell teachers something that can be used to improve instruction." When students fail their driver's permit exams it is not unusual for them to report the reasons for failure to their respective driving teachers who in turn use this information to prepare other students to pass the exam. The NHSTA (1975) state that "...it *behoves* the driving instructor to prepare his students for the license examination."

The use of the old-fashioned and rarely used word "behoves", which means to be "necessary, proper or advantageous for", is appropriate considering that the paying client of a commercial driving school begins instruction with the expectation of acquiring a driver's permit. However, given the uncertainty of the relationship between the criteria of driver's permit exam and the goal of safety, feed-back from students who fail their exam may actually lead to a conflict of interest for driving teachers. This conflict is acknowledged in the same NHSTA report cited above which advises that:

> "... the [driving] instructor should recognize that the goal of his instructional program is safe driving, not simply preparing his students to pass the examination, and he should attempt to see to it that students accept this goal." p.1-7

The National Professional Driver Education Association (1966) agree that instructors should inform their students of the inadequacy of training that merely meets the minimum requirements of a driver's permit exam, but it rejects the burden of responsibility placed on driving teachers by the NHSTA and asserts that it is "...the responsibility of the student to render the final decision in this regard." It should be emphasized that this respect for the individual's right to determine his or her own safety, while commendable, is not always advisable in the case of the youngest and riskiest driver's permit candidates.

Realistically, however, even the most conscientious driving teachers may find it difficult to fail students for two reasons. One, failing students who appear to be collision risks, but who are competent according to permit exam standards, will not necessarily prevent them from licensing. Stoddard (1987) presents corroborative evidence for this point when he reports that government permit examiners are critical of driving schools for only teaching young drivers "...how to pass the license exam", instead of teaching them "how to drive". Two, acquiring a reputation for failing "competent" high risk driving students might discourage future enrollment at that particular driving school without adding any clear benefit to public safety. The point of view of the professional driving school teacher might be summarized as follows:

> If the government does not take the political and economic risks involved in administering a driver's license exam to screen out unsafe drivers, (a responsibility that is clearly within it's mandate), on what grounds can it then expect driving teachers

operating in a competitive market to risk their livelihoods by failing candidates who may appear risky but who are nevertheless qualified to pass the government exam?

6. Usability

Usability in the theory portion of standardized permit exams has been greatly enhanced by user friendly computers with pictures and diagrams accompanying the questions. However, to the extent that the practical exam is administered by one evaluator to a wide variety of candidates in relatively uncontrolled traffic situations, there is always the possibility for communication difficulties, particularly with non-native language speakers, that can influence the outcome of the exam.

7. Retest potential

Retest potential refers to the idea that if students fail and must be retested, an alternative form of the first exam should be available. This is feasible with knowledge exams where different exams can be made up from banks of alternate questions. In terms of the practical exam, however, it may not be feasible to develop alternative and equivalent forms for retest purposes. Simply giving the same exam over again may yield misleading information because candidates who pass the practical exam after repeated attempts may have only learned how to perform the limited number of manoeuvres on the exam and very little else. Therefore, it may be important to develop an equivalent but different form of the driving exam. One might also consider the possibility that candidates who need several attempts to pass their practical exams may have difficulties that should be evaluated in a distinctly different manner.

Types of Standardized Exams

There are a number of types of standardized exams and it is not always clear which type or types best describe the driver's permit exam. For example, is a driver's permit exam considered an achievement test that measures how much has been learned about a subject? We have seen that it seems to function that way in terms of feed-back to the driving teacher. McKnight (1997) contends that the permit exam should be treated as a competency test to determine if potential graduates possess basic skills. Some researchers have suggested that the permit exam should also be used as a diagnostic test to reveal the strengths and weaknesses of candidates in specific subjects and skills which can be remediated with further training.

It is also not clear whether test-scores should be norm-referenced, comparing the scores of one student with others, or criterion-referenced, indicating a degree of mastery of knowledge and skill objectives.

With the increasing popularity of graduated licensing and multi-stage examinations it will become possible to develop formative and summative tests which can encourage the development of a full range of safe driving skills over a longer period of time rather than granting full priviledges after exams that by necessity can only cover a limited range of competencies.

Section 1 - Summary

The preceding critical review of the standardization of driver's permit exams was undertaken in order to better understand the nature of the relationship between the two variables of interest, namely performance on permit exams (theoretical and practical) and collision rates. Our ability to interpret any relationship or lack of relationship between these two variables will be limited by the degree to which permit exams do not sufficiently meet the criteria of standardization. The next section will review the literature on confounding variables.

Section 2
Confounding Variables

Many characteristics associated with candidates for a driver's permit may influence both their performance on the exams (theory and practical) and their risk of collision involvement. Some of these confounding factors are demographic, i.e. age and gender, and can be controlled for statistically. Others, like lifestyle and informal training, are less easily measured and thus more difficult to control. Figure 1 presents a partial list of potential confounding variables and the time periods when the variables of interest (exam performance and collision rate) could be influenced. The confounding variables are divided into two groups, individual factors and learning. It is probable that many of these variables interact.

Figure 1: Potential Confounding Variables and Time Periods When These Could Influence the Relationship Between Driver's Permit Exam Performance and Collision Rates

POTENTIAL CONFOUNDING VARIABLES	<----->	TIME PERIODS
INDIVIDUAL FACTORS		PRIOR TO THEORY & PRACTICAL EXAMS
AGE		DURING THEORY & PRACTICAL EXAMS
GENDER		DURING LICENSED DRIVING
FAMILY BACKGROUND		DURING POST-COLLISION DRIVING
LIFESTYLE		
ACADEMIC INTELLIGENCE		
INTERPERSONAL INTELLIGENCE		
LEARNING		
FORMAL DRIVER TRAINING		
INFORMAL TRAINING		
PREVIOUS EXPERIENCE		

In addition to the time periods prior to exam performance and prior to collision events, it might be important to consider the time period following a first collision event as well. Sheppard (1982) reports that 16 of the 48 collision involved drivers he interviewed said that they had learned nothing from the experience. Different reactions to collision events might relate to driver characteristics that could influence both permit exam performance and the likelihood of involvement in more than one traffic collision. The rest of section 2 will briefly discuss the confounding variables listed in Figure 1 with the aim of improving our ability to interpret the results of the existing studies on exam performance and collision rates to be discussed in section 3.

Individual factors

Individual factors generally refer to those unique traits which could influence new drivers' capabilities and/or willingness to understand and comply with standards and rules of safe driving behaviour. These factors could also affect an individual's performance on the permit exam and his level of collision risk afterwards.

Age

In Quebec, 16 year olds have the highest pass rates for both the theory and practical driver's permit exams and pass rates appear to decrease as the age of the candidate increases (SAAQ, 1996). Forsyth (1993) also found that younger drivers did better on their driving exams and had higher collision rates. Peck (1985) suggests that, regardless of the data showing that younger drivers are overinvolved in collisions compared with older age groups, "it should not be inferred that age is a good predictor of an individual's accident propensity." While age may not directly predict collision risk, some research (Hirsch, 1997; Mercer 1990, in Mayhew and Simpson, 1990) suggests that due to the large measure of self-selection in the licensing process, the age when candidates choose to license might be a marker of collision risk. Maycock (1994) found that males who first license between the ages of 17 and 19 needed three years of experience to achieve the same rate of collision frequency achieved in only one year by males who first license between the ages of 20 and 24. It would appear, therefore, that studies undertaken to determine the nature of the relationship between performance on a driver's permit exam and subsequent rates of collision involvement should control for age at time of licensing.

Gender

In Quebec, males in every age category have slightly higher pass rates on the practical driver's permit exam than females (SAAQ, 1996). Males also appear to be twice as likely as females to be involved in traffic collisions (Dionne *et al.* 1997). Among drivers who first license between the age of 17 and 19, males need three years of experience to achieve the same rate of collision frequency that females achieve after only one year (Maycock, 1994). As with age, it would appear that gender should also be controlled when examining the relationship between driver's permit exam performance and collision rates.

Family background

Socio-economic status and educational levels could potentially influence both the performance on the driving exam and collision risk. Murray (1998) found that young Swedish men and women drivers with lower school marks and lower educational attainment were over-represented in car collisions and that higher risk exposure in terms of driving distances was not a factor. No data was collected on the driver's permit performance of these drivers, but one might hypothesize that lower educational achievement might also be associated with lower scores on the theory exam.

A less obvious but potentially more critical influence on exam performance and collision risk is the social learning about driving that takes place within the individual's family. Carlson and Klein (1970) found positive correlations between fathers' and sons' conviction incidence and between delinquent traffic

behaviour and poor academic performance. To the extent that driver's permit theory exam performance is influenced by academic performance, it is conceivable that an individual who scores poorly on his exam and has a higher than average collision risk might be manifesting the influence of his or her family background.

Lifestyle

It appears probable that certain lifestyle traits could confound the relationship between performance on the driver's permit exam and collision risk. Teenagers who are very active socially and/or athletically might be more motivated to perform well on their driver's permit exam in order to increase their liberty and mobility. The parents of these teenagers may even encourage them to license earlier in order to be released from the obligation to provide transportation to and from numerous events. Once licensed, these teenagers are also more likely to adopt the driving patterns (i.e. night driving, carrying more than one teenage passenger) which have been identified by Williams (1995) as characteristic of higher collision risk for new teenager drivers. Although difficult to obtain, measures of motivation for driving and types of exposure anticipated might prove to be confounding factors in the relationship between exam performance and collision risk.

Academic intelligence

Frequently used measures of intelligence are academic performance and IQ scores, both of which tend to covary positively. Weak correlations have been established between higher collision rates and poor academic performance and lower IQ scores (Harrington 1972, O'Toole 1990, Smith and Kirkham 1982, Stock *et al.* 1983). Assuming that academic performance and IQ scores are good predictors of performance on the driver's theory permit exam, it is possible that any differences in collision risk related to theory exam scores might be attributable in part to confounding variables such as socio-economic levels, family background, over-confidence and increased exposure.

Interpersonal intelligence

Gardner (1987) refers to another type of intelligence that is not measured directly by IQ scores which he calls "interpersonal intelligence", defined as the ability to understand other people and work cooperatively with them. At face value it would seem that this ability might be essential to avoiding the type of traffic conflicts with other drivers and road users that could result in collisions. Harrington (1972) provides corroborative support for this hypothesis with the finding that low grades in high school citizenship, a

measure of work habits, co-operation and classroom behaviour generated essentially by teachers, were weakly predictive of increased collision risk.

One interesting implication of the hypothesis that "interpersonal intelligence" is critical for safe driving is that the actual content of the driver's permit exam may be less important than the symbolic challenge presented by the exam itself. In other words, many of the candidates who perform better on permit exams may already be predisposed to driving more safely. If they perform better on exams, it might be because they are genuinely willing to cooperate with their driving teachers, permit examiners and fellow road users. It is possible that these same individuals would drive safely even without taking any permit exam. Research indicates that safer driving behaviours are not necessarily associated with increased knowledge of risk (Sheppard and Stoveken, 1993) nor with increased levels of driving skill (Williams and O'Neill, 1974).

Learning

Surprisingly, relatively little is known about how individuals learn to drive. What can be said with some certainty is that the process is multidimensional and continuous over several months, possibly longer. Because the driver's permit exam requires that a certain amount of learning must be demonstrated, candidates for this exam frequently take some sort of pre-exam training. Some research findings suggest that the type of training an individual undergoes prior to licensing could confound the relationship between exam performance and collision risk.

Formal driver training

Formal training is defined here as driving courses consisting of theory classes and/or practical lessons given by professional teachers. Formal driver training may improve performance on the driver's permit exam. Harrington (1972) found that compared with teenagers who didn't take driver training, teenage drivers who did had higher scores on their practical exams. Stock *et al.* (1983) report that researchers in the DeKalb study first assumed that 50 % of the students assigned to driver education classes would become licensed drivers. The final pass rate for driver education students was in fact 74 %. Assuming that this higher than expected pass rate reflects the improved competence of the trained driver's permit candidates, this result would indicate that formal education improves exam performance. Another way in which formal driver education might improve performance on the driver's permit exam is through the influence of a driving teacher who would discourage incompetent students from presenting themselves for the exam until they are ready. Hall and West (1994, in West and Hall, 1995) noted that instructor ratings were predictive of practical exam outcome - so there was some correspondence between instructors' ratings of the pupils and the opinions of the independent examiners.

If formal driver education improves exam performance it could confound the relationship between this performance and collision risk by also increasing exposure at a younger age. Plato (1983) found that parents of teenagers tend to have confidence in the safety value of driver education and do not feel that any further training is required after licensing. It is conceivable, therefore, that teenagers who take formal driver education compared to teenagers who do not might have greater access to an automobile, therefore greater exposure and increased collision risk.

Informal training

Informal training is defined here as any driving practice done under the supervision of a driver who is not a professional teacher. Some student drivers may need many hours of driving practice in order to achieve the competence needed to pass a practical driver's permit exam. Hirsch (1997) noted that insufficient driving practice between lessons was often cited by driving teachers as a reason for lack of competence among student drivers. Forsyth (1992a, in Maycock, 1994) found that driving practice for males is associated with an increased probability of passing the permit exam.

Different types of driving practice can also influence collision risk. Maycock (1994) found that male drivers who practice with friends prior to licensing have a collision frequency that is 18% higher than males who did not. On the other hand, females who practiced with friends had a 13% lower collision frequency than females who did not. Even practice with well-intentioned adults may increase the risk of certain types of collision.

Gregersen (1997) evaluated the effects of a 1993 Swedish law that allows new drivers to begin practising under adult supervision at 16 years rather than waiting until age 17 1/2. When surveyed, the adult supervisors of 16 year old drivers in the new programme expressed greater disagreement with driving school instructors compared with the adult supervisors of 17 1/2 year old drivers in the previous system. Another result of the 1993 law was an increase in the frequency of rear-end collisions for 16 year old drivers in the new system compared to 17 1/2 year old drivers from the old system. Hypothetically, it is possible that a principle point of disagreement between driving instructors and private supervisors is on proper following distances in traffic. Experienced drivers do tend to follow too closely (Evans, 1983; Summala, 1987) and driving instructors tend to strongly emphasize maintaining following distances in traffic that are longer than the social norms. Therefore, one can speculate that after the 1993 law change, adult supervisors may have effectively undermined the advice of driving instructors concerning following distances, which in turn may have led to an increased number of rear-end collisions among new 16 driver old drivers. Until more is known about the effects of different quantities and qualities of informal training, driving practice should be considered as a potentially significant confounding factor in the relationship between exam performance and collision risk.

Previous experience

Maycock (1995) found that both male and female novice drivers who had ridden a motorcycle prior to obtaining a permit to drive an automobile had a lower collision risk than those who did not. The reduction for males was 10% and not statistically significant but for females it was 21% over three years. Maycock (1995) proposes that these results suggest that collision avoidance skills acquired while riding a motorcycle are transferred into car driving, and that collision avoidance skills are not necessarily those associated with car control but are 'higher order' skills associated with hazard perception and sound judgement. While these points may be valid, it is also equally possible that the type of individual who first chooses (and in some cases, is permitted) to ride a motorcycle *and* who survives the experience may already possess other traits that predispose him or her to be a safer automobile driver.

Summary of Section Two

Numerous in-depth research studies have confirmed that human errors are the sole or contributory factors in nearly all traffic collisions (Rumar, 1985, in Evans, 1985). If we can assume that individual driver traits may systematically produce errors that can contribute to collision involvement, it is not altogether surprising that researchers have observed several statistically significant relationships between collisions and individual driver-related variables. In the next and final section we will review what is known about the relationship between performance on the permit exam and collision risk.

Section 3
What is Known

In section three we will review the findings of a total of 24 studies that examine the nature of the relationship between collision risk and performance on driver's permit exams, both theory and practical. Before proceeding, it should be mentioned that criteria for exam performance differ across studies. The first of the two criteria of exam performance specified by the SAAQ, the number of attempts required to pass the exam, is only reported by three researchers, Dionne *et al.* (1997) Kaestner (1964, in MacDonald, 1987) and Maycock (1995). The remaining studies reviewed here correlate driving records either with total permit exam scores and/or scores on selected parts or specific manoeuvres of the permit exam. The second criteria of exam performance specified by the SAAQ, duration of learning process, is also only correlated with driving records in three studies, Dionne *et al.* (1997), Harrington (1972) and Maycock (1994), In addition, due to the relatively low frequency of collision events and/or the unreliability of collision data, some researchers have selected traffic violation records in conjunction with or as a surrogate for collision records.

Another point worth mentioning is that in previous literature reviews on this topic (Atkins, 1984; Mayhew and Simpson, 1990; Staysafe, 1988; Torpey, 1988), little or no differentiation was made between exams administered to novices and those given to experienced drivers, which potentially confounds the analysis of the overall findings. Therefore, the studies presented here have been arranged according to type of candidate and type of evaluation (see Table 2). The focus of this present literature is restricted to automobile permit exams, both theory and practical, for novice candidates. However, mention will be made of pertinent findings from studies on commercial and renewal permit exams for experienced drivers as well as from studies on advanced and experimental permit exams. All the studies will be summarized in Tables 3, 4 and 5. Each study will be numbered, i.e. #1, for easier reference in the discussion sections following each table. Studies will be repeated in different tables if they present findings that pertain to each.

Table 2

Different types of research studies that correlate descriptive data on driver's permit exams with driving records

Candidate Type	Evaluation Type	Type of driver's permit exam	
Novice	Automobile permit	Theory	Practical
Novice	Motorcycle permit		
Experienced	Commercial permit		
Experienced	Renewal		
Experienced	Advanced and experimental		
Experienced	Advanced and experimental		
Experienced	Advanced and experimental		

Previous Literature Reviews on Novice Automobile Permit Exams

The general conclusion of previous literature reviews on the relationship between collision risk and scores on the driver's permit theory exam is that scores on written exam cannot accurately predict driving behaviour (Atkins, 1984; Mayhew and Simpson, 1990; Staysafe, 1988; Torpey, 1988). Similarly, the general conclusion of previous literature reviews on the relationship between collision risk and practical exam scores is that scores cannot accurately predict driving behaviour (MacDonald, 1987; Mayhew and Simpson, 1990; McPherson and McKnight, 1981). These conclusions appear to be valid insofar as exam results, taken as a single and end measure in the process of driver licensing, have not proven to have sufficient specificity and sensitivity to act as a screen for high collision risk drivers. However, the question under consideration in this present review differs from previous literature reviews in that it examines the general nature of the relationship between exam performance and collision records. In light of this broader question, we can observe that in the majority of the studies described within the previous literature reviews, as well as in other studies conducted after those reviews were written, researchers have consistently discovered statistically significant correlations of varying strengths between driver's permit exam scores and collision risk. In the majority of studies, superior licence exam performance indicated safer future driving records. In some cases, these relationships applied to the entire study population, in others they applied only to specific age and gender groups within the study population. Tables 3 to 5 report the most relevant findings of these studies which are described in more detail and summarized in the pages following each table.

Table 3

Studies correlating driver's permit theory exam scores (total or partial) with driving records

Study Number	Author(s)	Findings
#1	Freeburg and Creech (1971 in Atkins 1984)	Exam scores added to background information (i.e. age) predicted collision risk for males only.
#2	Dreyer (1976)	Higher scores on exams covering only road rules and signs were weakly associated with fewer collisions and convictions.
#3	Conley and Smiley (1976)	Certain exam errors correlate positively with violations and others negatively .
#4	Stoke (1978 in Atkins 1984)	No discernible pattern of prediction was found among the few correlations that emerged.
#5	Carpenter (1978a)	Six month prospective study found no difference between two types of theory exams. Number of errors on both exams positively predicted violations and collisions.
#6	Carpenter (1978c)	One year prospective study of the effects of adding safe driving content to exams found an increased collision risk for candidates who passed new safe exam with same pass threshold as standard exam. No effect on collision risk was found when pass threshold for new exam was higher. The number of errors on both exams correlated with number of driving violations.
#7	Schuster (1978)	Found evidence that the cognitive teaching and testing of collision avoidance techniques reduced collision risk for beginning drivers for the first year after training.
#8	McKnight and Edwards (1982)	Two-year prospective study found that new drivers who took special manuals and exams had significantly fewer collisions with convictions than the control group which received the regular driver's manual and exam.
#9	Dionne *et al.* (1997)	Found that new drivers who passed their theory exams in one trial had fewer collisions than those who took more than one trial to succeed.

Study #1: Freeburg and Creech (1971) compared theory exam scores to driving performance and found that score alone did not accurately predict collisions or citations. However, successful predictions of collision risk could be made concerning males when theory exam scores were added to background information such as age, formal education, years of driving, and miles driven per week.

Study #2: Dreyer (1976) developed exams which tested only knowledge of the rules of the road and of signs concluded that those with better theory exam scores tended to have fewer subsequent collisions and convictions; however, these correlations were low. Females tended to do better on the theory exam, worse on the practical exam than males, and also had fewer collisions than males.

Study #3: Conley and Smiley (1976) conducted a four year prospective study of 22,523 new drivers and then examined the records of a subpopulation of 5,848 drivers who had received at least one violation and 1,048 drivers who had been involved in a collision. Their objective was to study the relationship between knowledge and driver behaviour. Knowledge was measured by the answers on one of five forms of the Illinois theory exam, each consisting of 25 multiple choice items developed by Conley (1969). Driver

behaviour was indicated by collision characteristics and violations. The study also tested the hypothesis that those who had the most errors in knowledge would have the greatest number and severity of violations and by extension, the most violation points. To this end, eleven violation categories, which represented the highest frequency of violation and which had corresponding questions on the theory exams, were chosen for analysis. Although the overall conclusion was that there is no consistent pattern of knowledge, sex of driver, and source of education to suggest predictability of moving traffic violations, there were nonetheless some interesting findings.

Errors on the exam questions concerning signs, signals and markings, lane usage, and speeding weakly predicted violations in the same categories. Errors on the exam questions concerning stopping, following too closely, and reckless driving indicated a decreased likelihood of having a particular violation in question. Each of the 11 violation categories, except for passing, following too closely, and reckless driving, had at least one form of the exam that yielded questions that met the minimum 90% confidence standard of predictability. Concerning gender, males and females are equally unpredictable overall, though each seems to have violation categories in which prediction has a greater probability of success. The least amount of negative correlation occurs with those drivers who have not had either a high school or commercial driver education course. The high school course recipients have the greatest amount of negative correlates and thus the largest record of unexpected relationships between knowledge and behaviour.

Study #4: Stoke (1978 in Atkins 1984) found no discernible effect when he compared the subsequent collision and violation history of groups of new drivers with their performance on a theory exam. According to the author of the study, this result indicates two conclusions: (1) that exams on the rules of the road on their own cannot adequately screen risky drivers, And; (2) that even if the exams do create an incentive to learn the material in the driving manual, assuming that the knowledge is of some importance, either the theory exams do not create proper incentives or alternatively the exams and manuals do not cover the proper material.

Study #5: Carpenter (1978a) attempted to determine if two series of exam forms testing knowledge of different types of information (either uncodified "safe driving" knowledge or standard rules of the road), differentially affected subjects' subsequent driving records, and if so, to what degree exam scores correlated with driving performance. Data from a six-month follow up after the theory exam revealed no statistically significant differences between the mean driving-records of experimental and control group (standard exam), indicating that the "safe driving" theory exams did not result in a change in collisions or convictions. All correlations between numbers of items wrong and prior or subsequent driving records were positive and statistically significant, indicating a slight tendency for drivers who made fewer errors on either exam series to have fewer collisions and convictions than drivers who made more errors.

Study #6: Carpenter (1978c) found an adverse effect of knowledge on collision risk when new expanded theory permit exams were administered to inexperienced (first-time) drivers using different passing scores. First time candidates who were administered new exams having similar pass score thresholds as the standard exam had significantly *more* collisions in the year following testing compared with the control group, which received the standard exam. One can speculate that this difference might be due to the risk-increasing effect of overconfidence manifested by the candidates who passed the experimental exam with a relatively low pass threshold. This hypothesis is supported by the finding from the same study that found no evidence of an increase in collisions among candidates receiving the new exam in conjunction with a more stringent passing score requirement. Presumably the higher pass threshold eliminated the higher risk drivers. Exam score correlations with subsequent driving records were similar for the two exams. Those who had fewer errors had fewer traffic convictions than applicants who had more theory exam errors.

Study #7: Schuster (1978) programmed instruction/testing to teach safety techniques to 192 high school students in driver education. The independent variable was training feedback/testing, which had 4 levels: (a) no exam and no feedback; (b) exam with an IBM answer format, but no item feedback; (c) exam with a 'punchboard', a testing device providing immediate automatic scoring, and immediate individual item feedback; and (d) double testing with punchboard and training feedback. Pressed punchboards provided the programmed testing training by registering a response and indicating the correctness of the choice immediately. If initially wrong, a subject continued working until that item was correct. Separate ANOVAs were done for (a) number of driving collisions, and (b) moving violations year by year in the 3 years following training. For the first year only, the punchboard-twice drivers had one-fourth the collisions of the no-exam control drivers. The author concluded that the cognitive teaching and testing of collision avoidance techniques helped beginning drivers for the first year after training to drive with fewer collisions. Investigation on prolonging the effect is needed.

Study #8: McKnight and Edwards (1982) conducted a two-year prospective study to determine whether designing special manuals and exams to accommodate drivers with certain characteristics, specifically new applicants, renewal applicants and older applicants, would improve driving safety. They then tested the results of this approach on collision risk. They found that the treatment group of new drivers had significantly fewer collisions with convictions than the control group who received the regular driver's manual and exam.

Study #9: Dionne *et al.* (1997) studied SAAQ statistics for the period starting 1989 and ending 1993 to evaluate the effects of a 1991 government reform in the driver licensing system. From 1983 to 1991 all new drivers in Quebec were obliged to take a driver education programme consisting of 28 hours of theory and eight hours of driving. The theory could be taken before the age of 16 but the learner's permit required for the eight hours of practical driving could not be obtained before that age. Learner's permits were issued upon proof of registration with a driving school and without any theory testing. The required

eight hours of driver training could be completed in a minimum of 17 days. Therefore it was possible for new drivers to complete their training, pass their theory and practice exams and obtain a full priviledge driver's permit three weeks after turning 16 years of age. The 1991 reform eliminated the obligation for theory classes, required success on the theory test as a condition for obtaining a learner's permit, increased the number of required hours of driving instruction from eight to 12 and imposed a three month delay between the date of obtention of the learner's permit and the first appointment for the practical exam. This reform did not appear to have any direct effect on collision rates per new permit holder for both genders and all ages. Nevertheless, certain effects pertinent to the relationship between theory exam performance were obtained. New permit candidates who succeeded on their theory exam in one trial were involved in fewer crashes for both genders. Those who took more than one trial to succeed registered crash rates 32% and 21% higher in the prereform period and 28% and 14% higher in post reform for men and women respectively.

Summary of Findings of Table 3

What can we conclude about the nature of the relationship between performance on the theory driver's permit exam and collision risk based on the studies listed in Table 3? Five of the nine studies, #2, #5, #6, #8, and #9, report statistically significant correlations of various strengths between higher exam scores (or success on the first attempt to pass the exam) and subsequent collision and/or violation records. A sixth study, #1, found that for males only, lower exam scores in combination with other factors predicted higher collision risk. An adverse effect was observed in study #6 when a new experimental exam was administered with the same pass threshold as the standard exam. However, this adverse effect disappeared when the pass threshold on the experimental exam was raised, indicating that the increased collision risk associated with the experimental exam might be associated with overconfidence on the part of the newly licensed candidates. Increased collision risk associated with overconfidence might also account for the results of studies #3 and #4 that found both positive and negative correlations between specific exam errors and specific violations.

If we consider the evidence of the studies reviewed above and assume that, in general, higher theory exam scores indicate increased safety, we can hypothesize that the weak and sometimes inverse correlations between exam scores and collision risk might be due to the fact that a standardized theory exam is administered to a heterogeneous population of permit candidates. For some subgroups, a low exam score on certain questions may indicate a lack of competence that could increase collision risk. For other subgroups, a higher score on certain questions may signify increased competence which could lead to over-confidence and greater risk-taking. One solution to this dilemma would be to examine identifiable sub-groups of permit candidates differently. Study #8 demonstrated that significant safety results can be achieved when different groups of novice drivers are treated with specialized training manuals and exams. Another means for reducing collision risk might be to organize the training and

testing of novice drivers along the principles of specific cognitive skills related to collision avoidance, as demonstrated by study # 7.

Novice Automobile Permit: Practical Exams

In the following section we will review the studies that examine the relationship between various measures of performance on the practical exam and subsequent risk of collision of traffic violation (see Tables 4 and 5). Detailed descriptions of these studies accompany the tables and are followed by a brief discussion.

Study #10: Campbell (1958, in MacDonald, 1987) compared a group of drivers involved in fatal collisions with a random sample. The collision group were found to have a lower average passing score on their original practical exam than the random sample, but the groups did not differ significantly on most of the individual manoeuvres which constituted the total score.

Study #11: Lauer (1960, in MacDonald, 1987) concluded that a single manoeuvre, parallel parking with six feet clearance, is the best indicator of competence to drive as indicated by subsequent collision rate, with a secondary indication available from correct turning manoeuvres in which signals were given. The researcher recommended that the actual practical exam be confined to these manoeuvres.

Study #12: Kaestner (1964, in MacDonald, 1987) investigated the relationships between performance on the Oregon permit exam and subsequent collision record. Passing scores of males were not found to be significantly related to collisions. For females, those with high passing scores were more likely to go five years without collision than females with low passing scores. There were no significant relationships for either gender between practical exam failures or passing practical exam scores and the percentage of drivers without collisions.

Study #13: McRae (1968, in MacDonald, 1987) found significant but weak correlations between North Carolina driver permit exam scores and subsequent collision and violation records. Drivers aged 16 to 20 were classified into three groups according to their record in the two years subsequent to licensing: clear record, minor violations only, and collision (two or more collisions, or one collision plus one major violation). Using weighted values for the various practical exam manoeuvres, significant differences were found in scoring patterns between the groups, the collision group having the lowest scores. Deficiencies in two different classes of skills seem to contribute to increased collision risk. The first was the "physical handling of the automobile" class, including 'brake stop', turn about, stop and start and clutch manoeuvres. The second was an "interaction with traffic" class, including attention, keeping in lane, right of way and 'first to slow' sign.

Table 4
Studies that found that higher scores on the practical exam correlated with lower risk of collision

Study Number	Study	Findings
#10	Campbell (1958, in MacDonald, 1987)	Lower passing scores associated with higher collision risk.
#11	Lauer (1960, in MacDonald, 1987)	Parallel parking and turning best predictors of collision rate.
#12	Kaestner (1964, in MacDonald, 1987)	No significant relationships between practical exam failures and collision risk. For females only, higher scores were associated with five years without collisions.
#13	McRae (1968, in MacDonald, 1987)	For ages 16 to 20 only, significant but weak associations exist between increased collision risk and exam scores indicating poor control skills and lack of awareness.
#14	Waller (1968 in MacDonald, 1987)	For ages 30-59 only, higher exam scores significantly associated with lower collision rates.
#15	Harrington (1972)	For males aged 16 and 17 only, lower practical exam scores associated with higher collision and traffic violation records.
#16	Creech and Grandy (1974 in Mayhew and Simpson, 1990)	Significant but weak correlations between practical exam scores and subsequent driver records.
#17	Coppin (1977 in Mayhew and Simpson ,1990)	Poor performance during the backing/parking manouevre best indicator of driving record.
#18	Forsyth (1992a, 1992b, in Maycock, 1994)	Errors made during test same for both accident groups but severity of errors different; more women made control errors. For males, none of the individual car control error groups were predictive of collisions. Females with three control errors had collision risk 26% higher than those who did not make these errors. Four or more "awareness and anticipation" errors were strongly positively correlated with increased collisions for males (24%) and females (19%).
#19	Maycock (1995)	No statistically significant differences in collision risk associated with number of exams taken after controlling for age, sex and exposure.
#20	Dionne *et al.* (1997)	After law reform requiring a 3 month learning period females who succeeded at the first attempt at the practical exam after the reform had 9.2% fewer collisions than females who made more than one attempt to pass.

Study #14: Waller and Goo (1968, in MacDonald, 1987) found little relationship between collision rates and passing scores on the Californian practical exam. Among drivers aged 15-29 there were no significant differences in collision rate by exam score. However, among drivers age 30-59, those with high and mid-rage scores had significantly lower collision rates than lower scoring drivers. Thus, there was evidence of exam validity only for drivers over 30 years of age.

Study #15: Harrington (1972) related passing scores of 16 and 17 year olds on the California practical exam to number of collisions during the first four years of driving. Several statistically significant relations were found, but none were very strong. For males, there was a statistically significant correlation ($p<.05$) between lower practical exam scores and number of collisions over the subsequent four years. Lower practical exam scores also correlated significantly ($p<.05$) with convictions over the

subsequent four years for females (-.024) and males (-.046). Increased collision risk is significantly ($p<.050$) and positively correlated for males who license at a younger age (.055) and have longer durations (.030). The duration of the learner's permit is significantly ($p<.050$) and negatively correlated with convictions for both males (.075) and females (.098).

Study #16: Creech and Grandy (1974, in Mayhew and Simpson, 1990) found significant but weak correlations between driver permit exam scores and subsequent driver records.

Study #17: Coppin (1977) referred to unpublished California research which indicated that performance during the backing/parking manoeuvre is the best predictor of one's future driving record.

Study #18: Forsyth (1992a, 1992b) found that the type of errors made during test were the same for both accident groups but that the severity of those errors were different. Errors were divided into to categories, car control and perceptual/judgemental. For male drivers, none of the individual car control error groups were predictive of subsequent accident liabilities. More women made control errors, and there was a the strong positive correlation between errors committed during the execution of the special maneuvres (turning in the road, reversing and emergency stopping) and subsequent accident liability. Women drivers with three errors of this kind had an accident liability 26% higher than those who did not make these errors.

In the perceptual/judgemental category, "awareness and anticipation" were strongly positively correlated with accidents for both genders. Male drivers commiting four (or more) errors of this kind while on the test had an accident liability which was 24% higher than males who did not commit any errors of this kind. Female drivers commiting four (or more) errors of this kind while on the test had an accident liability which was 19% higher than females who did not commit any errors of this kind.

Study #19: Maycock (1995) summarizes some of the key results from the British study of collisions experienced by a cohort of novice drivers during the first three years of driving. Self-reported collision records were associated with a range of attributes concerning the way they learned to drive, their performance on the Department of Transport practical exam, and certain self-reported aspects of their driving skill and behaviour.

Exam performance in terms of the number of attempts required to pass the practical exam was analyzed in relation to collision risk. Maycock considers that this criteria of exam performance focuses attention on an important issue of interpretation. If training for the exam and the exam itself succeeds in its purpose of bringing all drivers up to the same standard of driving - and by implication a uniform standard of safety on the road for a given age and gender - then the collision risk of drivers who have passed the exam should not depend on how many exams have been taken. Judged at the 5% level of significance, the results of the analysis of this variable indicate that there are no statistically significant collision

differences related to how many exams have been taken after controlling for age, gender and exposure. In fact, for male drivers the effect is very small and negative. For females the effect is larger (significant at the 10% level) and positive. The study also found that males with a duration of 110 months of "learning to drive" had a collision risk 28% lower than males who had been learning for only 2 months prior to licensing.

Table 5

Studies that found that higher scores on the practical exam had either no effect or correlated positively with higher risk of conviction or collision

Study Number	Study	Findings
#21	Wallace and Cramar (1969, in MacDonald, 1987)	No significant relationship between exam scores and subsequent four-year driving record.
#22	Jones (1973 in MacDonald, 1987)	No significant correlations between practical exam score and subsequent six month and one year collision records.
#23	Sheppard *et al.* (1973 in MacDonald, 1987)	No statistically significant relationship between any of the 67 types of driving error and collision risk.
#24	Ratz (1978a, c)	Higher scores correlated significantly with more convictions.
#25	Dionne *et al.* (1997)	Evaluation study of the effects of new licensing rules. For males, success at the first attempt of the practical exam before the reform associated with a significantly higher crash rate (6%) in first year of driving. Effect disappears after law reform requiring a 3 month learning period.

Study #21: Wallace and Cramar (1969, in MacDonald, 1987) found no significant relationship between practical exam scores in the State of Washington and subsequent four-year driving record.

Study #22: Jones (1973, in MacDonald, 1987) found no significant correlations between California practical exam scores and subsequent six month and one year collision records of teenage candidates.

Study #23: Sheppard *et al.* (1973, in MacDonald, 1987) studied the relationship between minor faults made by 1,123 drivers when passing the official exam and their collision rate in the following year. They found that those with several kinds of faults were no more likely to be involved in a collision than those

few kinds of faults. There were no relationship between any one of the 67 types of error and subsequent involvement in collisions.

Study #24: Ratz (1978a) developed two modifications of the standard California practical exam -- the first to make the exam more difficult, the second to make the exam more comprehensive and more difficult. Both exams had a first time fail rate of approximately 50%. Parallel parking was selected for use on the new exam on the basis of its correlation with practical exam scores and it dual-rates reliability. Both the standard and the comprehensive exam were significantly correlated with age, the older drivers tending to receive lower scores. The new exam was significantly correlated with gender, the males tending to have higher scores. The standard exam was not significantly correlated with gender. Both practical exams were significantly correlated with convictions in that higher scoring applicants showed a slight tendency to receive more traffic convictions.

There were no more individual exam items that were significantly correlated with either collisions or convictions than could be expected by chance. Exposure was not controlled for.

Ratz (1978c) also attempted to determine if novice drivers would have safer driving records if they took a longer, more "comprehensive" practical exam compared with the standard practical exam with parallel parking and a higher failure rate. A sample of 36,000 previously unlicensed candidates for a California driver's permit were given one of three treatments. The first (control) group given the standard California practical exam, with failure rate equal to the current statewide average. The second group was given the standard California practical exam with scoring altered so 50% of the subjects failed on their first attempt, plus an exam on parallel parking. A third group was give a practical exam which required approximately twice as long to complete as the standard practical exam and included substantially more driving in high-density traffic. The first time failure rate for this group was 50%. One year subsequent collision and conviction records were analyzed to determine treatment effect. No significant differences were found. Because the results did not indicate that there were benefits to be expected from implementing either program, and because both programs would be more expensive to administer, implementation was not recommended. Once again, exposure was not controlled for.

Study #25 : Dionne *et al.* (1997) found that success at the first attempt of the practical exam before the reform was associated with a significantly higher crash rate (6%) in the first year of driving for male drivers only. This effect disappeared after the reform. However, females who succeeded at the first attempt at the practical exam after the reform had 9.2% fewer collisions than females who made more than one attempt to pass. Also, accumulated experience as measured by the number of days with a driving permit is associated with a lower crash rate, especially for 16 year old males and 16-17 year old females, but not for older age groups. There were marginal age effects on crash rates: males 20 years of age and over and females 17 and over had lower crash rates in the first year of driving than the 16 year olds. The authors concluded that the two results related to age indicate that new permit holders do not

represent a homogeneous group of crash rates even though the regulation does not make any distinction. The same applies for gender, where males have twice the crash rates of females.

The duration of learning to drive, as measured by the delay between the obtention of the learner's and regular permits, increased by 1.3 months in the post reform period, whereas the mean age of acquisition of the regular or probationary permit declined, especially for women. Economic recession was present at the same time as the reform, making it difficult to disassociate the two effects (reform and recession) on the diminishing number of first permits obtained.

Summary of Findings of Table 4 and Table 5

What can we conclude about the nature of the relationship between performance on the practical driver's permit and collision risk based on the total of 16 studies listed in Tables 4 and 5? The majority of studies, all 11 represented in Table 4, report statistically significant positive correlations between some measure of performance on the practical exam for one or both genders and lowered collision risk. Table 5 presents five studies, four of which produced no statistically significant results and one which produced a positive correlation between exam performance and collision risk that disappeared when the learning period was increased from three weeks to three months. We will now examine the study results more closely in terms of exam performance as measured by total scores, partial scores, number of attempts needed to pass and the duration of the learning period.

Exam performance as measured by total exam score: In terms of total exam scores, better overall performance on the practical exam appears to be associated with safer but not necessarily more legal driving records. Study #15 found that higher total scores indicated lower risk of collisions and convictions among 16 and 17 year olds of both genders. Studies #10 and #16 found that higher total scores indicated lower collision risk, presumably also for study populations of younger drivers of both genders. In study #14, higher total scores indicated lower risk of collisions only for novice drivers aged 30 to 59. In study #12, higher total scores indicated lower risk of collisions only for female novice drivers. However, studies #21 and #22 report no significant relationships between total exam scores and collision risk. Study #24 reports that higher exam scores correlate significantly and positively with higher conviction rates but not with collisions.

Exam performance as measured by partial exam scores: In terms of partial exam scores, four out of eleven studies found statistically significant correlations between higher collision rates and errors in two classes driving skills: car control skills and perception and judgement. Collisions were predicted by errors in the following car control tasks: parallel parking (#11), stopping, turning, clutching manoevres (#13); reversing and parking (#17), and; turning in the road, reversing and emergency stopping, for

females only (#18). Only study #23 found no relationship between minor faults made by novice drivers during the practical exam and their collision rate in the following year.

In the perceptual/judgemental category, errors in attention, keeping in lane, yielding right of way and slowing helped predict collision risk (#13). In study #18, drivers who committed four or more "awareness and anticipation" errors during the practical exam compared with drivers who committed no errors of this kind were at increased collision risk within each gender group, males (24%) and females (19%).

Exam performance as measured by number of attempts needed to pass the practical exam: Study #25 reports that success at the first attempt of the practical exam was associated with a significantly higher crash rate (6%) in the first year of driving for male candidates. However, this effect disappeared after a legislative reform extended the duration of the learning period from three weeks to three months. After the reform, female candidates who succeeded at the first attempt at the practical exam had 9.2% fewer collisions than those who took more than one attempt. Studies #12 and #19 found no statistically significant relationship between exam failures and collision rates. However, in comparison with study #25, studies #12 and #19 each have study populations 1/20 the size and the collision data of inferior quality.

Exam performance as measured by "duration" of learning period: One of the specific research questions which this review attempts to address is the nature of the relationship between duration, the time measured between the obtention of the learners permit and the obtention of the first driver's permit, and collision risk. The authors of study #25 ask whether collision risk could be reduced by extending the duration? The answer to this question concerning male drivers is negative, according to study #15, which found that among 16 and 17 year olds males, duration is significantly ($p<.05$) and positively correlated with collisions ($r = .030$). Duration is significantly ($p<.05$) and negatively correlated with convictions for both males and females, ($r = -.075$) and ($r = -.098$). However, the answer is positive according to study #19, which found that longer durations are associated with decreased collision risk: males with a duration of 110 months of "learning to drive" had a collision risk 28% lower than males who had been learning for only two months prior to licensing.

Conclusion

As anticipated in the introduction, it is very likely that both variables of interest, permit exam performance and collision involvement, are influenced by a wide variety of other known, unknown and possibly unpredictable variables, some of which may be correlative and not easily disentangled, i.e. age, maturity, experience, and exposure. Therefore, any relationship or lack of relationship reported in this document between driver's permit exam performance and collision records might easily reflect the

influence of confounding variables. As a result, at the present time, it is very difficult to establish any clear relationships between exam performance and collision rates.

However, ff permit test administrators are interested in improving the validity of driver's permit exams, two results are worth noting. The first is that of McKnight and Edwards (1982), who found that the use of special manuals and exams designed to accommodate drivers with certain characteristics, specifically new applicants, renewal applicants and older applicants, were associated with significantly fewer collisions with convictions than the control group who received the regular driver's manual and exam. Adopting this approach to license exams would require a more rules of standardization could be interpreted more broadly and exams could be necessitate changing the rules of standardized testing and could raise legal challenges based on discriminatory treatment.

The second result could be used to improve the content validity of permit tests. Schuster (1978) found evidence that the cognitive teaching and testing of collision avoidance techniques reduced collision risk for beginning drivers for the first year after training. To the best of my knowledge, no other research has found this promising result and it is definitely worthy of further investigation.

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