

Prediction of Driving Accident Risk in Novice drivers in Ontario:
Part One: the Development of a Screening Instrument.

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Abstract

Research Questions:

Our initial hypothesis in part one of the study was that, severity ratings from driving Instructor's structured observations of students driving behavior would positively correlate with other aspects of the experimental screening instrument that included objective computerized measures of cognitive impulsivity as well as subjective measures of temperament and driving behavior.

Our second hypothesis, to be tested in part two of this research, is that a combination of objective driving ratings and computerized measures of cognitive impulsivity along with subjective self-report measures will produce screening instrument that will predict outcome of driving based on a combination of Ministry of Transport of Ontario outcome data for accidents and convictions as well as self reported accident experience collected by telephone interview, collected over the initial four year risk period. This could allow for development of preventative remedial programmes for high risk group of novice drivers

Method:

The current "gold standard" for predicting problem driving is based on both subjective and objective descriptions of actual driving behaviour. This study utilized driving instructors evaluations of driving based on real-time, on the road, observations of driving behaviour to generate a four factor risk profile, a global Risk Rating, a Current Risk, a Safety rating and prediction of Future accident. This Risk profile was correlated with results from an office based series of measures utilizing a screening instrument consisting of objective computerized cognitive measures along with subjective self-report measures of driving behaviour and personality style. Multivariate statistics and Logistic Regression analysis generated correlation findings regarding the amount of agreement regarding risk measured by the driving instructor and the office based measures of risk.

Results:

We have been able to demonstrate that approximately 33% of a convenience sample of volunteer subjects is rated as being at high risk of future driving problems by their driving instructors on a Risk Rating scale. This proportion of high-risk drivers is reflective of the total student group of students trained in the programme during this study based on evaluation of risk measured by the driving instructors on the same scale by the same driving instructor group where the prevalence of high risk drivers identified in the larger more representative sample was 25%. Demographic correlates of male sex and grade level achievement in school were strongly associated with driving instructors' evaluation of risk. Age appeared to be unrelated to risk. The significant correlated pathology measured by the experimental screening instrument of tests associated with increased driving risk relate primarily to cognitive inattentiveness as measured by ratings of cognitive variability of attention on the Conner's CPT-II accounting for 13% of the variance which when combined with temperamental variable of impulsivity as measured by the Novelty Seeking trait on the Temperament and Character inventory (TCI) accounts for a total of 21% of the variance. When factoring in gender and two measures on the self-report driving style instrument (JDQ) we were able to account for up to 32 % of observed and predicted driving instructor risk measures. Thus our initial hypothesis was supported. The more definitive empirical answer as to which combination of variables will eventually provide the best prediction of outcome of driving risk will become clearer with the second part of this study which will follow up the sample over a four year period of driving risk to determine the outcome with a combination of official MTO data and self -report telephone interview. This in turn will help us better define which combination of variables most accurately predicts problem driving behaviors over time in this group of novice drivers known to be at increased risk in comparison to more experienced and older road users.

Introduction

Background.

There are six million drivers in Ontario. 1.3 million or 22% are deemed to be problem drivers who have had previous driving offences or crashes and are at increased risk for "problem driving"(Ministry of Transportation of Ontario 1991). The Ministry of Transport publication "Ontario Road Safety Agenda" (1994) outlines the epidemiology of problem driving. One specific target group known to be at increased risk are younger, new drivers. New drivers are three times more likely to be killed than the average driver. They make up 15% of licensed drivers and have 30% of driver fatalities. Statistics from "Drinking and Driving in Ontario Statistical Yearbook 1990" indicates that the 19 - 24 year-old group are over-represented both in terms of non-drinking accidents as well as drinking related accidents. For this reason, new drivers have to go through a graduated licensing program. At the age of 16, an application can be made for a beginner's license. After obtaining a G1 licence, the probationary driver can drive under the supervision of an experienced driver. The probationary driver must stay off 400 series highways, abide by a 12:00 a.m. to 5:00 a.m. curfew, and have zero serum alcohol whilst driving. After 12 months supervised driving, eight months if they have completed an approved MTO approved driving course, they can take their G2 road test that allows them to drive without a supervising driver in the car but with the continued requirement of zero blood alcohol. After a further 12 months they can apply to take their final road test to obtain the full G licence. This is the graduated licensing program currently in force in Ontario. This system tries to protect against risk through education and progressive experience. Whilst the effectiveness of the graduated licensing program is beginning to be evaluated, current best estimates are that two thirds of all accidents are not predictable on the basis of current knowledge of driver characteristics and training (Ontario Road Safety Agenda, 1994). This study will attempt to show that ***a screening instrument*** designed to evaluate new drivers' impulsivity may lead to more accurate prediction of problem driving and eventual primary prevention interventions.

Impulsivity, a behavioural characteristic of adolescent drivers: Beirmess, Simpson and Mayhew (1993) examined Grade 9 and 10 high school students (roughly ages 14-16) in Eastern Ontario. They evaluated the social, psychological and behavioural characteristics of this group and related them to self-reported crash involvement. The data demonstrated that the difference between young people who became involved in a collision and those who did not were evident up to three years prior to their crash involvement. The authors described the characteristics of the subjects in terms of **problem behaviour theory**, aspects of which they labelled as a form of behavioural impulsivity. Characteristics in this profile included: a) higher thrill and adventure seeking and experience seeking; b) greater tolerance of deviance; and c) a more liberal attitude towards alcohol use. Their driving records showed they were: a) more likely to have received a traffic ticket; b) to have had to take evasive action to avoid collision; and c) scored higher on a rating scale of risky driving practices. Conclusions by other researchers (Wilson, R.J. & Jonah, B.A. 1988) have suggested that a small subset of youth, characterized by an overabundance of these factors, exhibit a wide range of problem behaviours not the least of which is involvement in traffic crashes. In particular, adolescents with a diagnosis of attention-deficit/hyperactivity disorder (ADHD) are at increased driving risk (Nadaraja et al., 1997; Murphy & Barkley, 1996; Barkley et al., 1993). However, ADHD cannot explain all the at-risk individuals. Current research has not fully identified all the life style variables involved, nor has it yet succeeded in determining which are the most important predictors of collision involvement (Beggs et al., 1999). Furthermore, other factors such as gender, conduct problems and distance driven, all predict increased driving risk (Woodward et al., 2000.) Other studies have explored a central variable, impulsivity, that may be common to both normative and clinical samples and has been shown to be one of the key temperamental variables related to increased driving risk (Gottfredson & Hirsch, 1980; Gorenstein & Newman, 1980; Fowles, 1988; Cloninger, 1987; King et al., 1992; Kindlon et al., 1995). Jerome and Segal (2000), explored impulsivity as a key factor linking problem behaviour theory as manifested by conduct problems and substance misuse with problem driving behaviours such as speeding and aggressive driving patterns ("road rage"). This study attempts to examine the relationship between this key construct of impulsivity and the prediction of problem driving.

What is impulsivity: Impulsivity is often defined as an urge or desire to act that is difficult to resist. While this sounds to be a simple proposition in fact it is much more complex. Impulsivity is currently conceptualized as a temperamental characteristic (Cloninger, 1996), with a biological basis related to executive function of the brain (Barkley, 1997). We all have a different propensity for impulsive responding the expression of which is modified by development; by the assimilation of societal rules, social empathy, and moral development and other general, life experiences. Impulse control is therefore a reflection of this developmental process in transaction with this basic temperamental dimension. Impulsivity is defined by the following two paradigmatic models: Firstly a difficulty inhibiting a response when the response is not part of an ongoing behavioral sequence, and secondly a difficulty stopping a dominant response when the response sequence is ongoing. The evaluation of impulsivity has been extensively studied (cf. Oldham et al., 1996) since it is the core characteristic of many psychiatric disorders (i.e. ADHD, bipolar affective disorder, addictions, bulimia etc.). Current research has focused largely on the cognitive systems thought to control impulsivity. The two main approaches to assessing the cognitive domain involve firstly, the assessment of inhibitory control and secondly, the measurement of speed and accuracy of response. Tests of impairment in inhibitory control are thought to assess modulation, planning and inhibition of behaviour. They are based on neuropsychological tests of executive frontal lobe function. More impulsive individuals have been shown to have significant difficulty delaying responding and switching to more appropriate strategies. The second group of measures are not specifically related to the inhibition of a dominant response, but assess speed and accuracy in carrying out a task. They characteristically involve processing auditory or visual information followed by a motor response. More impulsive individuals have been shown to perform tasks faster but less accurately. Reliable psychometric properties of these impulsivity measures have recently been described (Kindlon et al. 1995; Tannock, 1998).

Evaluation of impulsivity: This study hypothesized that a combination of newer cognitive tests of impulsivity and more traditional general measures of temperament and character as well as specific reports of behavioural style related to attention and impulsivity might more reliably predict that subgroup of new drivers at-risk for problem driving. Prior studies evaluating at-risk adolescent drivers did not use the newer cognitive measures of impulsivity, but relied heavily on semi-structured interviews and rating scales (Nada-rajá et al., 1997; Murphy & Barkley, 1996; Barkley et al., 1993). This study proposes to combine these two types of measures of impulsivity and a variety of self-report rating scales in order to prospectively predict driving risk in a *non-clinical* sample of Ontario secondary school students. This has never been done in prior studies reported in the literature.

The evaluation of driving risk: The current “gold standard” for predicting problem driving is based on both subjective and objective descriptions of actual driving behaviour. Barkley et al., (1993), and Nada- Raja et al. (1997), both demonstrated that driver self-report in a sample of young first time drivers significantly correlated with actual driving records. Donnelly et al. (1992), showed that driving instructors evaluation of drivers performance on the road was the best predictor of problem driving in elderly drivers with Alzheimer’s disease. West and Hall (1998) demonstrated that both self-report and driving instructors’ structured observation were highly predictive of problem driving. Dobbs and associates have demonstrated that empirically derived driving instructor observation accurately predicted hazardous errors in older patients showing cognitive decline. Furthermore, Dobbs and his coworkers have been able to show that these hazardous driving errors can be accurately predicted on the basis of a cognitive screening battery (Dobbs, Heller and Schopflocher, 1998; Dobbs et al., 1998). Our study utilized driving instructors’ evaluations of driving based on real-time, on the road, observations of driving behaviour. A subjective, semi-structured self-report questionnaire, The Jerome Driving Questionnaire, and an objective driving instructors’ evaluation, utilizing an instrument based on the West and Hall studies were used to provide ratings of subjects’ observations about their own driving as well as objective observations of their driving behaviours completed by their driving instructor.

Research Questions:

- a) We hypothesized that severity ratings from driving instructors' structured observations of students' driving behaviour would positively correlate with other aspects of the experimental ***screening instrument*** which included ***objective*** computerized measures of cognitive impulsivity as well as ***subjective*** measures of temperament and driving behavior.
- b) We hypothesize that, in part two of this study, a combination of objective driving ratings and computerized measures of cognitive impulsivity along with subjective self-report measures will produce ***a screening instrument*** that will predict outcome of driving based on a combination of Ministry of Transport of Ontario outcome data for accidents and convictions as well as self reported accident experience collected by telephone interview, collected over the initial four year risk period.

Method:

Participating sites and collaborators: This study was conducted through the University of Western Ontario, Department of Psychology. Dr. A. Segal and Dr Laurence Jerome are Adjunct Professors at U.W.O in the departments of Psychology and Psychiatry, respectively, Dr Segal was formerly a senior educational psychologist with the Thames Valley District School Board. Both Drs. Jerome and Segal are also Consultants to the Provincial Demonstration School Program for ADHD. Experimental Subjects were recruited from students enrolled in courses offered through the Driver Training Centre at Thames Secondary School. Thames Secondary School is located in London, Ontario and is part of the Thames Valley District School Board. The participants volunteered to participate in this study.

Duration of this study: Following the initial data collection, the participant new drivers in this study will be followed for a period of two years with probes of the MTO data bank occurring at the end of two years.

Procedure: Sixty-six participants between the ages of 16-19 volunteered to take part in the study. The driving instructors evaluated the driving risk of each of the volunteers. The risk ratings were based on the driving instructors' impression of their observed driving ability. The instructors were asked to identify the students' risk based upon their observational experience of the student. Driving instructor continuous visual analogue ratings scales on all current students determined risk severity. Three groups, representing high, medium and low risk samples were selected. Since the driver training offered in the public schools lowers insurance rates and provides earlier access to MTO examination centres it was felt likely that this recruitment method would provide a representative normative sample of novice drivers (Vaughan R). Exclusion criteria for entry into the study included current use of prescribed psychoactive agents or acknowledged recreational drug use within 24 hours of testing, the presence of any physical or neurological impairment that would affect reaction time and limitations in reading skills sufficient to interfere with testing. An equal numbers of males and females participated in this study. The Thames Valley Driving Program required one instructor to be assigned to each student and that instructor was solely responsible for all training. The literature on evaluation of driving risk, described above, suggested that individual driving instructors are reliable at predicting problem driving based on their observations of students driving. Since the prime research objectives were related to whether the cognitive impulsivity data and the severity ratings of driving behavior, observed and self-report, could successfully predict problem driving the issue of the inter-rater reliability between driving examiners judgment regarding risk was not critical. Furthermore, it was felt that the Ministry of Transport outcome data would eventually provide a means of validating the judgments of individual driving instructors as well as other items on the test battery.

The Screening Instrument.

The screening instrument consisted of ***two categories*** of measures. Firstly ***objective computerized cognitive measures*** and ***objective measures of driving behaviour made by driving instructors***. The second measures included a range of ***subjective self-report measures of driving behaviour and personality style***. These instruments are described more completely below:

Objective computerized cognitive measures:

The Stop-Signal Paradigm Test - The stop-signal paradigm (Schachar et al 1993) was used to assess inhibitory control; subjects were engaged in a choice reaction time (go) task and attempted to inhibit their responses to the go task when they heard a stop signal. Reaction times to the stop signal (SSRT) and to the go signal (GoRT) were used to examine inhibition and response execution respectively. Administration time was less than 15 minutes.

The Conners' Continuous Performance Test (Conners' CPT- II) - This computerized instrument is the most widely used commercially available test of the variables of attention and behavioural inhibition (Conner's, K. A.2000). The Participant must continuously respond to non-targeted letter stimuli, but inhibit responding to infrequent visual targets. The CPT has normative data developed on both clinical and normal populations. Administration time was 14 minutes.

Objective measures of driving behaviour made by driving instructors:

Four measures of risk based on driving instructor observation were obtained:

1 Driving Instructor Risk Rating- (Risk Rating) - This is a visual analogue scale completed by the driving instructor after five hours of driving observation of the student. The driving instructor responded to the question "Rate this student on your estimation of current safety based on your observations of their current driving behaviour" The instructor placed an X on a ten centimetre line; the further from the origin on the left, the higher the rating of risk.

Driving Instructor Checklist - Objective severity ratings of problem driving were obtained from a semi-structured behavioural observation instrument, with demonstrated reliability and validity used in an English driving study, the Driving Instructor Checklist (West & Hall, 1998) was adapted for North American conditions. This checklist was modified for North American expression and left-hand driving. No changes to content were made. This paper and pencil instrument asked driving instructors to rate the Subject on driving skill, safety, and future ability and safety. The skill rating section was considered very similar in content to the Thames Valley School Board drivers evaluation mentioned above. These yielded three additional measures of risk prediction:

2 Current Risk.

3 Safety Risk.

4 Future Risk

Subjective self-report measure of Driving Behavior and personality style:

Adult Attention Scale

This is an eighteen item self report questionnaire providing scores for inattention as well as hyperactivity and impulsivity. The scale items are derived from the Diagnostic and Statistical Manual of the American Psychiatric Association 4th edition with age corrected norms. (Barkley & Murphy, 1998).

Jerome Driving Questionnaire (JDO) This is a visual analogue scale consisting of 12 scales rating the subjects impression of their current and future driving skills over the next twelve months. The subject was asked to place an X on the line distant from the origin to indicate their subjective rating of risk.

Health & Life style Questionnaire (HLS) Standard information regarding health status, current medication usage, current recreational drug usage and accident history was collected.

The Temperament and Character Inventory (TCI) - (TCI Cloninger, 1996) was given which evaluated the temperamental profile of impulsivity (Novelty Seeking) within the context of a broader assessment of other temperament and character traits. The TCI is a widely reference research instrument which has been shown to evaluate the temperamental characteristic of impulsivity. The TCI is computerized and presents 240 descriptive statements to which the Subject responds true, this statement describes me, or false, indicating the statement is incorrect. Normative data is available and the test is self-scoring within the software program. There are no offensive or sexually provocative statements in the TCI. Administration time is approximately 40 minutes.

Youth Risk Behaviour Surveillance System. (YRBS) - This is a widely used epidemiological survey instrument with known validated characteristics used in numerous studies evaluating health risk problem behaviours in community youth samples. (Youth Risk Survey, 2001).

Demographic Questionnaire In addition to the above measures, standard demographic information in relation to age, gender, height, weight, grade point average in school, family composition, and family occupation were collected.

Results

The participant sample was drawn the classes at the Thames Valley District School Board Driver Education Centre who volunteered their time. Table 1 below describes the demographic characteristics of that participant group. The sample was evenly divided along gender lines with 33 male and 33 female participants. The age range was between sixteen and nineteen years of age with the over half the sample falling within the sixteen year old band. The vast majority of these students came from married or common law, two parent families, while slightly less than 20% were from homes where divorce or separation had affected the family composition. The predominant proportion of the parental occupational classification was categorized as professional and or managerial. Data on this occupation factor was missing from two participants. Therefore, the percentages presented in this table represented the available sample. Self-reported grade average for the previous school year was requested. All subjects responded to this question. In the main, the grades achieved by the participant sample were indicative of a highly achieving group of students with an average grade of 77.98%. The distribution statistics of range and standard deviation are also presented in Table 1.

Table 1 Demographic Description of Participant Sample.

GENDER		AGE DISTRIBUTION	
Male	Female	Age	Frequency
33	33	(years)	
GRADES IN SCHOOL		16	39
Mean	77.89%	17	18
Range	53-96%	18	7

FAMILY STATUS

Married/Common Law	75%
Widowed	4.7%
Separated/Divorced	18.8%
Single	1.5%

PARENTAL OCCUPATION

	Mother	Father
Professional	41.5%	50.8%
Managerial	10.8%	14.8%
Skilled	27.7%	29.9%
Unskilled	6.2%	1.6%
Unemployed	13.8%	3.3%

The results from the variety of cognitive, self-report, demographic measurements and a number of driver instructor risk predictions were subjected to correlational analysis. The prediction of risk was the intended purpose of this study. Risk was operationally defined, in the first phase of this study, as the general impression of the student risk by the driver instructor. The instructor's **Risk Rating** was measured by their response on a visual analogue scale. In addition, they completed a more extensive checklist, which evaluated current skill level, **Current Risk**, their own feeling of safety whilst driving with the student, **Safety Risk** and their professional opinion about the long-term driving risk of their student, **Future Risk**. We conducted a bivariate correlational analysis examining the association of this constellation of risk predictors with cognitive measures of impulsiveness, self-report measures and demographic features. The statistically significant relationships are reported in the tables below. Table 2 illustrates the findings relating to the Risk Rating evaluation of the driver instructor, after 5 hours of direct on the road observation, at mid-training, of the risk potential of their students. Approximately 33% of the experimental sample was rated by the Driving Instructors as being high risk. Data from the total sample on Risk Rating was collected for the whole group. This yielded a prevalence of high-risk ratings by the Driving Instructors of 25% of a series of 360 consecutive students during the study period.

Table 2 The statistically significant correlational relationships of cognitive, self-report and demographic variables with the driver instructor prediction of student Risk Rating.

<u>RISK RATING CORRELATIONS</u>	
	.280
JDQ Frustration	p<.03 n= 60
	-.258
JDQ Concentration (b)	p<.04 n= 60
	.280
TCI Novelty Seeking	p<.02 n= 65
	.258
TCI Exploratory Excitability	p<.03 n= 65
	.386
Conners' CPT-II HitRTSt.Error	p<.002 n= 64
	.273
Conners' CPT-II Variation of St. Errors	p<.02 n= 64
	-.309
Grade Average	p<.01 n= 66

The correlations in Table 2 show the main significant relationships between predicted risk of driving and independently determined cognitive, self-report and demographic variables. The Jerome Driving Questionnaire (JDQ) was found to have two subscales related to inattention and frustration response that predisposed toward risk (Concentration and Frustration). The TCI segregated two scales from the factors designed to measure impulsiveness (Novelty Seeking and Exploratory Excitability). The latter scale is a subscale of the superordinate Novelty Seeking factor. One of the computerized cognitive tests, the Conners' CPT- II, yielded two variables that appeared to load very heavily on inattentive characteristics. One additional finding related to the cognitive battery should be recognized. The Stop Signal Reaction Time from the Stop Signal task was found to be negatively related to the Risk Rating for the female participants; $r = -.395$, $p < .02$. Lastly, the demographic variable of Grade Average also appeared related to risk potential. Despite multiple factors examined for possible statistical association, only the inattentive and impulsive factors were found to be significantly correlated with Risk Rating. A stepwise regression was conducted on these significant correlational variables as they related to the Risk Rating. Table 3 presents the results of that analysis.

Table 3 The regression analysis of the Risk Rating factor.

<i>VARIABLES</i>	<i>F</i>	<i>df</i>	<i>p</i>
Conners' CPT Hit RT St. Err.	8.595	1.56	.005
Conners' CPT Hit RT St. Err. and TCI Novelty Seeking	7.472	2.55	.001

The results indicated that the combination of the inattentive variation measure from the Conners' CPT and the Novelty Seeking self-report score from the TCI accounted for most of the variance of the Risk Rating factor. These two measures accounted for 21.4% of the common variance. Table 4 illustrates the significant correlations of the factors that were related to the Current Risk of the student driver. This measurement was based on the results of the driver instructors' response to questions on the Driver Instructors Checklist regarding skill development at the end of the course of study, involving some 10 hours of on the road observation and testing. Once again the self-report variables appeared to relate to driver inattentiveness (Barkley Inattentive Scale and JDQ Day Dreaming) and impulsiveness (JDQ Risk Taking). Grade Average and Gender were associated demographic indicators.

Table 4 The statistically significant correlational relationships of self-report and demographic variables with the driver instructor prediction of student Current Risk.

CURRENT RISK	
	.278
Barkley Inattentive	p<.03 n= 56
	.321
Grade Average	p<.009 n= 65
	-.352
Gender	p<.004 n= 65
	.264
JDQ Day Dreaming	p<.04 n= 59
	-.294
JDQ Risk Taking	p<.02 n= 59

A stepwise regression was conducted on these significant correlational variables as they related to the Current Risk. Table 5 presents the results of that analysis. It should be noted that the combination of Gender and the two JDQ measures of inattentiveness (Day Dreaming) and impulsiveness (Risk Taking) once again accounted for 32% of the common variance.

Table 5 The regression analysis of the Current Risk factor.

<i>VARIABLES</i>	<i>F</i>	<i>df</i>	<i>p</i>
Gender	9.172	1.50	.004
Gender and Risk Taking	8.222	2.49	.001
Gender, Risk Taking and Day Dreaming	7.547	3.48	.001

The Safety Risk factor related to Driver Instructor's feeling of safety while driving with the student. This factor was also derived from the Driver Instructor Checklist completed following the complete training period. A single correlation was found to significantly relate to this factor. The TCI Impulsive subscale of the Novelty Seeking factor yielded a significant correlation, $r(64) = .304, p < .01$. Once again the correlate of risk was with student impulsiveness. The remaining risk prediction of Future Risk was also found to relate to a combination of cognitive, self-report and demographic variables. These results are presented in Table 6.

Table 6 The statistically significant correlational relationships of cognitive, self-report and demographic variables with the driver instructor prediction of student Future Risk.

FUTURE RISK	
	.257
TCI Disorderliness	p<.04 n= 64
	.266
Conners' CPT Commission Rate	p<.03 n= 63
	-.405
Grade Average	p<.001 n= 65
	-.393
Gender	p<.001 n= 65

The TCI Disorderliness subscale of the Novelty Seeking factor was the significant self-report measure. Again it was noted that this subscale is associated with the temperamental variable of impulsiveness. The cognitive measure Commission error from the Conners' CPT-II was also related to Future Risk. Commission errors are considered a measure of the ability to inhibit an ongoing response, i.e., a measure of impulsiveness. Gender and Grade Average were once again related to the prediction of risky driving in the future. One additional correlation was found with the prediction of Future Risk applied primarily to the male participants of the study who reported on the YRBS that they had experienced violence or threatened violence where a weapon was used and/or had engaged in more than one physical fight, inside or outside of school, $r(63) = .325, p < .009$. No other risk predictor correlated with the violence questions on the instrument. However we did find a correlation between reported accident exposure on the HLS and reported violence exposure on the YRBS, $r(64) = .265, p < .03$.

A stepwise regression was conducted on these significant correlational variables as they related to the Future Risk. Table 7 presents the results of that analysis. The combinations of the two demographic variables were the only statistically significant variables and they accounted for 22.9% of the common variance.

Table 7 The regression analysis of the Future Risk factor.

VARIABLES	F	df	p
Grade Average	12.182	1.61	.001
Grade Average and Gender	8.898	2.60	.001

Also of interest were the differences found in the sample that related the risk predictions of the Driver Instructors to Gender. In general, the females were seen as less risky in the Current and Future risk prediction. Table 8 presents the means and standard deviations of the four risk predictors for male and female students.

Table 8 Means and standard deviations for risk predictors for male and female participants.

GENDER		RISK RATING	CURRENT RISK	SAFETY RISK	FUTURE RISK
Males	mean	5.655	33.410	16.340	21.380
	s.d.	2.422	8.809	1.994	4.141
Females	mean	5.012	27.610	16.150	18.420
	s.d.	2.660	6.764	1.302	2.762

Differences between males and females were found on the Current Risk, $t(63) = 8.89$, $p < .001$, and Future Risk, $t(63) = 3.39$, $p < .001$, but not the Risk Rating $t(64) = 1.07$, $p > .05$, and Safety Risk, $t(63) = .21$, $p > .05$, predictors. Furthermore, when we examined non-driving accident exposure on the HLS, males were at increased risk, $n(66) = -.256$, $p < .03$.

Discussion

Demographic correlates

In a study population of normal, non-clinical population of novice first time drivers who were undergoing formal driving instruction through a school board based programme we have been able to demonstrate that approximately 33% of a convenience sample of volunteer subjects is rated as being at high risk of future driving problems by their driving instructors on a Risk Rating scale. This proportion of high-risk drivers is reflective of the total student group of students trained in the programme during this study based on evaluation of risk measured, by the driving instructors on the same scale, by the same driving instructor group, where the prevalence of high risk drivers identified in the larger more representative sample was 25%.

In relation to demographic correlates, we found evidence that males were rated as significantly more at risk than females on driving instructor measures of current and future risk. In addition a self-reported history of pre-existing non-driving accidents showed males to be at increased risk of these types of accidents. However, there was no correlation between increased risk of non-driving accidents and driving instructor ratings for driving risk for either gender. The finding of increased risk in male novice drivers was in keeping with literature on reported driving accidents in novice drivers (Traffic Safety Facts 2000, Young Drivers). However, the ability of driving instructors to predict this male vulnerability prior to independent driving and prior to any actual car accidents has not been previously documented.

The relative absence of any strong association between high-risk life style behaviors on the YRBS and driving instructor risk ratings, argued against a general factor for increased accident risk independent of type of accident type. This is supported an earlier negative finding by Begg et al. 1999, where high risk- taking behaviors were not strongly associated with traffic accidents. However, the negative finding in this relatively younger sample than in the Begg study was more persuasive, for as Begg et al note in their study, risk taking behaviors are thought to be more influential on accident risk in younger cohorts and the effect is thought to attenuate with age. Hence we have evidence to argue against the original proposition of Tillmann & Hobbs (1949), that young people “drive as they live.”

The data was even more strongly associated with self-reported grade achievement where we found that higher grade average was associated with lower risk ratings by the driving instructors. We noted an inverse relationship between self-reported grades in school and driving instructor risk rating and current risk. This association with grade achievement in school also held true for future risk ratings.

Age was unrelated to driving instructor rated risk both currently and in relation to future prediction. This would argue that age by itself might not be a factor in any positive benefit of graduated licensing in reducing accident risk. Rather the increased exposure during an extended probationary period rather than later age at independent driving would seem to be the critical factor in any improved risk seen in those drivers completing a graduated license protocol. Presumably this could be tested by comparing the risk of those starting to drive at a later age without the graduated exposure with those of similar age, but completing a graduated licensing. It should be noted that our sample had a restricted age range and the above inference about age being independent of risk may be an anomaly of this data limitation.

Objective and self report screening instrument correlates

Whilst emphasizing the *non-clinical nature* of this sample, we have been able to show that *clinical measures* of psychopathology were able to identify greater than 20% of the variance in risk evaluation made by the driving instructors based solely on observed driving behaviors. The significant correlated pathology measured by the experimental screening instrument of tests associated with increased driving risk relate primarily to cognitive inattentiveness as measured by ratings of cognitive variability of attention on the Conner's CPT-II, accounting for 13% of the variance which when combined with temperamental variable of impulsivity as measured by the Novelty Seeking trait on the Temperament and Character inventory (TCI) accounts for a total of 21% of the variance. When factoring in gender and the two measures on the self-report driving style instrument (JDQ) we can now account for up to 32 % of observed and predicted driving instructor risk measures. Thus, our initial hypothesis was supported. Furthermore, the fact that, at least in the population under study, continuous severity measures of risk, as opposed to discrete categorical dichotomous groupings, more accurately capture the distribution of measured risk would argue for driving risk being better conceptualized as a continuous rather than a discrete phenomenon.

The finding, noted above, regarding gender was supported by additional findings from the screening instrument. The finding of an inverse relationship between SSRT and accident risk as measured by the driving instructors lends support to females being better able to inhibit a response, i.e. slow down when necessary than the males in the group. In this way the Stop-Signal Paradigm measures whilst not directly correlating with risk as perceived by the driving instructors lend indirect support to the proposition that females in this sample have better impulse control than their male counterparts.

One of the key issues in interpreting this data is related to the reliability of perceived current and future risk as rated by the driving instructors. It should be noted that the risk rating profile of the driving instructors was collected over a 10-hour period of observation; the initial risk rating was collected at 5 hours and the other judgments were made after 10 hours. The prediction of future risk is always problematic with reliability of risk being best at the time or close to the time of the direct observation. So future risk prediction would usually be inherently less reliable. However, correlations of the four risk evaluations by the driving instructors indicate that there is strong correlation between these different risk evaluations; Current Risk was most strongly correlated with all of the other three variables. Future Risk, then current Safety, followed this in strength of correlation and the least closely correlated variable was the earlier five-hour global evaluation of risk rating. These correlated findings would argue for a degree of internal consistency of driving instructor ratings, despite different rating questions; the timing of the evaluation being the best predictor of correlation.

Implications of initial findings for further research

Until we have prospective follow-up data in this sample we have no way of determining which combination of observations are predictive of outcome. The prospective follow-up is, thus, critical in determining the best mix of observations from this screening instrument in conjunction with direct driving instructor observations.

Given that driving instructors are currently identifying up to a quarter of pupils as high risk and given that no specific interventions currently exist for this high-risk group, how should driving instructors respond? Again, unless we know how valid their predictions are it would be premature to develop long-term intervention strategies at this time. However, it would be possible to examine the driving errors of the high-risk group to see whether there are specific patterns of driving errors that distinguishes them from medium and low risk groups. This might provide driving instructors with a profile of problematic driving behaviors that could be targeted for improvement and that would have evident utility in immediate remediation. Further analyses examining the type of driving errors observed by driving instructors in this sample and generating profiles of aberrant driving behavior would provide answers to the question as to whether there is a specific pattern of unusual driving behaviors that occur in this high risk group or whether all driving behaviors are more generally disturbed in a non-specific way. Recent observations suggest that in clinical populations i.e., ADHD and Dementia, there are specific patterns of driving errors i.e., Barkley et al, Dobbs et al, unique to these clinical groups (Barkley et al, 1993, Dobbs et al, 1998).

If specific behavioral patterns emerge in a “normal” non-clinical high risk group, exploration of their associated temperamental, characterological and cognitive correlates would help better define the nature of such a population of drivers and help identify them for early preventative interventions, i.e. the anxiety prone driver who may have pre-existing traits of temperamental anxiety on personality and subjective driving style measures, as opposed to the primarily cognitively impulsive driver. In addition, further studies looking at profiles of established MTO high-risk groups, such as those with an accumulation of excess traffic points scores requiring an MTO interview, might usefully be studied with this approach as they are demonstrably at more risk and are more likely to have more extreme temperamental and cognitive profiles than this initial normative group where profiles are evidently less deviant. This may be particularly relevant to that combination of emotional instability and cognitive impulsivity that was not very prevalent in this initial study, but would be predicted to be in evidence in the more disturbed samples already known to the MTO. We surmise that this group would more likely contain individual drivers who would manifest the phenomena of “road rage” which we conjecture is a combination of both emotional lability and cognitive impulsivity.

The more definitive empirical answer as to which combination of variables will eventually provide the best prediction of outcome of driving risk will become clearer with the second part of this study which will follow-up the sample over a four year period of driving risk to determine the outcome with a combination of official MTO data and self-report telephone interview. This, in turn, will help us better define which combination of variables most accurately predict problem driving behaviors, over time, in this group of novice drivers known to be at increased risk in comparison to more experienced and older road user.

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