

**Association between leisure activity and risky driving behaviour in  
young drivers in Canada**

by

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## Abstract

**Background:** There are myriad risk factors for risky driving behaviour in youth. Perceived environment which is defined as the perception of driving risk and norms is the most complex factor. Leisure activities are a central part of youth's daily lives that can substantially shape the driving perceived environment by providing the platform for interaction with peers, family, society, and media. However, the potential relationship between leisure activities and risky driving behaviour has seldom been studied. The purpose of this study was to examine the relationship between various leisure activities and risky driving behaviour among young drivers in Canada.

**Methods:** An online survey-based cross-sectional study was conducted. Participants aged 16–24 years were approached through Facebook advertisements. The survey comprised of four questionnaires, namely, sociodemographic, personality trait (Mini-IPIP), leisure activities, and Behaviour Young Novice Driver Scale (BYNDS). Chi-square test examined differences between the driver group and proportional odds logistic regression was used to determine the relationship between the predictor variables and risky driving behaviour.

**Results:** Participants ( $n=964$ ), aged  $18.34\pm 2.31$ , were grouped into high risk (46.9%), medium risk (32.4%), and low risk (20.7%) drivers. Those with higher levels of drug engagement (OR=2.09, CI 95%=1.21-3.71), time with friends (OR=1.98, CI 95%=1.46-2.68), social media engagement (OR=1.83, CI 95%=1.34-2.49), and movie watching engagement (OR=1.52, CI 95%=1.00-2.31) tended to manifest more risky driving behaviour. In contrast, those with high levels of reading/writing engagement (OR=0.60, CI 95%= 0.42-0.85), volunteering engagement (OR=0.60, CI 95%=0.36-0.96), and playing video game engagement (OR=0.56, CI 95%=0.38-0.81) were less likely to perform risky driving behaviour. Other factors such as owning a car (OR=3.01, CI 95% 2.21-4.11), being male (OR=2.52, CI 95%=1.85-3.42), being simultaneously employed and a student, (OR=1.58, CI 95%=1.16-2.16), high driving exposure (OR=2.58, CI 95%=1.54-4.41), high neuroticism (OR=1.83, CI 95%=1.23-2.73), high extroversion (OR=1.60, CI 95%=1.09-2.35), and low imagination (OR=1.53, CI 95%=1.01-2.34) increased the likelihood of risky driving behaviour.

**Conclusions:** This study provides new insight and explores the association between leisure activities and risky driving behaviour. Results from this study could be used to further explore leisure activities as a potential determinant of risky driving behaviour in future injury prevention research.

## **Lay Summary**

This research sought to understand the association between leisure activities and risky driving behaviours among young drivers (aged 16-24) in Canada. When it comes to leisure activities, high-risk drivers, compared to low-risk drivers, tended to spend more time with friends. They were also more likely to be engaged in music, movie watching, social media, and activities involving alcohol and drugs. Those who were highly engaged in activities such as volunteering and reading or writing showed less risky driving behaviours. With respect to personality trait, our findings also showed that high-risk drivers were more likely to be those with a high level of neuroticism, high level of extroversion, and low levels of imagination. It is important to understand the relationship between leisure activities and risky driving behaviours as it could help identify factors that influence unsafe driving practices in young drivers and aid in the design of future injury prevention programs.

## **Preface**

This dissertation is original, unpublished and independent work by the author Vahid Mehrnoush. I came up with, nurtured, and implemented the idea, drafted the protocol, recruited the youth advisory committee (24 young folks), held focus groups, developed and validated leisure activity questionnaire, deployed the survey on Facebook, collated and analyzed the data, and drafted the final manuscript. The interim data analysis and final result were presented by the author, Vahid Mehrnoush, at Trauma Association of Canada (TAC) 2019 and 2020, respectively. The fieldwork reported in Chapter 2 was covered by University of British Columbia Behavioural Research Ethics certificate number (H17-00086).

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## List of Abbreviations

AB: Alberta

BAC: Blood Alcohol Concentration

BC: British Columbia

BYNSD: Behaviour of Young Novice Drivers Scale

GDL: Graduate Driving Licencing

IPIP: International Personality Item Pool

LRT: Likelihood Ratio Test

MB: Manitoba

MVCs: Motor Vehicle Crashes

NB: New Brunswick

NL: Newfoundland and Labrador

NT: Northwest Territories

NS: Nova Scotia

NU: Nunavut

ON: Ontario

PE: Prince Edward Island

QC: Quebec RSS: Road Safety Strategy

SK: Saskatchewan

UBC: University of British Columbia

WHO: World Health Organization

YT: Yukon

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## **Dedication**

I dedicate this work to the next generations of drivers, all young drivers, all over the world. I hope that no family or individual suffers from any burdens of motor vehicle crash in near future.

# 1. Introduction

## 1.1 The health and economic burden of MVCs among youth in Canada

### 1.1.1 Mortality burden

Globally, MVCs are the leading cause of death in 15-29 year-olds <sup>(1)</sup>. Forty young people die of MVCs each hour, and many more sustain disabilities or emotional scars which they will carry for the rest of their lives <sup>(2)</sup>. In Canada, MVCs are among the leading causes of hospitalization, premature death and potential years of life lost for youth <sup>(3)</sup>. Young drivers between 15 and 24 years old in Canada are overrepresented in fatalities and serious injuries involving vehicle crashes <sup>(4,5)</sup>. In 2015, this group accounted for 18.5% of driving fatalities and 21.7% of serious injuries, despite being only 12.3% of all licensed drivers in Canada. (Table 1.1)

**Table 1.1 MVC-related fatalities, serious injuries, and total injuries in 15-24 years old and all ages, Canada, 2015**

Age	Licensed Drivers (%)	Fatalities (%)	Serious Injuries (%)	Total Injuries (%)
15-24	3,103,514 (12.3)	343 (18.5)	2,228 (21.7)	33,922 (21)
All ages	25,272,915 (100)	1858 (100)	10280 (100)	161902 (100)

Transport Canada Annual Report: 2015 (4)

### 1.1.2 Economic burden: Emergency department visits/Hospitalization

In addition to personal injury health burden, the economic burden associated with MVC-related injuries weighs heavily on Canada's health care system <sup>(6,7)</sup>. In 2012 MVCs caused 165,172 injuries costing billions of dollars, particularly related to healthcare cost and productivity losses due to serious injuries requiring hospital admission <sup>(7)</sup>. Parachute Canada <sup>(4)</sup> reported that in 2010, transport related incidents, after falls, and were the second most common cause of injury-related emergency room visit, hospitalization, and disability. Of transport incidents, motor vehicle collisions constitute the majority of deaths (43%), hospitalized treatment (51%), emergency room visits (56%), and partial (i.e., a permanent disability with partial recovery), and total (i.e., complete and permanent loss of earning power) disabilities (49% and 52%, respectively). Transport injuries ranked third in direct costs of injury (i.e., health care costs arising from injuries) at \$2.1 billion (13%), after falls and other unintentional injuries. In addition, transport incidents, regardless of the mode of transport, were the

major cause of indirect costs of injury (i.e., costs attributed to reduced productivity, disability, and premature death) in 2010, accounting for \$2.1 billion or 20% of total indirect all-injury costs. Motor vehicle collisions imposed the greatest single societal cost (included both economic burden and valuation of quality of life lost due to MVCs) totalling \$2.2 billion. They also made up 50% of all transport-related incidents. In addition, motor vehicle collisions had the highest costs when considering both direct and indirect costs, \$1.2 billion and \$987 million, respectively. In terms of the health burden, MVC-related injury in young people aged 15-19 years old and 20-24 years old accounted for the highest rates of transport-related hospitalization. Young people (ages 15-19 and 20-24 years old) had the first and second highest rates of transport-related emergency room visits and transport-related permanent partial disabilities <sup>(4)</sup>.

### **Need for root cause analysis**

Canada's Road Safety Strategies (RSS) 2025 identifies young and novice drivers (under the age of 25 years) as one of the key risk groups that should be targeted to improve road safety. RSS 2025 highlighted the fact that recognizing MVC contributing factors is critically important in order to set effective initiatives to improve the safety of this target group and enhance road safety in general <sup>(8)</sup>. Factors such as human initiated (e.g., impaired driving, speed and aggressive driving), vehicular (e.g., occupant protection measures), and environmental (roadway configuration, roadway construction, road surface condition, road and roadside design, weather conditions) <sup>(8)</sup>.

### **1.2 MVCs contributing factors**

A variety of frameworks and approaches have been applied to identify the risk factors for road traffic injuries <sup>(9-17)</sup>, including:

a) Safe System Approach (SSA) is an Australian proposed framework to help countries to devise effective road safety strategies to eliminate fatalities and severe injuries. This approach is grounded on three principles: 1) Despite all measures, human fallibility of a driver is acceptable to happen but not at considerable cost to other road users' lives or to the system. 2) Roads, roadsides and vehicles need to be designed to minimise crashes. 3) Road safety requires shared accountability and responsibility. Accordingly, some target driver groups especially young or novice drivers and some key contributing factors (e.g., speed and aggressive driving, distracted driving, drug and alcohol impaired driving, fatigue impaired driving) were prioritized as topics to address in SSA <sup>(12)</sup>.

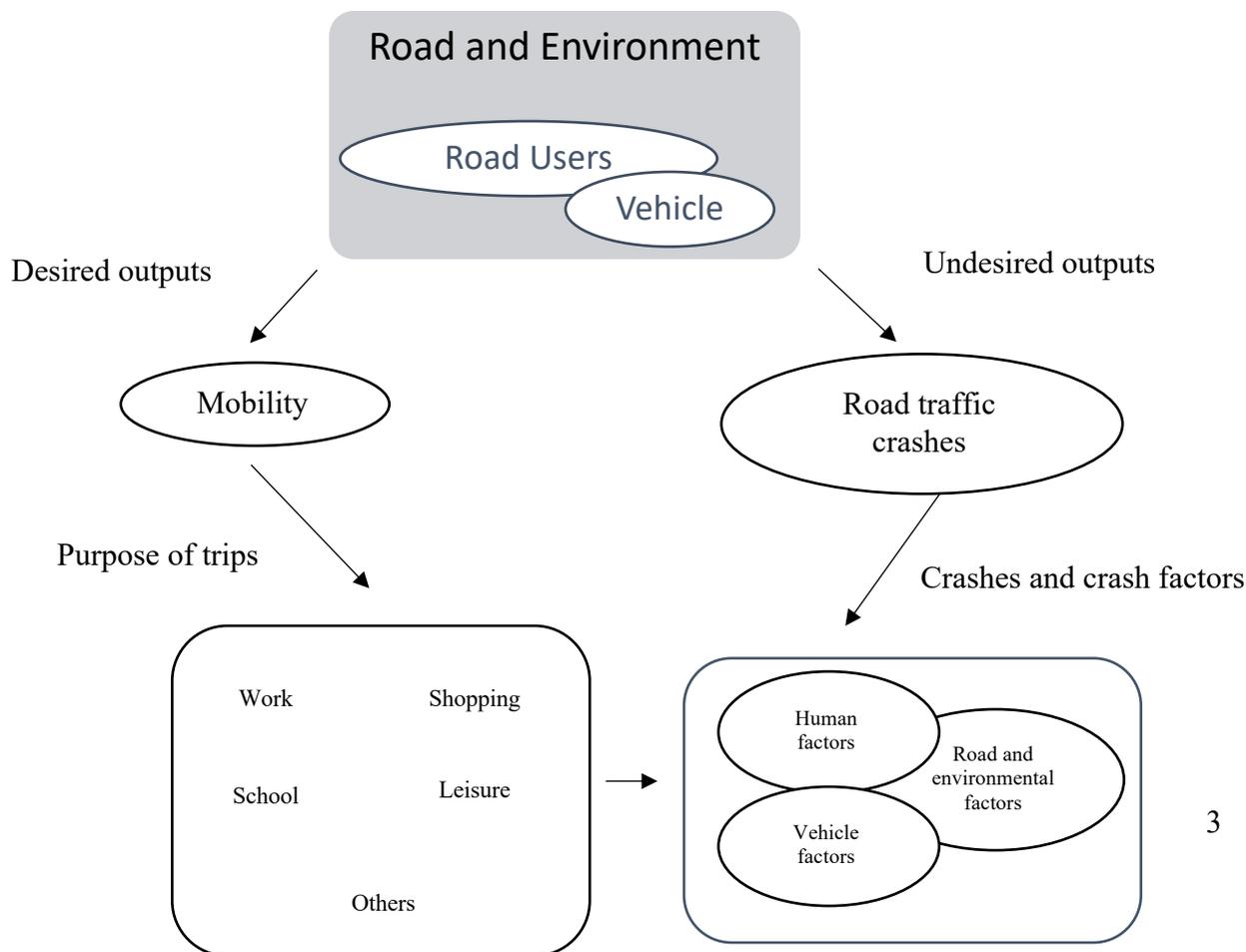
b) Systems Approach is adopted by WHO conceptualizes the road traffic system as a whole, designs the basic elements of transportation system, and interlinks the major risk factors in transport and road system. This approach helps the road traffic injury prevention strategies with identifying the potential contributing factors for risky driving behaviour and their interactions <sup>(13)</sup> (Fig 1.1).

c) Public Health Approach provides a four-step process that helps to guide how to approach health-related issues like MVCs: 1) Identify the size of the health burden, 2) Identify risk factors and causes, 3) Discern the preventive measures, and then 4) Implement prevention programs on a large scale and evaluate these programs. This approach is promoted by the WHO <sup>(14)</sup> and the U.S. National Center for Injury Prevention and Control, Atlanta <sup>(15)</sup>.

d) Haddon Matrix is a commonly used conceptual framework in injury prevention which serves to identify the influencing factors at different phases of an injury (Pre-event, event, and post-event) <sup>(16)</sup>.

**Figure 1.1 Schematic representation of the system approach (adapted from the World Health Organization’s framework for the elements of road and transport systems).**

Risk factors for road traffic crashes fall under three major categories: human factors, vehicle factors, and environmental factors. Mobility for different reasons, such as leisure, is a desired output but it can interact with crash factors. The original WHO draft included three components (desired outputs, undesired outputs, In our modified version we removed the “other” component which is irrelevant to this topic <sup>(12)</sup>).



According to these frameworks, and based on literature (<sup>18,19</sup>), contributing factors for MVCs broadly fall into three categories: (1) Environment factors; (2) Vehicle factors; (3) Human factors

### **1.2.1 Environmental factors**

Physical environmental factors include road infrastructure (such as undivided roadways, road curvature and inclination, road surface condition, merge and exit points, and bridge structures), lighting, weather conditions, and visibility of objects. The role of safety-oriented road engineering in reducing the frequency and severity of road traffic crashes is undeniable. Conversely, unsafe road networks can contribute to crashes because of unsafe road design. For example, misleading road environment elements (i.e., they are designed in a way that the driver is not aware of what is expected of them and does not behave appropriately) or signs which prompt error, or where some changes to the road would have attenuated the risk of crash. Moreover, the road environment may also determine how road users perceive their environment which, in turn, affects the crash risk (<sup>20</sup>). That is to say, road signs and traffic controls guide road users' actions. Therefore, road safety engineering measures also work through influencing human behaviour.

### **1.2.2 Vehicle factors**

Although the crashworthiness of private vehicles has improved, further advancements are possible. Vehicle factors related to design (e.g., crash avoidance, crashworthiness), maintenance, recalls, aftermarket vehicle modifications, commercial vehicles, unusual vehicles, automated vehicles, and new and emerging vehicle technologies play crucial roles in not only preventing MVCs but also in determining the severity of MVC-related injuries (i.e., occupant contact with the vehicle's interior, or other inadequate vehicle protection safety standards) (<sup>21</sup>).

### **1.2.3 Human factors: The leading cause of MVCs**

Human factors include the driver's mental and physical capacity, amount of driving training and level of experience, adopted driving style and driving errors. Social circumstances like cultural and social norms, socioeconomic status, and peer pressure to take risks can also influence driver behavior. Generally, human factors fall into the human condition (such as alcohol or drug involvement; extreme fatigue), and human actions (behaviours) (e.g. driving without due care; speeding; failing to signal; improper passing (<sup>22-24</sup>)). Driving behaviours are the major constituent of the human factors. Rumar et al. stated in his book that human factors, such as driving behaviour, are involved in 90 percent of

crashes<sup>(25)</sup>. Despite the focus on vehicle safety in traffic crashes, human factors such as risky driving behaviours are more important<sup>(21,26)</sup>. Road trauma prevention strategies that utilize knowledge about human factors in conjunction with engineering and enforcement policy can improve crash reduction effectiveness<sup>(20)</sup>. Nabi et al., in a study on 13,447 French drivers found that MVCs decreased by changing drivers' negative attitudes towards driving laws by including posted speed limits or warning signs regarding impaired driving on roads<sup>(27)</sup>. The International Traffic Safety Data and Analysis Group (IRTAD) annual report (2017), which contains the most up-to-date road safety data, proposed measures, and strategies for 40 countries<sup>(28)</sup>. For Canada, identified behaviours of road users included speeding, impaired driving, distracted driving, driver fatigue, and a lack of seatbelt use as significant contributing factors to road crash fatalities all of which can be proposed as focus points for injury prevention strategies<sup>(29)</sup>.

The major topics identified in Canada's Road Safety Strategy are the key risk groups (e.g., young drivers, high risk drivers, vulnerable road users, and medically-at-risk drivers) and the key contributing factors (i.e. speed and aggressive driving, alcohol and drug impaired driving, distracted driving and fatigue impaired driving)<sup>(6)</sup>. Collectively these topics are aimed at capturing the human factors especially associated with risky driving behaviour<sup>(6)</sup>.

MVCs can result from human factors alone or in combination with environmental and/or vehicle factors. It is unclear what proportion of total MVCs are caused by each factor (i.e. environmental, vehicle, and human). However, human factors have been deemed to be the leading determinants both in the general population and among young drivers<sup>(21-23)</sup>. In addition, it is worthwhile considering that even simple behavioural modifications such as increasing knowledge about simple traffic rules (commitment to the speed limit, compliance with seat belt use, not use of a mobile phone, and respect for traffic signals) can impact road safety<sup>(4)</sup>. For instance, a 1% reduction in speed results in reducing the likelihood of a fatal collision by 5%<sup>(9)</sup>.

### **1.2.3.1 Risky driving behaviours as the most common human factor**

Risky driving behaviour are considered to be among the more significant human factors resulting in MVCs<sup>(22,30)</sup>. Ferguson et al. stated that risky driving behaviours are generally more prevalent in younger drivers (16-24 years old) and attributed most MVCs in youth to reckless and risky driving behaviour<sup>(30)</sup>. Rhodes et al., in a phone survey of 504 drivers aged 16-20 years old and 409 drivers aged 25-45 years old showed that the younger drivers were more risky drivers<sup>(31)</sup>. In Canada, risky

driving behaviour is the leading cause of MVC related injuries and deaths in youth (<sup>5,32</sup>). In other words, risky driving behaviours (e.g., speeding, driving under influence of alcohol and/or drugs, and distracted driving) are the leading contributing factors in MVCs especially in young drivers. Identifying the factors influencing risky driving behaviours can help understand root cause.

### **1.2.3.2 Definition of risky driving behaviour**

By definition, risky driving behaviours are those actions undertaken by drivers which expose themselves, their passenger(s), and other road users such as pedestrians, cyclists, drivers, and passengers in other vehicles to hazardous situations, harm, or fatal injury (<sup>33</sup>). Examples include traffic law infringements such as speeding, driving under the influence of alcohol or drugs, cellphone distracted driving, tailgating, wearing no seatbelt, improper passing, inappropriate lane usage, right-of-way violation, illegal turns, and control sign violations. Risky driving behaviour can be either deliberate, regulations violations, or unintentional, such as errors and distractions (<sup>34</sup>).

### **1.2.3.3 Physiology of risk taking in youth**

As noted above, in addition to a limited knowledge of regulation rules and a lack of driving experience (and the associated acquired skills), driver physiology and development also plays role. From a psycho-physiology perspective, incremental changes in physical, cognitive, emotional and social development, experimenting, and risk-taking typify adolescence. Generally, changes in patterns of dopaminergic activity around the time of puberty are linked to increases in sensation seeking followed by an increase in risk-taking in adolescence (<sup>35</sup>). Along with understanding the physiological foundation, a full understanding of specific risky behaviours leading to injury or harm is critical. Gielen et al. highlighted that the behavioural approach, combined with environmental modifications, is integral to successful injury prevention strategies. To that end, they recommend that injury prevention researchers apply a conceptual framework that addresses a specific situation (e.g. motor vehicle crash), specific target group (e.g. young population), and the setting and the characteristics of the target behaviour (e.g. risky driving) (<sup>36</sup>).

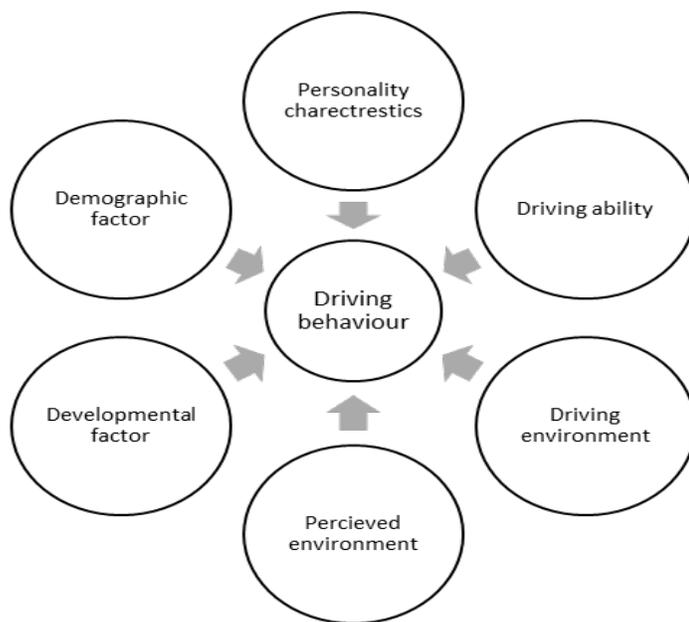
### **1.2.3.4 Contributing factors to risky driving behaviour in youth**

To come up with a solid approach to risky driving behaviour in youth, Shope et al., proposed a framework that included the aforementioned constructs and determinants influencing driving behaviour in young people, namely, perceived environment (i.e. parents norm, peer norm, community

norm, cultural norm, media and risk perception) personality characteristics (i.e. risk taking propensity, aggressiveness, susceptibility to peer pressure, and tolerance of deviance), driving ability (i.e. knowledge, skill, and experience), driving environment (i.e. weather, vehicle, and passenger), demographic factors (age, sex, education, employment status, SES), and developmental factors (i.e. physical, psychological, behavioural) (Figure 1.2). They defined the perceived environment, as the driver’s perception of driving behaviour norms, the driver’s attitude, and the driver’s perception of risk in the driving environment. According to Shope, the perceived environment, is perhaps the most complex category and plays a crucial role in determining risky driving behaviour in young people (23). Perception of driving behaviour norms and risk perception in a driving setting (i.e. driving tasks and conditions) is formed through interaction with the environment i.e. parents, peers, culture, community, and media throughout life. In other words, the perceptions of what driving behaviour is normal or risky, or what driving behaviour is socially disapproved or accepted, spring from major reference groups including parents, peers, and broader sources such as community, culture, and media (37). A body of psychosocial theories can be employed to uphold the influence of the perceived environment on driving behaviour (38-42).

**Figure 1.2 Factors influencing youthful driving behaviour**

All contributing factors in risky driving behaviour in youth fall under the following themes: developmental factors, personality characteristics, driving ability, demographic factors, driving environment, and perceived environment. Shope et al., believed that the “Perceived environment” is perhaps the most complex one (23).



## **1.2.4 Psychosocial theories for risky driving behaviour in youth**

Risky driving in youth can be approached by different psychosocial theories such as problem behaviour theory, social cognitive theory, social learning theory, and the theory of planned behaviour on which a great deal of psychosocial and behaviour-related literature have been founded.

### **1.2.4.1 Problem Behaviour Theory**

Problem Behaviour Theory is a multifaceted psychosocial conceptual framework. This framework explains those specific variations in adolescents' behaviours which are considered problematic and undesirable by the norms of conventional society<sup>(38)</sup>. These problematic and undesirable behaviours elicit some form of social sanctions and disapproval in society. Succinctly, this theory postulates that all behaviours result from the interaction between individuals and their environment. Problem behaviour arises from interaction within and across the following five major systems: (Figure 1.3)

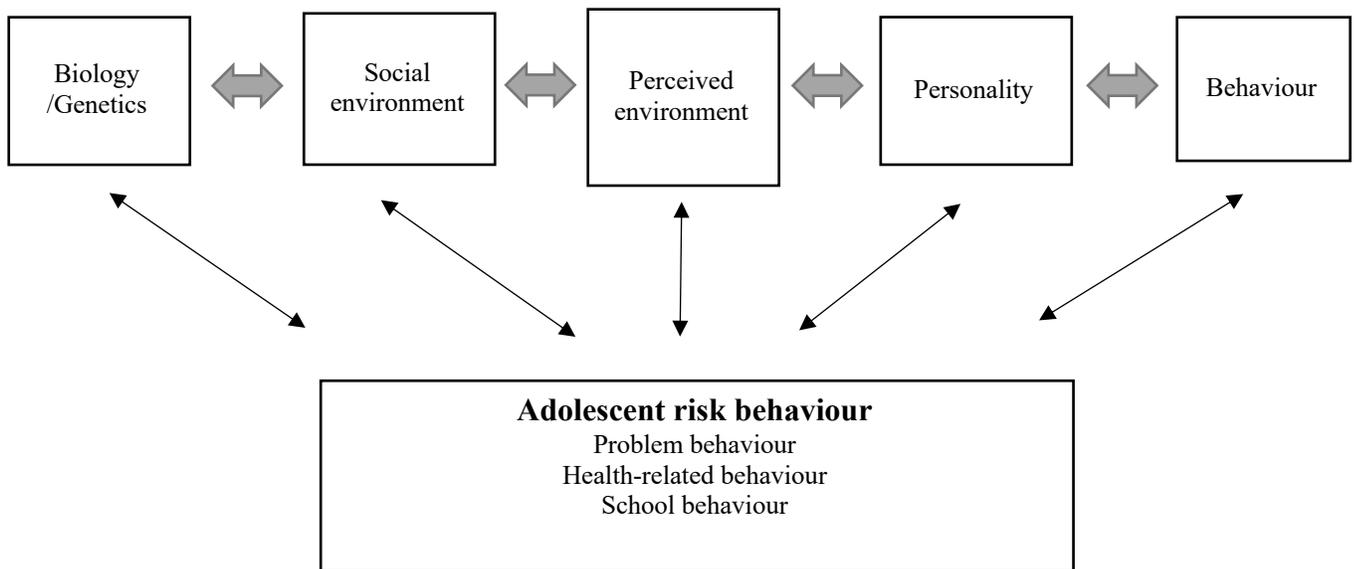
- **Perceived environment system:** indicates that friends' and/or parents' expectations, norms, and behaviours can influence youth. Moreover, parents' and peer's control and support models can prohibit or promote problem behaviours in youth. Accordingly, an adolescent is more likely to engage in a problem behaviour when they perceive their parents' and/or peer's norms, expectations, and behaviours are in keeping with and underpin that problem behaviour. In the case that the foregoing parents' and peer's factors are incompatible, i.e. one supports while the other discourages that problem behaviour, youth acknowledge greater influence and support from their peers relative to their parents.
- **Personality System:** suggests that intrinsic factors within an individual can contribute to problematic behavior. The personality system includes personal values, beliefs, expectations of achievement, attitude and level of intolerance towards deviant behaviours, self or social orientation, self-efficacy, locus of control (individual's belief about the extent they have control over what occurs to them) which are mainly rooted in social learning and developmental experience.
- **Behaviour System:** includes both behaviors that contribute to problem behavior (unconventional behavior) and socially approved behaviours (conventional behaviour). This system specifies that an adolescent who engages in one risky behaviour will be likely to engage in more risky behaviours. Influential behaviours include experimental or regular use of substances, risky sexual activity, and irresponsible driving

- Social environment: includes some variables such as parental ideology (maternal or paternal traditional beliefs and religiosity), home climate, peer influence, and media influence.
- Biology/Genetics: includes gender differences, family history of risky behaviours such as parents who regularly overuse alcohol.

Each system includes variables categorized as instigations (factors that increase the likelihood of engaging in problem behaviours) and controls (factors that decrease the likelihood engaging in problem behaviours). The overall balance between instigations and controls within and across all five systems drives an individual to perform or to avoid a problematic behaviour. Moreover, this theory states that adolescence is a period of time when they are prone to form risky habits. In this period, also called “transition proneness”, adolescents mimic adults’ behaviours, which are typically not appropriate for adolescence, such as unprotected sex, smoking, substance abuse, and binge alcohol drinking, and driving under the influence of alcohol or drugs. Adolescents perceive that performing such “adult” behaviour would transition their status from “young” or “less mature” to “adult” or “more mature”. In other words, adolescents engage in these activities to show others that they are not “children” or “immature” anymore (38,39).

**Figure 1.3 Problem Behaviour Theory.**

According to this theory, a problem behaviour springs from the interaction of five major systems. Each system consists of risk factors which promotes the problem behaviour and protective factors which help to avoid that particular behaviour (39).



#### **1.2.4.2 Social Learning Theory and Social Cognitive Theory**

Social Cognitive Theory (SCT) which evolved from Social Learning Theory (SLT) and has been among the most commonly used theories in the health behavior intervention literature. SCT and SLT hold that both psychological factors and the social environment can play a role in the development of behaviour<sup>(40)</sup>. The theories posit that behaviour results from a learning process which occurs in a social context.

SLT and SCT have five common communal constructs, while one more construct, i.e. self-efficacy was added to SLT as it evolved from SCT. Reciprocal Determinism: The main concept of the theories which refers to the mutual interaction and influence of personal factors (e.g. cognitive skills, attitude, a set of learned experience) and social environment.

- 1- Behavioural capability (self-control): An individual has to know what and how to do it. It asserts the actual ability to perform a behaviour
- 2- Observational Learning: An individual can reproduce a behaviour by observing or witnessing it performed by others in their social environment
- 3- Reinforcements: The internal or external responses to a behaviour that can prompt a person to continue or refrain from it. In other words, reinforcement can be positive or negative.
- 4- Expectation and outcome expectancy: The perception of others' expectation and the belief about the perceived consequences and outcomes of a behaviour are what an individual takes into account prior to engaging in that behaviour.
- 5- Self-efficacy: The individual's belief about or level of confidence in one's ability to successfully perform or master a behaviour<sup>(40)</sup>.

#### **1.2.4.3 Theory of Planned Behaviour**

The Theory of Planned Behaviour by Icek Ajzan (1985)<sup>(40)</sup> is a psychosocial framework designed to predict and explain individual's behaviour in particular context. This theory posits that the major determinant of a behaviour is the intention to perform that behaviour which is under the influence of and tightly related to:

- Attitude, which is an individual belief of a certain act or behaviour. That is to say, attitude reflects on an individual's belief about the consequence and how they evaluate that outcome which, in turn, leads to approval or disapproval of that behaviour by themselves.

- Subjective norm, which focuses on the individual's social network group such as family, peers, culture, community, and society, and what those reference groups consider and appropriate, and what leads to approval or disapproval.
- Perceived behavioural control, which expresses a person's belief on how easy or hard it is to display certain behaviours. It reflects an individual's perception of their skills related to whether they could handle or manage that behaviour.

Ajzen believed that it is essential to take these themes into account to understand a behaviour and to implement any intervention to change a behaviour <sup>(40)</sup>.

#### **1.2.4.4 Evidence on how social norms may lead to risky driving behaviour in youth**

The foregoing psychosocial theories spotlight the role of social environments, especially the reference groups (i.e. important others). The main types of social norms that have been distinguished in the literature are descriptive norms and injunctive norms <sup>(41,42)</sup>. Descriptive norms refer to perceptions of how commonly a behaviour is performed in the corresponding social environment, thereby demonstrating what behaviours are perceived as effective and adaptive. Injunctive norms refer to perceptions of what other people, especially reference groups, commonly approve or disapprove of, which can motivate to acquire/maintain or withhold or withdraw a particular behaviour through the promise of social approval/blending or sanctions, respectively <sup>(43)</sup>. Of reference groups, parents and peers are two important social sources of influences on youth. A substantial body of literature provides evidence of social norm influences on youth driving behaviours <sup>(44-49)</sup>. According to some studies, the influence of parent's behaviour such as parental monitoring and restrictions on teen driving were inversely associated with risky driving behaviours among teens. Their results showed that those who exhibited higher levels of risky driving were more likely to report low parental monitoring and low parental restrictions on their driving <sup>(45,46)</sup>. This can be justified by the control model of parents in the perceived environment system of problem behaviour theory or influence of subjective norm (disapproval) on behaviour according to the theory of planned behaviour (above). Carter et al., found that teens who perceived their parents to engage in driver distraction more frequently reported higher engagement in driver distraction themselves. Also, parents' self-reported driver distraction engagement was positively associated with that of their teens <sup>(46)</sup>. This can be explained by not only social cognitive theory, i.e. the construct of observational learning and mutual interactions of teen and social environment, but also by the subjective and descriptive norms influence

and support modeling of the perceived environment in theory of planned behaviour and problem behaviour theory, respectively.

Merrikhpour et al., surveyed 71 teens (aged 17-19 years)-parent dyads in Toronto, Canada, to understand the role of parental and peer norms in teen driver distraction, and to investigate the existence of social norm misperceptions among teens. The results showed that teens' perceptions of parent and peer norms were predictive of their self-reported distraction engagement. However, they found that the teens misperceived, i.e. overestimated, their parents' and peer's norms of distracted driving. Upon further experimental investigation, they showed that an intervention on the social norm correcting the corresponding misperception can positively affect driving behaviour in teens <sup>(48)</sup>. Simons-Morton et al., showed that teens who reported to have more risk-taking friends (those who smoke cigarettes, drink alcohol, get drunk at least once a week, use marijuana, drive after having two or more drinks in the previous hour, exceed speed limits, and do not use safety belts) had significantly higher rates of crashes or near crashes and risky driving <sup>(19)</sup>. Moreover, Allen et al., postulated that in the presence of peer passengers, teens were concerned with maintaining and strengthening their relationships with their peers rather than solely trying to drive safely <sup>(49)</sup>.

Community, culture, and media as wider social sources can influence the perception of driving by presenting the modeling of how risky a driver can be; how likely it is to be injured or killed in a crash; how likely it is to get a ticket or be fined or even jailed for a particular driving rule infringement <sup>(23)</sup>. The social environment system of Problem behaviour theory (above) can add support to such findings.

#### **1.2.4.5 Evidence on risk perception and risky driving behaviour in youth**

Risk perception is a well-studied component of the perceived environment in youth. The level of risk perception varies from one individual to another and depends on factors such as past experience, driving training, age, and other personal and sociocultural factors <sup>(50,51)</sup>.

Many previous studies found that "low" risk perception of driving is a significant predictor of risky driving behavior <sup>(45,52-55)</sup>. However, evidence remains inconsistent. In a telephone survey study, Carter et al., questioned 403 drivers aged 16-18 years old and their parents about their risk perception and distracted driving behaviour to examine the effect of social norms and risk perception on the youth's driving behaviour. They found that low risk perception in youth, distracted driving behaviour in their parents, their perception of parents' norm of distracted driving behaviour (i.e., youth thought

parent frequently drove while distracted), and perceived peer norms of distracted driving behaviour were all predictive of their own distracted driving behaviour <sup>(46)</sup>. In a survey study on the effect of drivers' risk perception and perception of driving tasks on road safety attitude., Ram et al., found that the risk perception was highly correlated with the perception of a specific driving task (e.g. speed adaptation according to the flow of traffic and judging the appropriate speed required when executing a safe pass manoeuvre according to the positions of following and upcoming vehicles. Both risk perception and perception of driving tasks were also correlated with the driver's attitude toward traffic rules, driving responsibility (e.g. stopping the vehicle prior to a crosswalk, following in a traffic lane), and distracted driving. They concluded that the higher risk perception an individual had, the more likely they were to adopt safe driving behaviours <sup>(51)</sup>. Likewise, Rhodes et al., surveyed 504 young adults (aged 16-20) and found that risk perception was a predictor of risky driving behaviour <sup>(31)</sup>.

However, there is a fairly robust study contradicting the foregoing findings. Ulleberg et al., investigated the direct and indirect effects of personality trait, attitude and risk perception toward risky driving behaviour in 3942 Norwegian adolescents <sup>(52)</sup>. They found that attitude had a significant direct impact on risky driving behaviour, personality trait exerted an indirect effect mediated through attitude, and risk perception was only a weak predictor of risky driving behaviour <sup>(54)</sup>.

In conclusion, perception of normative driving behaviour and risk perception in driving can promote or discourage risky driving behaviours in young people <sup>(23)</sup>. Moreover, attitudes towards traffic safety which arise from the knowledge of traffic rules (cognition), personal characteristics like respect and feeling towards other road users (affective), and the manner of driving (behavioural) can influence an individual's driving behaviours that lead to a higher or lower tendency to engage in risky driving behaviours <sup>(52)</sup>. All these factors (risk perception, perception of norms in driving setting, and attitude towards road safety) are greatly influenced by youths' environments, which can influence acceptance of risky driving behaviours and lead to a higher or lower tendency to engage in risky driving behaviours <sup>(55)</sup>.

### **1.2.5 Theoretical Framework for the current study- Why Leisure Activity matters**

As discussed above, family, peer groups, community, culture, and media can all influence risk perception, expectations and outcome expectancy, social (subjective and injunctive) norms, and attitude towards risky driving in young drivers. Approaches that consider the role of attitude, norms, and behavioural change are recommended to be incorporated in injury prevention strategies <sup>(23)</sup>.

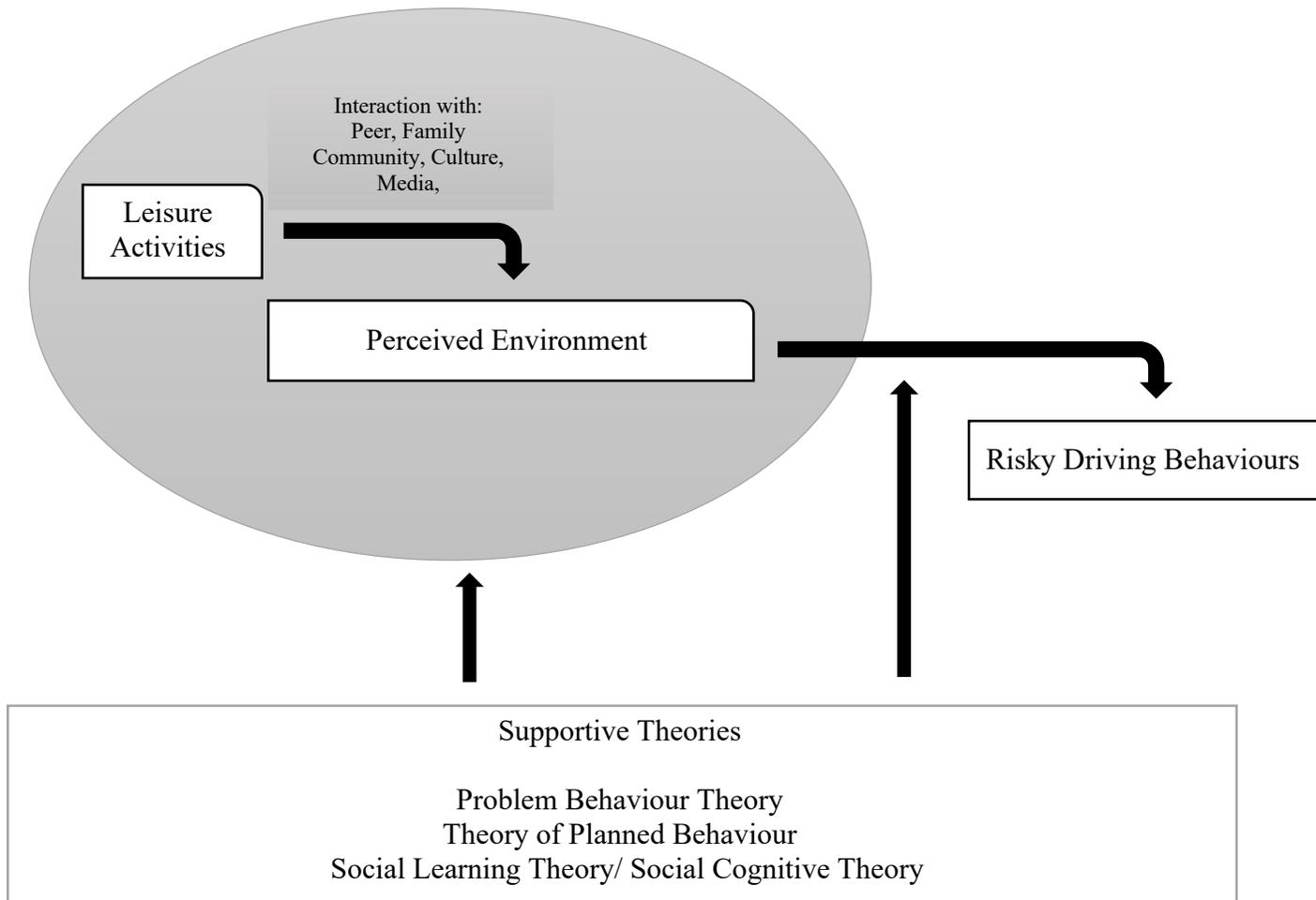
There is a need to understand the perceived environment more thoroughly given its contributing role in risky driving behaviour. To better understand how perceived environment influences driving behaviours in young drivers in Canada, it is useful to know how and to what extent (level of engagement) youth interact with their social environment (i.e., how they spend their daily life). According to the Statistics Canada General Social Survey (2010), leisure time related activities constitute almost 25.5 percent of young Canadians daily activity. Canadians aged 15-24 years old spend 6 hours and 8 minutes per day on leisure activities including “socializing”, “passive leisure” (watching TV, reading books, other passive leisure), and “Active leisure” (active sport, computer use, video games, other active leisure) (<sup>56</sup>). Thus, leisure time provides youth with the opportunity to be exposed to various elements of the perceived environment and is also a source for acquiring their perception of norms and risks in a driving setting (by interacting with family, peers, community, culture, society, and media). Figure 1.4 illustrates the conceptual theory describing the relationship between perceived environment and risky driving behavior in young drivers.

It is apparent that leisure time activities have both the sources (i.e, family, friends, community, and media) and the time (according to the aforementioned Statistics Canada report) (<sup>55,56</sup>) to influence driving behaviour of young drivers. Figure 1.5 illustrates the theoretical framework of current study explaining why and how leisure activities may influence driving behaviour. This framework is informed by the psychosocial theories described in section 1.2.4. From psychosocial standpoint, determinants of a behaviour are attitude, subjective norms, and behavioural control which are influenced by other factors such as behavioural belief, control belief, and normative belief. This framework shows the interaction of all factors and also where leisure activity (main independent variable of this study) can hypothetically exert its effect on risky driving behaviour. Leisure activities hypothetically influence risk perception, descriptive norms, social norms, and emotional self-regulation as described in Figure 1.5. According to Ulleberg et al., effects of personality traits are generally mediated through attitudes. Direct effect of attitude on risky driving behaviour is significant. Altruism is the only personality trait that has direct effect on risky driving behaviour. Risk perception has no direct effect on risky driving behaviour (<sup>52</sup>). (Fig 1.5)

The following sections describe in detail the relationship between leisure activities and risky driving behaviours taking into consideration confounders such as socioeconomic status (SES), driving status, and personality traits.

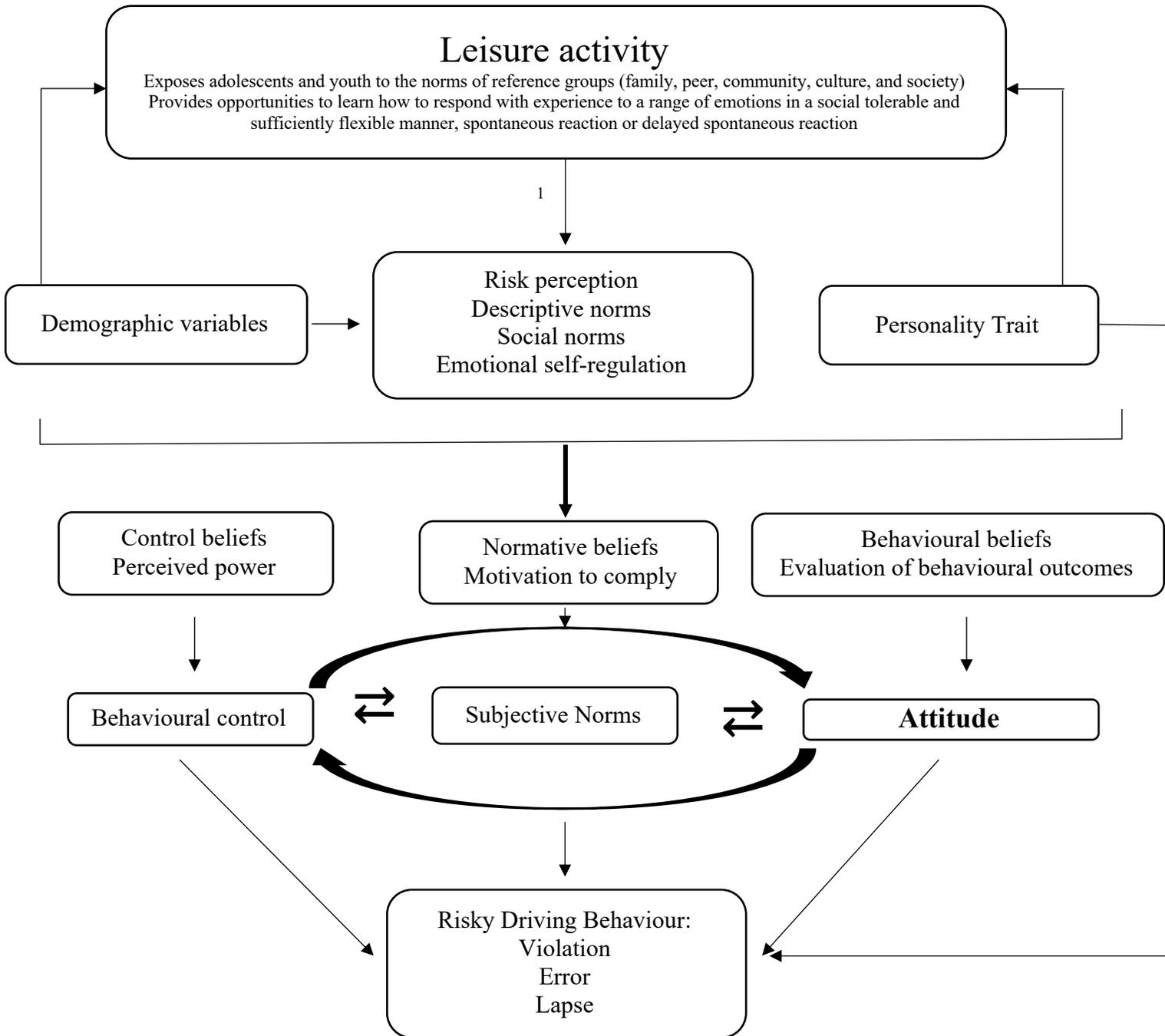
**Figure 1.4. Leisure activities play a role in perceived environment and risky driving behaviour.**

Human factors are the primary causes in most in MVCs. Risky driving behaviour, a human factor, is most often associated with young drivers. Perceived environment, i.e., behavioural norm and risk perception in driving setting, is a complex factor that elicits risky driving behaviour in youth through interactions with their parent, peers, culture, community and media. These interactions occur through leisure activities of youth which explain the link between the type of leisure activities and risky driving behaviour.



**Figure 1.5 Theoretical framework of the project**

<sup>1</sup> Leisure activity can exert its effect on risk perception, social norms, and emotional self-regulation whereby it can influence risky driving behaviour



## 1.3 Leisure activities and general risk-taking behaviour

### 1.3.1 Leisure activity definition

Leisure activity refers to pleasurable and personally purposeful activities that one engages in during free time. Free time is defined as unobligated time, outside of work, school, or self-care activities usually in the evenings and on weekends. Leisure is often related to a sense of freedom and internal motivation (i.e., you engage in activities that you want to, not because you have to) <sup>(57)</sup>. Youth engage in a variety of leisure activities such as individual and team sports, spending time with family and friends, socializing, volunteering, playing video games, watching TV and movies, social media, and so on. Leisure activities fall in two broad categories: structured and unstructured (Table 1.2). They can also be categorized into: (1) social activities (e.g, spending time with friends); (2) creative or expressive activities (e.g., artistic pursuits); (3) cognitive activities (e.g., reading); (4) spiritual activities (e.g., meditation) and (5) physical activities (e.g., walking, gardening) <sup>(58)</sup>.

**Table 1.2 Leisure activity categories.**

<b>Structured</b>	<b>Unstructured</b>
Leisure or recreation activities that are typically deeply engaging (e.g., require an investment of attention and effort) and support personal expression	“Doing nothing” or passive forms of activity that require low levels of engagement and often occur outside of organized recreation or leisure context
Examples: volunteering, sports or club activities. This is sometimes also referred to as “active leisure.”	Example: hanging out, watching television, listening to music, going to the mall, watching movies

### 1.3.2 Influence of Leisure Activities on Behaviour

Normative behaviours and expectations of parents and peers, cultural and community norms, and the media-transferred norms can be very influential in enabling youth to adopt or change behaviours and also establish or reform their perception of norms and risk. Youth spend a substantial amount of time on leisure activities and socialize with family, peers, and community members. etc. (Section 1.2.4). They observe behaviour and perform similar behaviour or adjust their own behaviour to others’ <sup>(41,59)</sup>.

### **1.3.2.1 General influence of leisure activities on youth**

Leisure activities usually have positive impact on youth such as an increase in their social skills<sup>(60)</sup>, they promote positive moods and emotions<sup>(61)</sup>, enhance stress management<sup>(62)</sup>, and help to develop psychosocial maturity and adjustment<sup>(63)</sup>. An inherent characteristic of adolescence is being amenable to adopt or change a behaviour under the influence of leisure activities. Studies show that structured leisure activities<sup>(64)</sup> and level of satisfaction from leisure activities<sup>(65)</sup> affect physical health and mental well-being. Freire et al., found that engagement in leisure activities improved self-esteem, satisfaction with life, and psychological well-being in youth by helping them acquire and learn several developmental skills such as emotional control strategies and emotional self-regulation, i.e., the ability to respond to experience with socially acceptable and adequately flexible emotions<sup>(65)</sup>. These strategies help individuals to apply cognitive skills to cope with stressful situations by reassessing their initial perception and attitude. As a result, individuals can learn how to re-interpret, modify, and reframe their perception of a situation or stimulus that elicits a behaviour reflecting negative emotional reaction<sup>(66)</sup>.

### **1.3.2.2 Role of leisure activities in instigating or controlling risk-taking behaviours**

Based on the psychosocial theories (Sections 1.2.4 and 1.2.5), certain leisure activities may either promote or prevent risk-taking behaviours. A great deal of literature has demonstrated the influence, either positive or negative, of different leisure activities on behaviour in young individuals<sup>(67-70)</sup>. Darling et al., in a cross-sectional study on 3761 high school students in California, found that school-based extracurricular activities reduce the risk of substance abuse and increase grades and positive attitudes towards school<sup>(65)</sup>. Studies on 228 Canadian and 3368 Norwegian youth (12-18 years old) found that organized leisure activities decrease problematic alcohol use<sup>(66)</sup>. Budra et al., studied 10279 students aged 11 to 15 in 2017 and found that structured leisure activities such as sports (either individual or team) decreased risky behaviour such as smoking and drinking<sup>(68)</sup>. Other studies show that young people who participate in pro-social activities such as volunteering and attending church were less prone to risk-taking behaviour like drinking alcohol<sup>(71-73)</sup>.

On the other hand, there is also research suggesting that some leisure activities may adversely affect youth and promote risky behaviour. Carnagey et al., in a review of literature revealed that playing violent video games not only increased aggression but also desensitized youth to violence in real life and decreased pro-social behaviour<sup>(72)</sup>. Contrary to the majority of literature concerning the

advantages of engaging in sports, Leichliter et al., studied 51483 college students and found that the athletes had more alcohol consumption per week, got more involved in binge drinking and substance abuse than those who were not involved in sports. This effect was stronger for males than for females. Leichliter et al., found that athletes were more likely to experience adverse consequences of drinking and substance abuse (such as driving under the influence), being injured, being involved in an argument or fight, or missing a class <sup>(73)</sup>. Similarly, Lorente et al., studied 815 high school students and reported that sport involvement, in particular involvement in group sports, is related to increased alcohol consumption <sup>(74)</sup>. Brenner et al., also found similar findings for team sports, when they studied 720 college athletes <sup>(75)</sup>. Peretti et al., surveyed 10807 adolescents (14-19 years old) in France and found that, after controlling for confounding factors, repeated alcohol use (defined as to have drunk alcohol 10 times or more during the past 30 days) was associated with regular involvement in individual sports other than team sports, and was more frequent among intensive sportswomen (defined as 8 or more hours per week). Regular involvement in individual sport was also linked to cannabis use in boys <sup>(76)</sup>. Wichstrom et al., conducted a 13-year follow up study on 3251 Norwegian students aged 13-19 years and found that involvement in organized sports not only predicted alcohol intoxication, but also was associated with tobacco and cannabis use <sup>(77)</sup>. Moreover, the results of a study by Marten et al. showed an association between the sport discipline and drinking alcohol. Those involved in swimming and diving reported the highest rate of alcohol consumption compared to other sports <sup>(78)</sup>.

### **1.3.3 Leisure activities and risky driving behaviour**

Like other behaviours, driving behaviour can also be positively or negatively influenced by leisure activities (See theoretical framework - Figure 1.5). Limited leisure activities have been examined with respect to their association with driving behaviour.

#### **1.3.3.1 Spending time with parents (Parental influence on driving behaviour)**

There is clear evidence that the driving behaviour of parents and other family members has a strong influence on children's subsequent driving behaviour <sup>(79-81)</sup>. Parents act as role models for their children, therefore, as they go about their daily life, they establish norms for their children about what is considered acceptable driving behaviour and what is considered to be risky driving behaviour. <sup>(82,83,84,85)</sup>. Moreover, spending time with parents can influence driving behaviour through parent-

child socialization, both directly (e.g., verbal persuasion) and indirectly (e.g., vicarious experience) (<sup>84,86</sup>). Youth's driving behaviour is positively impacted by parental monitoring (<sup>87</sup>) Loubean et al., showed that parental influence can even be used as a teaching tool for improving driving behaviours in young individuals (<sup>86</sup>). Importantly, driving violations and driving styles of young adults were found to be associated with those of their parents (<sup>87,88</sup>). Ferguson et al., in a study in the USA reported that driving records and crash rates of young drivers were related to those of their parents (<sup>47</sup>), and Miller et al., in a study in Israel showed that, in addition to crash rate and driving record, young individuals' driving style was also similar to that of their parents. (<sup>89</sup>). Simon-Morton et al., in the USA revealed that the graduated driving licence system (GDL) allows new drivers to gradually acquire driving skills and experience over time) (<sup>90</sup>). In another study in the USA, Simon-Morton et al., found that risky driving behaviour in young drivers decreased when parents were present but increased when peers were present (<sup>19</sup>).

### **1.3.3.2 Peer Influence on Driving Behaviour**

Individuals who perceive that their peers engage in problem behaviour(s) are also more likely to engage in that behaviour themselves (<sup>36-40,91</sup>). For example, youth who observe and perceive their friends having unsafe sex (<sup>92,93</sup>) or using alcohol and drugs (<sup>94</sup>) are or will be more likely to engage in these behaviours themselves. Peers exert direct and/or indirect pressure on young drivers' behaviour while driving and spending time with them. Young drivers may change their speed or driving behaviour to fulfill their peers' expectations, especially when peers are present as passengers (<sup>95</sup>). Furthermore, having multiple teenage passengers, a common occurrence in youth leisure time, is a risk factor for property damage, injury, and fatal crashes in teenage drivers (<sup>96</sup>).

### **1.3.3.3 Playing video games**

In terms of the type and intensity level of a video game, two studies found that young people who played a racing video game tended to take more risks in critical driving situations in real life than those who played a neutral game (characterized as having no competitive component). In addition, the higher the intensity level of the racing game, the higher the risk-taking tendency while driving (<sup>97,98</sup>). However, there is mixed evidence when it comes to the effect of video games including car racing on real world driving behaviour. While some literature has found that playing video games has positive impact on driving behaviour through improving visuomotor control (<sup>99</sup>), more evidence shows that playing racing video games has a negative influence on actual driving behaviour, such as

several lane changes or speeding (<sup>100,101</sup>). Beullens et al., surveyed 589 drivers aged 18-24 years and found that those who played video games containing reckless driving were more likely (2-4 times) to drive without a license. Moreover, playing such video games seemed to be a better predictor of unlicensed driving than age, risk perception, and sensation seeking (<sup>102</sup>). Greitemeyer et al., in a study on 103 students at Austrian universities evaluated the influence of media content on driving behaviour. The results showed that youth who played a pro-social video games drove less recklessly compared to those who had played a neutral one (<sup>103</sup>). Moreover, a multi-wave longitudinal study conducted via a phone survey reported that playing mature-rated video games was related to increased risky driving behaviours and sensation seeking (<sup>101</sup>). Fischer et al. found that “risk-glorifying” media (e.g., reckless driving in video games, and drinking and smoking in movies) can change people’s self-concept and increase their risk-related cognition which can lead to increased risky behaviours such as risky driving (<sup>104</sup>).

#### **1.3.3.4 Watching Movies and Television (TV)**

Media (e.g., TV and movies) may affect the perception of reality, risk and norms in young people (<sup>103-105</sup>). A study that surveyed 1178 young drivers revealed that young adults who watched movies containing reckless driving scenes were more likely to demonstrate risky driving behaviour in real life (<sup>106</sup>). Beullens et al., in another survey-based study on 462 young drivers found that watching news was a negative predictor while watching action programs on TV was positively associated with risky driving in youth (<sup>107</sup>).

#### **1.3.3.5 Alcohol- or drug- involved activities**

The role of activities involving alcohol and drugs on driving behaviour has been extensively researched. In addition to the impairment influence on driving skills, balance, and coordination; alcohol and drugs also alter risk perception resulting in changes to driving behaviour and increase risky driving behaviours (<sup>108</sup>). Notably, driving after alcohol use is highly associated with binge drinking (<sup>109</sup>). Stevely et al., in a systematic review on the association of the drinking context with acute alcohol-related harm found the drink driving was associated with the following contextual characteristics: place (i.e. licensed premises), timing (i.e. Fridays, weekends, holidays, and evening while mid-week for students), psychological status (i.e. in students, higher objective and lower subjective intoxication), and drink type (i.e. beer which is commonly consumed by binge drinkers and young people) (<sup>110</sup>).

According to data from the 2012 Canadian Community Health Survey, compared to other age groups, cannabis use is more prevalent among 15-24-year-olds (<sup>111</sup>). Capler et al., in a scoping review on cannabis use in the driving context indicated that 4-6% of drivers drove within two hours after cannabis use according to the roadside testing results from 2016. They highlighted young male high school students who drove within one hour after cannabis use, which is associated with reckless driving. Some psychosocial factors were shown to be in association with driving after cannabis use, including demographic characteristics, poly drug use and dependency, driving styles and attitudes towards risk. In the driving settings, cannabis use has been found to negatively influence reaction time, motor coordination, and short-term memory, divided attention tasks, making decisions under pressure and complex situations (<sup>112</sup>). In a recent unpublished meta-analysis including 81 experimental driving studies, Simmons et al., demonstrated that cannabis (as the most popular drug in the world), like alcohol, leads to a negative impact on driving performance, e.g., lateral control impairment. The combination of both drugs can aggravate the impairment in driving performance resulting from either drug in isolation (<sup>113</sup>). Moreover, drug usage is associated with increased injury risk in driving such as not fastening seat belts (<sup>114</sup>).

#### **1.3.3.6 Listening to music**

Listening to music while driving is a very common occurrence. Based on a study of 1780 British participants, driving performance was influenced when not only listening to music but also by the type of music played during the driving session. This influence was confirmed when it was found that drivers with four or more years of accident-free record were those who preferred to not listen to music while driving. Youth, aged 18-29, with less than four years' accident-free record tended to listen to dance and house music with a fast tempo and at high volumes. Characteristics of music such as tempo and volume are worth considering when it comes to the influence of music on driving behaviour (<sup>115</sup>). Based on another survey of 2000 public people in 2011 in the UK, Williamson et al. found that those who listen to drum and bass and heavy metal music (who are mostly young drivers), self-reported more aggressive driving behaviours when compared with classical music listeners. Jazz listeners tended to report receiving more speeding fines than other musical genre listeners. Reggae music listeners were more likely to experience near misses when driving. The survey results also showed music containing lyrics, louder, more complex music, and unfamiliar music were all more likely to be distracting. Some findings, however, might be confounded with age (<sup>116</sup>). Based on an experiment

with 50 drivers using driving simulators, Brodsky et al., found that violent-content and energetic types of music prompted the drivers to perform some risky driving behaviours, such as exceeding the speed limit resulting in a loss of lateral control <sup>(117)</sup>.

### **1.3.3.7 Social media**

Social media can influence behavioural norms and risk taking behaviour in youth <sup>(118, 119)</sup>. Abi-Jaoude et al., stated, in a published podcast at Canadian Medical Association (CMAJ), that social media can negatively affect youth mental health (i.e., self-view, interpersonal relationship, self-harms, and suicidality), despite the fact that digital interactions are the norm and social media use can also be beneficial (e.g. creativity, self-expression, on-line access to many resources, etc.) <sup>(119)</sup>. Driving behaviour is one of the least examined risky behaviour in term of its relationship with social media <sup>(118)</sup>.

Fast-evolving technology (e.g., the smart phones and increasing internet accessibility) has influenced people, especially youth, to increasingly conduct their social interactions online. Checking phones, texting, and calling while driving are areas of concern in the actions of young drivers which indirectly lead to more risky driving behaviours, such as distracted driving <sup>(120)</sup>. A subgroup analysis of a population-based survey of 1133 students in Ontario demonstrated that 36% of student drivers 16 years and older texted while driving <sup>(121)</sup>. Other social media, such as YouTube, can influence driving behaviour in youth through the streaming of top-viewed and top-rated videos that include high speed and risky driving behaviours <sup>(122,123)</sup>, for example 'sidewalk skiing' and 'ghost riding the whip' <sup>(59)</sup>. As noted, it seems that the influence of social media on driving behaviour can be explained by the theories (section 1.2.4) that attitude and perception of risky driving behaviour viewed on social media tend to be normalized, learned, and adopted by the younger population.

### **1.3.3.8 General lifestyle**

Gregersen et al., evaluated the association between lifestyle and car crashes. They found that the high-risk groups in MVCs were generally characterized by an average or below average engagement in sports, drank more often, had a little more "out and about" lifestyle (defined as having an interest in driving with friends, rock concerts, records, parties, disco, and movies), had a higher than average interest in cars, and had more ulterior motives in their driving (such as showing off, pleasure, sensation seeking). Intriguingly, the high-risk groups were also engaged more in cultural activities (classical music, theatre, and playing instruments) <sup>(124)</sup>. Bina et al., reported that risky

driving is positively associated with non-organized activities with friends (such as meeting friends, driving around, going to a club, staying in a pub, going to friends' homes), and non-organized activities at home (such as talking on the telephone, listening to music alone, just sitting doing nothing), especially for boys. Bina et al. also found that risky driving was negatively correlated with leisure activities such as reading for fun, physical exercise (e.g., running or biking), artistic activities, spending time in a library for boys only, and time spent with family. They concluded that antisocial and non-organized leisure activities with friends and at home such as drinking can be a predictor of risky driving behaviour in male youth. The study suggested that the level of engagement in risky driving is associated with the time spent outside the home with friends to a greater extent than with the type of activity (organized or non-organized). Bina et al. highlighted the important role of peers for behaviour normalization and for forming the perception of norms and risks in young drivers <sup>(125)</sup>. Overall, the association of different leisure activities and risky driving behaviour has not been extensively researched as indicated above by limited studies available.

## **1.4 Personality trait as a major confounder affecting both driving behaviour and leisure activities**

According to problem behaviour theory and Shope's conceptual framework <sup>(23)</sup>, personality traits can also play a role in the risky driving behaviour in youth. There is a large body of literature describing the association of different personality traits with risky driving behaviour and MVCs. In addition, the selection of leisure activities and the level of engagement in them can be influenced by personality traits <sup>(126,127)</sup>. Previous studies investigated the association between leisure activities and driving behavior or the association between personality traits and driving behaviour, but no prior study has examined personality as a confounder in the association between leisure activities and driving behaviour.

### **1.4.1 Role of personality traits in risky driving behaviour**

Despite a few studies that found no significant differences in driving behaviour among people with different personality traits <sup>(128,129)</sup>, other research concluded that personality traits can influence the drivers' approach to keep safe on roads <sup>(130,131)</sup>. The following sections describe how personality traits influence risky driving behaviour.

#### **1.4.1.1 Personality trait models (other than Big Five Model) and risky driving behaviour**

Risky driving behaviour in adolescence has been associated with impulsivity and aggression<sup>(132)</sup>, social deviance (defined as the recognized violation of cultural norms)<sup>(133)</sup>, developmental needs for sensation seeking<sup>(134)</sup>, feelings of invulnerability<sup>(135)</sup>, and underestimation of risk<sup>(136)</sup>. The following traits are shown to be closely associated with MVC related risky driving behaviours such as aggressiveness, sensation or thrill seeking, lower inhibitory control, lower attitudinal intolerance of deviance (i.e., cannot tolerate an action or behaviour that violates social norms), impulsiveness, aggression, being prone to boredom, impatience, and inattentiveness.<sup>(132-136)</sup>

#### **1.4.1.2 Big Five Model of Personality traits and risky driving behaviour**

In this thesis project, the Big Five model (or Five Factor Model) was chosen to study risky driving behaviour as it is one of the most common models found in literature. There are five personality traits in the Big Five model: extroversion, agreeableness, openness, conscientiousness, and neuroticism<sup>(137-139)</sup>.

The literature shows that extroversion, defined as the pleasure of interacting with others, and the tendency to be self-assured, outgoing, sociable, energetic<sup>(138,140)</sup>, is associated with crashes, traffic fatalities, traffic violations, impaired driving and physical aggression<sup>(141-144)</sup>.

Neuroticism, characterized by a tendency to be tense, anxious, intolerant to stress and challenges<sup>(140)</sup>, is also positively associated with reckless driving, aggressive driving, verbal and physical aggression in driving, traffic violation, and can pose a higher risk for MVCs and traffic fatalities<sup>(145,146)</sup>.

Conscientiousness, characterized by order, organization, self-discipline, pre-planning, and problem solving<sup>(140)</sup>, is inversely associated with verbal and physical aggression while driving, at-fault crashes, total crashes, and driving violation tickets<sup>(147,149)</sup>.

Individuals with agreeableness are characterized as trusting others, more forgiving, exhibiting altruistic behaviour, empathic, tolerant, and being generous and gentle<sup>(140)</sup>. They also exhibit a careful and less aggressive driving behaviour and drive in a less hostile, reckless, anxious, and furious manner<sup>(149,150)</sup>.

The relationship between risky driving behaviour and openness, characterized by aesthetic appreciation, values, idea acceptance, self-actualization, personal growth, and development<sup>(140)</sup> is inconclusive<sup>(120)</sup>. A few studies found a positive association between openness and aggressive

driving behaviour <sup>(149)</sup> and at-fault crashes <sup>(148)</sup>, while other studies show a positive relationship between openness and careful driving style and less reckless driving <sup>(147,151)</sup>.

### **1.4.2 Personality trait and leisure activity**

Participating in organized leisure activities is strongly associated with psychological well-being. According to social control theory, problematic behaviour tends to occur more often when bonds among young people and conventional societal institutions (e.g., family, school, church) are severed. Participating in unstructured activities can increase problematic behaviours by decreasing young people's bonds with conventional societal institutions <sup>(151)</sup>. McGuiggan et al., found that some components of leisure activities are better explained by personality attributes (planning, follow through, seeking variety, people, and pace of activities), or by demographics (participation in household tasks, team sports and modernity) or by both (risk characteristics of activities). Neither personality nor demographics determined the level of engagement in leisure activities <sup>(127)</sup>.

#### **1.4.2.1 Personality trait models (other than Big Five Model) and leisure activities**

According to the three-dimension (i.e., Psychoticism, Extroversion, and Neuroticism), Eysenck personality model combative leisure activities (such as martial arts and boxing) are associated with psychoticism and competitive leisure activities (such as sport clubs and team sports) are associated with extroversion personality traits <sup>(152,153)</sup>. Professional members of musical bands have been ranked higher on neuroticism, extroversion, and psychoticism scores <sup>(154,155)</sup>, although Hills et al., found no correlation between personality types and participation in amateur musical bands <sup>(153)</sup>. Interestingly, even TV program watchers vary in personality traits. Extroverted people and women were regular watchers of TV soap operas <sup>(156)</sup> while male undergraduate students with high neuroticism scores typically avoided comedy and adventure programs <sup>(157)</sup>.

#### **1.4.2.2 Big Five Model of Personality traits and leisure activities**

Researchers using the Big Five model found that extroversion and openness were associated with more physical activity and less inactivity (e.g., TV watching) <sup>(158)</sup>. In addition, engaging in social media is more common in extroverted and open individuals <sup>(159-161)</sup>. Lower neuroticism and higher conscientiousness were associated with more physical activity, less inactivity, and less sedentary behaviour <sup>(158)</sup>. Literature has shown that people with an openness personality tend to participate in developmental activities and embrace technology use. But they disliked religious activities <sup>(162)</sup> and

less challenging activities such as watching soap operas, or reading romantic fiction, while agreeable, conscientious, and neurotic people tended to participate in these activities <sup>(163)</sup>. People with the agreeableness personality trait disliked crafts, physical activities, and developmental activities (i.e. reading books as part of a job, attending public lectures, taking courses at a university, creative writing, going to the library, studying a foreign language, on-the-job-training, and attending movies), yet liked watching TV, religious activities, experiential activities, and social-public activities <sup>(162)</sup>.

## **1.5 Summary and Knowledge gap**

MVCs are one of the leading causes of hospitalization and premature death in young Canadians <sup>(3)</sup>. Despite the recent improvements in vehicles roadway design, and road safety strategies <sup>(22,164)</sup>, MVCs remain a major public health problem, especially in youth. A variety of frameworks and approaches have been applied to identify the risk factors for MVCs <sup>(9-14)</sup>. The contributing factors for MVCs broadly fall into three categories: environmental, vehicular, and human factors <sup>(15,16)</sup>. Among these factors, the human factor is a major contributor to MVCs. In youth, risky driving behaviour, such as speeding, distracted driving, impaired driving, and driving with fatigue, all fall under the human factor category <sup>(20-24)</sup>. By definition, risky driving behaviours are those actions undertaken by drivers which expose drivers, their passenger(s), and other road users (such as pedestrians, cyclists, and drivers and passengers in other vehicles) to hazardous driving situations <sup>(33)</sup>. Shope et al., proposed the following emerging constructs that contribute to risky driving behaviour: developmental factors, personality characteristics, driving ability, demographic factors, driving environment, and perceived environment. Shope et al., stipulated that the “perceived environment”, defined as the driver’s perception of norms, risk, and attitude, in a driving context, is perhaps the most complex contributing factor for risky driving behaviour in youth <sup>(23)</sup> There has been growing interest in the lifestyles of people who tend to be involved in risky driving behaviours <sup>(23,37-42)</sup>.

Leisure activities are a major component of daily activity in youth and can expose young individuals to various elements of a perceived environment <sup>(165)</sup>. Leisure activities is one of the main norms and a behavioural exchange platforms where youth can observe learn <sup>(166,167)</sup>. Youth can be immensely affected by the norms and behaviours through interactions with parents, peers, culture, community and media, any of which may immensely affect their driving behaviours <sup>(166,168)</sup>. The majority of literature has investigated the effect of one or a few leisure activities on a single or a

particular risky driving behaviour (e.g., aggressive driving). However, the relationship between leisure activities and driving behaviour has seldom been studied, particularly involving Canadian youth. In addition, evidence was mixed with respect to the effects of some leisure activities on driving behaviours and cannot be used for developing targeted safety and preventive strategies.

Moreover, the problem behaviour theories (38-40) have utilized an overarching approach to problem behaviour analysis focused on contributing factors (e.g., personality trait and sociodemographic factors) as being causal for problem behaviours such as risky driving behaviours (168-170).

Given the lack of evidence around the role of leisure activities in risky driving behaviours and the significance of a holistic approach, the current study was designed to primarily investigate the potential influence of leisure activities on driving behaviour while also taking the confounders of this association (personality trait and sociodemographic entities) into consideration (Fig. 1.6).

## **1.6 Study Aim, Objectives, and Hypothesis**

### **1.6.1 Aim**

Investigate the association between different types of leisure activities and risky driving behaviour among youth living in Canada.

### **1.6.2 Objectives**

The objectives of the study were to:

1. Investigate the association between leisure activities and risky driving behaviour adjusted for personality and sociodemographic factors
2. Describe the characteristics of driver risk-groups in young drivers in the context of leisure activities, personality, and sociodemographic factors

### **1.6.3 Hypotheses**

1. Leisure activities are associated with the risky driving behaviour of youth living in Canada.
2. Personality traits are associated with risky driving behaviour of youth living in Canada.
3. Sociodemographic factors are associated with risky driving behaviour of youth living in Canada.

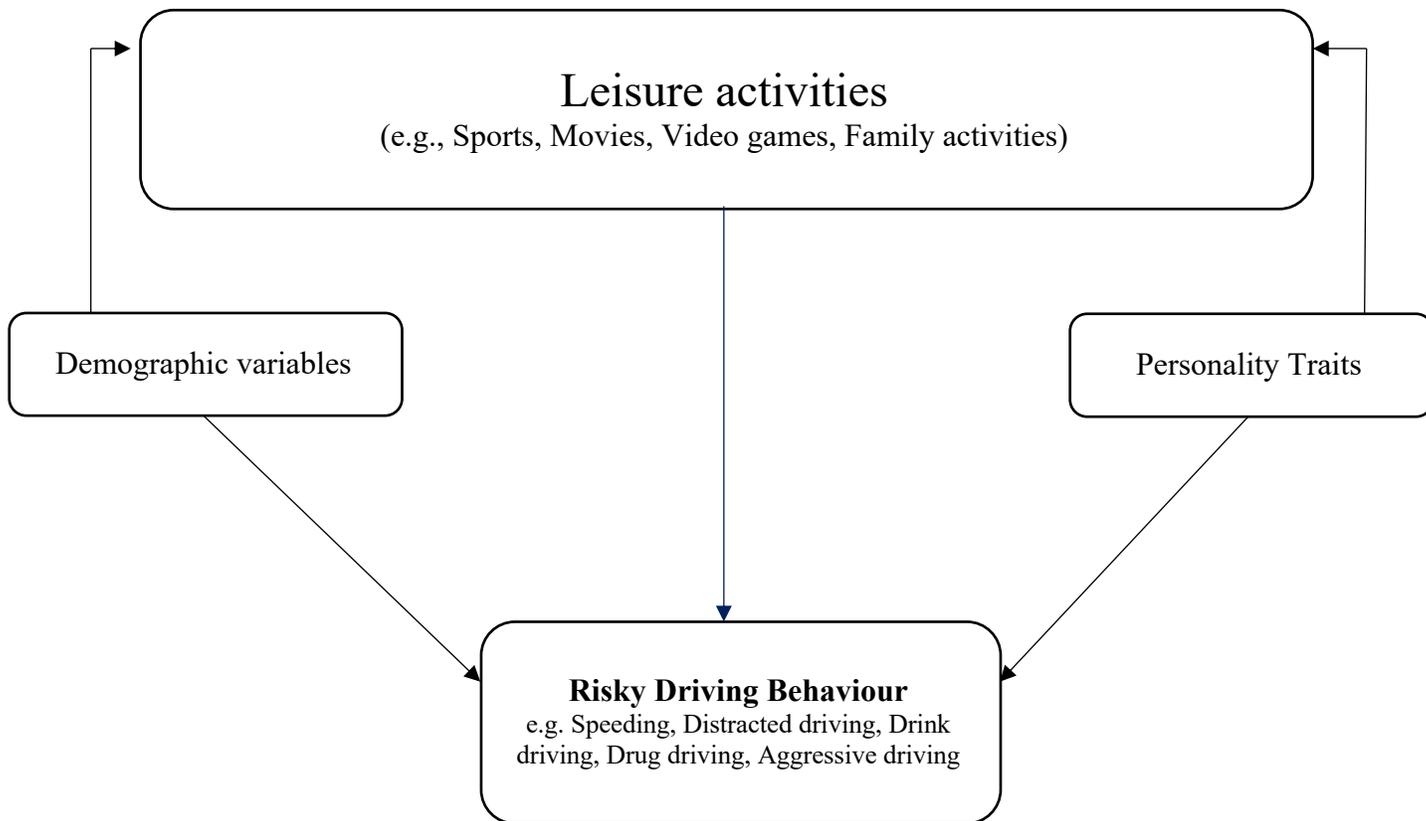
### **1.6.4 Study questions**

Are leisure activities associated with risky driving behaviour in Canadian youth?

What types of leisure activities are associated with risky driving behaviour among youth living in Canada?

**Figure 1.6 The association of leisure activities and risky driving behaviour**

The association of leisure activities and risky driving behaviour is the main objective of this study. Sociodemographic factors and personality trait are confounding factors affecting both leisure activities and driving behaviour that are also incorporated in the study design. This framework depicts the role of leisure activities on risky driving behaviours and how personality traits and demographic factors may influence this association.



## **2. Methodology**

### **2.1 Study design and target population**

This is a cross-sectional study with data collected through an online survey of young drivers in Canada conducted between March and May 2018. Participants who were 16 -24 years old living in Canada with a valid driving license and had been driving at least 2 hours per week in previous 3 months at the time of survey were invited to participate.

### **2.2 Engaging a youth advisory committee (YAC)**

Following the patient-oriented research strategy of Canadian Institutes of Health Research to transform the role of participants from a passive role to a proactive one, 24 youth (12 males, 12 females), aged 16-24, were engaged as a Youth Advisory Committee (YAC). These youth were from diverse geographic and demographic backgrounds: 20 from Metro Vancouver, three from Toronto, and one from Montreal. The first few young people were recruited by word of mouth (asking colleagues and other research teams). The remaining members were recruited by snowball sampling, with initial members assigned to approach young individuals from diverse backgrounds, i.e. different cities in Canada, cultures, ages (ranged 16-24 years) and genders, as well as different fields of interest in their social media, communities, clubs, and schools. YAC actively collaborated with the project from an early stage and contributed to the development of the study design, survey, data collection strategy and knowledge translation activities. Following YAC member preference, a Facebook group was created to allow interactive communication. The YAC was also consulted through interactive in-person meetings with refreshments held approximately twice per month for 15 months in the Research Pavilion at Vancouver General Hospital. Three members from Toronto joined the meetings via free online communication tools such as Skype or Face-Time services. Attendance of more than half of the members (twelve or above) was a requirement to convene the sessions. Those who were not able to attend the sessions were updated by posting meeting notes on the Facebook group. YAC member opinions were sought on road safety and its priority, developing the Leisure Activity and Sociodemographic Questionnaires, and reviewing the validated questionnaires for personality traits and driving behaviour to ensure they were understandable when presented to youth.

## **2.3 Survey instruments**

The online survey consisted of a cover letter (explaining the study and obtaining consent) (Appendix D), a sociodemographic questionnaire (SDQ), a leisure activity questionnaire (LAQ), and a driving behaviour questionnaire (using the modified version of validated Behaviour of Young Novice Drivers Scale (BYNDS), and a personality trait questionnaire (through a valid Mini International Personality Item Pool, i.e. Mini-IPIP) The order of questions in the survey followed the “warm up - cool down” approach in order to achieve a more completely answered survey.

### **2.3.1 Basic sociodemographic questionnaire**

The basic sociodemographic inventory consisted of twelve items which were developed with feedback from the YAC. This inventory (Appendix D) included the participant’s location by province, age, gender, drivers’ license status, amount of driving hours per week, number of cars in the family, personal car ownership status, education, employment status, living status (with whom), duration of driving independently (years), and family home ownership (Table 2.1). It was decided not to enquire about elements (such as family income) that warrant parental consent. Hence, socioeconomic status questions included questions on “home ownership” and “number of cars each family owns” which were used as proxies for socioeconomic status. Literature shows family structure affects risky behaviours due to the fact that single parent and both parents living situations can be different. According to Health Behavior in School-aged Children (HBSC), living arrangements of Canadian students: more than two thirds of Canadian young people (71%) live in home with both parents. The remaining youth live in single-family homes (with mother 14%, with father 3%), with a parent and stepparent (8%), or in another kind of arrangement including with grandparents, extended family, friends, or in a foster care situation (4%) <sup>(171)</sup>.

**Table 2.1 Sociodemographic variables, options in the survey, and final categories**

\*Final categories are the ones used for analysis

Variables	Survey inquiry	Answer Options in Survey	Final Categories
Gender	I identify as	Male/Female/Other	Male/Not Male
Age	What is your age in years?	Age in years from 14 to 25	16-19: Beginner Driver 20-24: Young adult driver <sup>1</sup>
Employment status	What is your employment status?	Employed Student Both (Employed and student) Other	Employed Student Both (Employed and student) Unemployed
Living status	Who do you live with?	Family (both parents) Family (single parent) With friend(s) Partner Alone Other	Living with both parents Living with a single parent Living with a spouse or partner or child Living alone or with friends, roommates, or with other relatives <sup>2</sup>
Socioeconomic status	How many vehicles does your family own?	None ≤ 2 >2	Low = No home, No Car, Moderate = ≤ 2 cars and No home, High= Home AND/OR car>2
	Does your family own their home?	Yes No	
Education status	Please indicate the highest level of your education.	Less than high school diploma Graduated from high school Some postsecondary Postsecondary diploma or certificate University degree <sup>3</sup> Other	Less than high school diploma High (Secondary) school diploma or equivalent Some post-secondary education <sup>2</sup>
Province	Which province/territory do you reside in?	AB, BC, MB, NB, NL, NT, NS, NU, ON, PE, QC, SK, YT <sup>4</sup>	AB, BC, MB, NB, NL, NT, NS, NU, ON, PE, QC, SK, YT <sup>4</sup>
<b>Driving profile:</b>			
Driver's license status	What is your driving license status? <sup>3</sup>	refer to Table A.1	With restriction Without restriction <sup>3</sup>
Drive independently duration	How long have you been able to drive independently?	<1 year 1-3 years 3-5 years >5 years	< 1 year 1-3 years >3 years
Driving exposure	In the last three months, how many hours a week, on average, did you drive? (Text required)	Time in hours from 0 to 168	Low: <11 hours/week Moderate: 11-20 hours/week High: >20 hours/week <sup>4</sup>
Driver's car	Do you own your own car (e.g. truck, motorcycle, van, SUV, etc.)?	Yes No	Yes No

<sup>1</sup> Categories based on the data available from:

[https://www.madd.ca/english/research/youth\\_and\\_impaired\\_driving\\_2006.pdf](https://www.madd.ca/english/research/youth_and_impaired_driving_2006.pdf)

<https://www.tc.gc.ca/eng/motorvehiclesafety/tp-tp15145-1201.htm>

[http://tirf.ca/wpcontent/uploads/2017/02/RSM\\_YD\\_Backgrounder.pdf](http://tirf.ca/wpcontent/uploads/2017/02/RSM_YD_Backgrounder.pdf)

<sup>2</sup> The options in the survey were based on Statistics Canada (<sup>174</sup>). For the analysis, the last two options merged to reduce the number of categories. Of note, the research team (supervisory committee and I) agreed that merging would not significantly affect the results.

<sup>3</sup> Due to having ten separate provinces and three territories, breaking the driving license to these two categories was the only way to make them united

<sup>4</sup> These categories were defined based on the responses from participants and the transport to and from activity from General Social Survey (GSS) 2015 conducted every 5 years that Average driving for age 15-24= 1.5 hr/d (<sup>172</sup>).

### 2.3.2 Behaviour in Young Novice Driver Scale (BYNDS)

In this study, drivers' profile was measured using the Behaviour of Young Novice Drivers Scale (BYNDS) which is a self-report measurement tool for risky driving behaviours. BYNDS was developed by Scott-Parker et al. and validated with drivers aged 17-25 years in Australia and 16-24 years in New Zealand (<sup>173,174</sup>).

The BYNDS consists of 44 items comprising five subscales:

1. Transient rule violations (13 items,  $\alpha=0.89$ ) defined as “risky behaviours that can be performed multiple times throughout the journey, such as speeding” - Questions 1 to 13
2. Fixed rule violations (10 items,  $\alpha=0.73$ ) defined as “behaviours that are stable throughout the journey, such as driving after using illicit drugs” - Questions 14 to 23
3. Misjudgement (9 items,  $\alpha=0.76$ ) which reflects “driving errors, such as misjudging the required stopping distance” - Questions 24 to 32
4. Risky driving exposure (9 items,  $\alpha=0.81$ ) which reflects “conditions which place the novice at greater risk of crash, such as driving at night with friends as passengers” - Questions 33 to 41
5. Driver mood (3 items,  $\alpha=0.87$ ) defined as “the driver's emotional driving, such as driving faster if they were in a bad mood” - Questions 42 to 44

The 44 questions are scored on a 5-item Likert scale, from 1 (never) to 5 (nearly all the time). The total score is calculated by adding up the score for each question. The composite score has a very high internal consistency measure (Cronbach's  $\alpha=0.97$ ). The composite score was weakly correlated with self-reported crashes ( $r_s=0.17$ ) and moderately correlated with future offences ( $r_s=0.21$ ), while more strongly correlated with the participants intentions to break traffic rules ( $r_s=0.44$ ) (<sup>175</sup>). The composite score of BYNDS was also used to categorize the drivers into three main risky driving behaviour groups: high, moderate and low risk (<sup>176,177</sup>). (Table 2.2)

Young drivers who score high have more tendency to engage in risky driving when there is a chance of not being observed by police. It is noteworthy that BYNDS covers all risky driving behaviours in young drivers such as speeding, distracted driving, etc. As the BYNDS was developed in Australia, the wording was modified with consultation from the YAC to reflect the Canadian driving context (e.g. driving on right side of the road versus on left side), and to replace Australian vernacular with Canadian terminology (e.g. “peak time” was changed to “rush hour”, “mates” was changed to “friends”) (Table 2.3). It should be noted that the BYNDS was used in a study in North

America which aimed to assess the association of risky driving behaviour and mental health symptoms in novice adolescent drivers (aged 16-17 years) in Pennsylvania (178). The psychometric properties of the BYNDS have not been validated in Canadian youth.

**Table 2.2 Driving behaviour categories based on the composite score of BYNDS**

Variable	Categories (based on the total score) Composite score range (44-220)
Risky Driving Behaviour	Low risk= Composite score <71 * Moderate risk = Composite score= 71-91 High risk= Composite score >=92

\*The cut-off values were adopted from the literature (179)

**Table 2.3 Questionnaire Changes on Young Novice Drivers Scale (BYNDS) instrument**

Canadian BYNDS	Australian BYNDS
You drove over the speed limit in areas where <i>you were unlikely to get caught</i>	You drove over the speed limit in areas where <i>it was unlikely there was a radar or speed camera</i>
You deliberately sped when <i>passing another vehicle</i>	You deliberately sped when <i>overtaking</i>
You travelled in the <i>left</i> lane on multilane highways	You travelled in the <i>right</i> lane on multilane highways
You <i>passed</i> a car on the <i>right</i>	You <i>overtook</i> a car on the <i>left</i>
You <i>used spoke/texted on a handheld cell phone</i>	You <i>spoke on a mobile that you held in your hands</i>
You misjudged the gap <i>in traffic</i> when you were turning <i>left</i>	You misjudged the gap when you were turning <i>right</i>
You turned <i>left</i> into the path of another vehicle	You turned <i>right</i> into the path of another vehicle
You misjudged the gap <i>in traffic</i> when you were <i>passing</i> another vehicle	You misjudged the gap when you were <i>overtaking</i> another vehicle
You <i>cut off</i> another vehicle when <i>entering the road</i>	You <i>entered the road in front of</i> another vehicle
You didn't always <i>signal</i> when you were changing lanes	You didn't always <i>indicate</i> when you were changing lanes
You drove <i>during morning and afternoon rush hour</i>	You drove <i>at peak times in the morning and afternoon</i>
You went for a drive with your <i>friends</i> giving directions to where they wanted to go	You went for a drive with your <i>mates</i> giving directions to where they wanted to go

For the entire questionnaire, refer to Appendix C

### 2.3.3 Leisure time activity questionnaire

The leisure time activity questionnaire was designed and developed after an extensive review of the literature (<sup>180-184</sup>) and revised based on feedback from the YAC. There is no instrument compatible with the young (aged 16-24 years) in the Canadian context that would inclusively and reasonably measure leisure activity. Therefore, a comprehensive list of leisure activities was abstracted from literature (<sup>185</sup>). For example at the time of developing the survey (2018), according to the most up-to-date statistics provided on the website of “BooknetCanada.ca” (a non-profit organization that develops technology, standards, and education to serve the Canadian book industry), Canadians spent their leisure time on browsing the internet (33%), spending time with family (32%), watching TV (31%), watching a movie (23%), and reading (22%). The distributions of these leisure activities were fairly similar to those found in the previous three years (<sup>187</sup>). Of note, the website updated the statistics in April 2019 which lists the following as popular daily leisure activities among Canadians, browsing social media and/or the web daily (60%), watching videos/TV/movies (56%), listening to music (51%), cooking (47%), and spending time with family (40%) (<sup>186</sup>). This update did not influence the survey.

Each major category of leisure activity was divided into subtypes using classifications from the literature (when available) and input from the YAC. For example, in 2001 Rentfrow categorized musical styles as 1. Classical, 2. Pop, alternative, rock, heavy metal, 3. Jazz, blues, 4. Traditional, folk, country, ethnic, 5. Rap, electronic, and 6. Other (<sup>181</sup>). From the perspectives of YAC members and two musician friends who I reached out to, these categories, however, did not seem reasonable due to the fact that very different genres fell under the same categories. Therefore, for this study music genre categories were developed in consultation with the musicians and then obtained acceptance from YAC. For the movie, book, and magazine types of entertainment, the categories were adapted from two studies which evaluated the association of these activities’ preferences with demographic factors and personality traits (<sup>181,185</sup>). An appropriate classification of educational categories was adopted from the Council of Minister of Education of Canada and Canadian degree qualification framework and degree categories (<sup>182</sup>). The sub-types of volunteer activities were drawn from the Statistics Canada questionnaire (<sup>187</sup>). For the final questionnaire, we included examples of activities from each sub-type (Appendix A).

With respect to the level of engagement in each leisure activity, the existing evidence was limited or non-existent for most activities and was not applicable to young Canadians. Therefore, the insight of the YAC members was sought with regard to how to enquire regarding the general types and subtypes of leisure activities, and the level of engagement in each leisure activity. Accordingly, level of engagement was categorized into 5 groups with varied hours/times per week depending on the leisure activity types (Table 2.4).

### **Pilot testing the Leisure Activity Questionnaire**

Each YAC member sought input from 3-5 young individuals with a different age, culture, and field of interest (different individuals than those who had previously been involved helping with the survey development). They found volunteer youth from their schools, social media, and friends contact lists. The total sample of 75 young individuals from Toronto, Vancouver, and Montreal were asked to read and answer the survey, and to share their insights on the following fields: types of leisure activity (i.e. whether there were any missing leisure activities), subtypes (whether participants could find their choice without confusion, whether there were any missing leisure activity sub-types), the cut off values on the five-item scale for level of engagement (whether they think that the cut off values of 5-item scale made sense to them), wording, and understandability. The majority of participants (73 youth) approved all aforementioned fields without any comment. There were a couple of comments from two of participants regarding the cut off points for the leisure activities and subtypes which were not approved in the YAC meeting. Therefore, the face validity of the questionnaire was verified. With respect to the content validity, we chose not to calculate internal consistency or reliability for the Leisure Activity Questions due to their factual nature. The leisure activity questionnaire is a categorization of possible leisure activities. If a youth spends most of their time doing one type of activity, then they likely do not spend as much time on the others. When Cronbach's Alpha is used to calculate internal consistency, it is meant to demonstrate consistency between different questions on a survey that measure the same construct. This is not applicable to the leisure activity questionnaire because each question was loaded on one construct, i.e., 13 questions measured 13 distinct leisure activities. Moreover, each question which represented one construct influenced one manifest variable. Therefore, even Explanatory Factor Analysis was not a reasonable option.

For leisure activity correlations, there can sometimes be issues with multicollinearity if two variables are too similar. However, there was not a problem with that in this case. When the

correlations were examined between high/low engagement in the 13 activities, the highest correlation was  $\rho=0.45$  (for movies and music) which was not high enough to cause multicollinearity issues. As noted above the leisure activity questionnaire consisted of thirteen types of activities which were evaluated in the current study based on the level of engagement and the sub-type of each leisure activity. For the analysis, the level of engagement collected based on the five-item scale was categorized into two groups: high or low engagement (Table 2.4). In addition, participants were asked for their top three choices from the sub-types of leisure activity within each category (if they had indicated that they partook in that specific leisure activity) (Appendix A, Table 2).

**Table 2.4 Leisure activities and level of engagement.**

The level of engagement was collected on a 5-item Likert scale (below-Primary category). Then, for the analysis, the level of engagement was stratified as Low or High engagement (below-Final categories)

Variable	Survey inquiry	Primary categories (in the survey)	Final categories (For analysis)
Video game engagement	In the last 3 months, how many hours a week did you play video games?	<ol style="list-style-type: none"> <li>1. None</li> <li>2. <math>\leq 4</math> hours per week</li> <li>3. 4 - 9 hours per week</li> <li>4. 9 - 14 hours per week</li> <li>5. 14+ hours per week</li> </ol>	1, 2, or 3: Low engagement 4 or 5: High engagement (applied to all rows)
Sport engagement	In the last 3 months, how many hours a week did you play sports?	<ol style="list-style-type: none"> <li>1. None</li> <li>2. <math>\leq 1</math> hour per week</li> <li>3. 1 - 3 hours per week</li> <li>4. 3 - 7 hours per week</li> <li>5. 7+ hours per week</li> </ol>	
Social media engagement	In the last 3 months, how many minutes a day did you spend on social media?	<ol style="list-style-type: none"> <li>1. None</li> <li>2. <math>\leq 30</math> minutes per day</li> <li>3. 30 - 60 minutes per day</li> <li>4. 60 - 120 minutes per day</li> <li>5. 120+ minutes per day</li> </ol>	
Movie engagement	In the last 3 months, how many hours a week did you spend watching movies?	<ol style="list-style-type: none"> <li>1. None</li> <li>2. <math>\leq 3</math> hours per week</li> <li>3. 3 - 6 hours per week</li> <li>4. 6 - 10 hours per week</li> <li>5. 10+ hours per week</li> </ol>	
Family engagement	In the last 3 months, how many times a week have you participated in an activity with your family? (N.B. It does not include the time you spent together at home doing your own tasks)	<ol style="list-style-type: none"> <li>1. Never</li> <li>2. Once a week</li> <li>3. 2-3 times per week</li> <li>4. 4-5 times per week</li> <li>5. 5+ times per week</li> </ol>	
Friend engagement	In the last 3 months, how many times a week have you participated	<ol style="list-style-type: none"> <li>1. Never</li> <li>2. Once a week</li> </ol>	

	in an activity with your friends? (N.B. It does not include the school time activities)	3. 2-3 times per week 4. 4-5 times per week 5. 5+ times per week	
Alcohol engagement	In the last 3 months, how many times a week did you drink alcohol?	1. Never 2. Once a week 3. 2-3 times per week 4. 4-5 times per week 5. 5+ times per week	
Drug engagement	In the last three months, how many times a week have you used recreational drugs?	1. Never 2. Once a week 3. 2-3 times per week 4. 4-5 times per week 5. 5+ times per week	
Art engagement	In the last three months, how many hours a week did you engage in art activities?	1. Never 2. ≤ 1 hours per week 3. 1 - 3 hours per week 4. 3 - 7 hours per week 5. 7+ hours per week	1, 2, 3: Low engagement 4, 5: High engagement (applied to all rows)
Reading/Writing engagement	In the last three months, how many hours a week did you spend on reading/writing something? (N.B. It does include reading/writing for a leisure activity and not for school or work)	1. Never 2. ≤ 1 hours per week 3. 1 - 3 hours per week 4. 3 - 7 hours per week 5. 7+ hours per week	
Volunteering engagement	In the last three months, how many hours a week did you act as a volunteer?	1. Never 2. ≤ 2 hours per week 3. 2 - 4 hours per week 4. 4 - 6 hours per week 5. 6+ hours per week	
Music engagement	In the last three months, how many hours a week did you listen to music?	1. Never 2. ≤ 15 hours per week 3. 15 - 30 hours per week 4. 30 - 45 hours per week 5. 45+ hours per week	
TV engagement	In the last 3 months, how many hours a week did you spend watching TV?	1. None 2. ≤ 3 hours per week 3. 3 - 6 hours per week 4. 6 - 10 hours per week 5. 10+ hours per week	

### 2.3.4 Mini-IPIP Questionnaire, measuring personality traits

Mini-International Personality Item Pool (Mini-IPIP) (Goldberg, 1999), is a validated questionnaire which measures the five personality traits based on the Big Five model, i.e. extroversion, agreeableness, conscientiousness, neuroticism, and imagination (openness) <sup>(189)</sup> (Appendix D). Donnellan et al., in a study on North American college and university students provide

evidence that Mini-IPIP is an effective, validated, and reliable questionnaire when researchers are seeking a fast method of assessment for Big Five Model. It has consistent and acceptable internal consistencies across five studies ( $\alpha$  at or well above 0.60) (<sup>190</sup>).

The Mini-IPIP questionnaire consists of 20 questions designed as “+” keyed and “-” keyed questions on 5-item Likert scale to assess the five personality traits. For “+” keyed items (i.e. questions 1, 2, 3, 4, 5, 11, 12, 13, 14), the answer "Very Inaccurate", "Moderately Inaccurate", "Neither Inaccurate nor Accurate", "Moderately Accurate", and "Very Accurate" are assigned values of 1, 2, 3, 4, and 5, respectively. For “-” keyed items (i.e. questions 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20), the scoring is reversed, i.e. the answer "Very Inaccurate" is scored a value of 5, "Moderately Inaccurate" a value of 4, "Neither Inaccurate nor Accurate" a value of 3, "Moderately Accurate" a value of 2, and "Very Accurate" a value of 1. A total scale score is calculated by just summing all the values for that scale (<sup>191</sup>). This instrument has been used to study personality traits of on 15,471 adults (mean age=29.1, SD=1.75) in North Carolina, USA. Of note, they were also interviewed while they were in grade 7-12 (ages 11-19) (<sup>192</sup>).

However, it has not been applied to young people in Canada. I enquired about the stratification of MINI-IPIP score (from the original website <http://ipip.ori.org/>), and was advised by Dr. John A. Johnson, Professor Emeritus of Psychology, Pennsylvania State University, to use local norms if possible, and report individual scores as below average, average, or above average. Accordingly, for the current study, we used local norms (from the participants) and opted for 3-category stratification. Based on the mean and standard deviation of the score in the sample, participants fell into three categories for each trait, i.e., low, average, and high (<sup>191,192</sup>). (Table 2.5)

**Table 2.5 Mini-IPIP measures five personality traits.**

The total score for each personality trait were rated as low, average, and high based on the Mean and Standard of Deviation (SD) of the sample in the current study.

Variables	Categories
Extroversion	Low: Total score < (Mean-SD*)
Agreeableness	Average: (Mean-SD) ≤ Total score ≤ (Mean + SD)
Conscientiousness	
Neuroticism	High: Total score > (Mean + SD)
Imagination	

\*Mean and Standard of Deviation calculated from the sample in the current study.

### 2.3.5 Canada Young Driver Survey (the entire survey)

The entire “Canada Young Driver Survey” (Appendix D), including all the aforementioned instruments (Table 2.6), was reviewed by two English instructors and two high-school teachers to assess grammar and punctuation, as well as wording and comment for any ambiguities. They had no comments and found the survey clear and ready for use by youths. Thereafter, 40 participants (approached by YAC members) pilot-tested the whole survey before deployment to finalize the survey. The YAC ensured that these participants were not those who had helped develop the survey previously (e.g., reviewing the leisure activity questionnaire) and this was the first time they were exposed to the survey. There was no change required afterwards.

**Table 2.6 Canadian Young Driver Survey**

The survey used in the current study consisted of four instruments

Instrument	Purpose	Developed by	Validation	The entire survey was reviewed by an additional 40 youth
Basic sociodemographic	Sociodemographic factors General driving profile	Research team and YAC	Research team and YAC (most variables' categories adopted from valid resources)	
Behaviour in Young Novice Driver Scale <sup>(176,177)</sup>	Risky Driving behaviour	Scott-Parker et al	Scott-Parker et al Modified by Research team and YAC	
Leisure time activity questionnaire	12 Leisure activities (level of engagement)	Research team and YAC	Reviewed by 75 youth	
Mini-IPIP questionnaire <sup>(190)</sup>	Personality trait	Donnellan et al.	Donnellan et al.	

## 2.4 Survey deployment

Study data was collected and managed using REDCap electronic data capture tools hosted at the University of British Columbia <sup>(193)</sup>. In consultation from YAC, it was decided to deploy a link to the survey via advertisement on popular social media networks including Facebook and Instagram. The promotional advertisement was a short video linked to the survey. The video was filmed by a team from YAC and their friends after obtaining verbal informed consent.

YAC was consulted on, and approved, the content and the text prompts contained in the video. To ensure that it would not affect participants' answers, the video was scripted in a neutral way that would not elicit any positive or negative feelings in viewers before participating in the

survey which can be viewed at the following link:

(<https://www.facebook.com/samplepageresearch/videos/1476408445814697/>).

Prior to publishing the link to the survey, which was embedded in the advertisement, a filter for age, location, and field of interest of viewers was set for age as 12-28 years, location as Canada, and field of interest as “all the options”. The rationale behind extending the age range from 12-28 years, which was wider than the age inclusion criteria, i.e. 16-24 years, was that young people use invalid ages in their Facebook accounts (younger or older). Moreover, in some provinces/territories, youth are eligible for driving licenses at ages lower than 16. The YAC members randomly checked 100 of their Facebook contacts and found all ages were correct. The link to the survey, embedded in the advertisement, was published on Facebook and Instagram for three months: March 1<sup>st</sup> to May 31, 2018. The YAC members also posted the advertisement on other social media and encouraged their friends and families to disseminate the link as well. Given that incentives (such as altruism, payment, recognition and visual props) may lead to increased response and engagement of the youth population for social research needs (<sup>194</sup>), the participants were entered into a draw for a chance to win one of fifty available \$10 gift cards (e.g., Amazon or Starbucks). The option of incentive (i.e., a gift card) was suggested by the YAC. To ensure anonymity, the winners were provided with an online link via emails to claim their gift cards.

## **2.4.1 Data management and Ethical Consideration**

### **2.4.1.1 Data collection**

REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry, 2) audit trails for tracking data manipulation and export procedures, 3) automated export procedures for seamless data downloads to common statistical packages, 4) Canada-based server, and 5) procedures for importing data from external sources (<sup>193</sup>). REDCap was supported by the Centre for Clinical Epidemiology and Evaluation’s (C2E2). To access data from the C2E2 instance of REDCap required research team members to use their UBC CWL (University of British Columbia Campus-Wide Login). The UBC IT department managed usernames and passwords for CWL, and the C2E2 REDCap Administrator supported access to the accounts. All data was stored on a secure institutional server at UBC.

### 2.4.1.2 Data confidentiality

Survey data included no personal information or identifier except the email addresses of those who were interested in the draw. There was no link between the retained email addresses and the corresponding survey responses, hence anonymity was maintained. In addition, the email addresses were stored in a separate dataset, unlinked from Record IDs, and destroyed as soon as the winners of the draw were notified. However, the emails of the fifty winners of the draw were kept, as required by UBC finance, for 5 years after publication. All gift cards were provided via email to an online E Gift Card link; no physical mailing addresses were collected.

## 2.5 Ethical Consideration

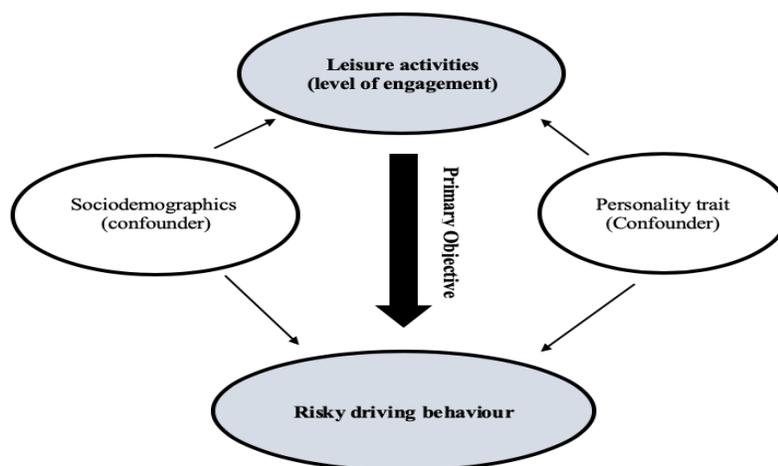
The study was approved by the Behavioural Research Ethics Board of the University of British Columbia (H17-00086).

## 2.6 Data Analysis

The diagram below illustrates the relationship of the constructs of the current study which can aid in understanding the analysis.

**Figure 2.1 Construct relationship Diagram (Analysis perspective)**

The association between the leisure time activities (primary predictor variables) and risky driving behaviour (outcome variable), shown as a thick arrow (primary outcome variables), was studied. This association was adjusted for personality traits and sociodemographic factors (both are other confounders and also predictor variables) (thin arrows). The adjusted association was investigated with proportional odds logistic regression (POLR) analysis.



## 2.6.1 Variables

The outcome (dependent) variable in the current study is risky driving behaviour and the predictive (independent) variables include leisure activities engagement level, personality traits, basic sociodemographics factors, and general driving profile.

**Table 2.7 Variables and categories**

Variable	Name	Measurement tool	Classification
Outcome	Risky driving behaviour	BYNDS questionnaire	High risk (score $\geq 92$ ) * Moderate risk ( $71 \leq \text{score} \leq 91$ ) Low risk (score $\leq 70$ )
Predictor	Leisure activity engagement level (13 leisure activities)	Leisure activity questionnaire	High engagement ** Low engagement
Predictor	Personality trait	Mini-IPIP questionnaire	Low ( $< \text{Mean} - \text{SD}$ ) *** Average ( $\text{Mean} \pm \text{SD}$ ) High ( $> \text{Mean} + \text{SD}$ )
Predictor	Sociodemographics General driving profile	Sociodemographic questionnaire	Refer to Final categories in Table 2.1

\* The cut-off points are adopted from the literature (Table 2.2)

\*\* The stratification in Low and High was explained in Table 2.4.

\*\*\* Each of five personality traits was ranked as Low, Average, or High based on the Mean and Standard of deviation (SD) of the current sample (Table 2.5)

## 2.6.2 Statistical analysis plan

The theoretical framework (Figure 1.5) illustrates possible ways that leisure activity can influence driving behaviour. In addition, it shows that personality and demographic factors are also able to affect driving behaviour. The Canadian Young Driver Survey (Table 2.6) collected all these variables to help shed more light on the possible association of leisure activity with driving behaviour while also considering personality and demographic factors. Raw data were exported from REDCap to Excel. The data was examined for completeness, cleaned, and coded for predetermined categorization of outcome and predictor variables; then, transferred to SPSS.

To investigate the association between leisure activity and risky driving behaviour in young drivers in Canada, the following analyses were conducted.

### **2.6.2.1 Descriptive Analysis**

Descriptive analyses were conducted to examine the characteristics of participants in terms of leisure activities, personality traits, demographic, and driving behaviours. All continuous variables were reported as means and standard deviations, and categorical variables as proportions. Bivariate analyses with Chi-square statistics were used to examine the differences in leisure activities, personality traits, and demographics among the three groups of risky driving behaviours.

Along with the chi-square tests, the contingency table of counts and proportions of the characteristics of the survey participants was presented. Also, each group of outcome variables, i.e. risky driving behaviour (high, moderate, low) was presented. Although the Chi square would not impose any assumptions about the functional form of that relationship, it was appropriate for the purpose of testing to determine whether or not a relationship or an association existed between each factor and risky driving behaviour. Thereafter, Spearman rank-order correlation test was applied to examine, first, the correlations between predictor variables (leisure activities, demographic factors and personality traits) and outcome variable (risky driving behaviour); then, the correlation among all the predictor variables themselves, to identify whether there were any highly correlated variables. Generally, it was possible to infer the direction of association by examining the descriptive statistics after Chi square and Spearman correlation; however, the formal test of association was left to the regression analysis.

### **2.6.2.2 Proportional Odds Logistic Regression analysis**

The next step was the Proportional Odds Logistic Regression (POLR) analysis, since the outcome variable was ordinal, low, moderate, or high risky driving behaviour, was applied to formally test these associations with estimates of the magnitude and direction of association in the form of an odds ratio. The main advantage of this approach is that all explanatory factors are modelled simultaneously so that any confounding effects that may be present can be controlled. The model also considers the ordinal nature of the data. To avoid multicollinearity, highly correlated variables were first identified and then the most appropriate variables fitted the model were singled out. Highly correlated variables might not only hurt the precision of the estimate coefficient in the model but also undermine the power of the model. In other words, having highly correlated variables in the model might lead to decreased level of significance for the real influential predictors. In turn, the actual non-correlated variables might happen to have higher coefficient magnitudes compared to the actual correlated

variables and, in a backward elimination procedure, be selected for the model instead. Given that the predictors are categorical, the correlation was assessed with the Spearman's rank statistic ( $\rho$ ). The cut-off value for deciding which predictors were too correlated was randomly set to  $\rho > 0.77$ . In the case of two highly correlated variables, the goodness of fit test would be applied to identify which one is, statistically, the better fit for the model. Given that there were no highly correlated variables were found according to the  $\rho$  cut-off value, goodness of fit processing was not required (Table B.1, Appendix B).

In analysis, no highly correlated variables were found. Consequently, goodness of fit processing was not applied (Table B.1, Appendix B). First, all the potential predictors from personality traits, leisure activities and sociodemographic factors were examined in a POLR to construct a full model for risky driving behaviour. Afterwards AIC stepwise selection (combination of forward and backward elimination) was applied to identify the best model, i.e., the most parsimonious model, which includes the variables that best fit the regression predictive model. Odds ratios (ORs) with 95% confidence intervals were reported. Stepwise regression (or stepwise selection) yields a predictive model which consists of the best subset of predictor variables selected by iteratively adding/removing predictors to/from the predictive model. This selection procedure ends up with the best performing model, i.e., Parsimonious model, which is a model that lowers prediction error. There are three strategies for stepwise regression (<sup>195,196</sup>):

- Forward selection, which starts with no predictors in the model, iteratively adds the most contributive predictors, and stops when the improvement is no longer statistically significant.
- Backward selection (or backward elimination), which starts with all predictors in the model (full model), iteratively removes the least contributive predictors, and stops when you have a model where all predictors are statistically significant.
- Stepwise selection (or sequential replacement), which is a combination of forward and backward selections. This method starts with no predictors, then sequentially adds the most contributive predictors (like forward selection). After adding each new variable, any variables that no longer provide an improvement in the model fit will be removed (like backward selection).

The current study practised fitting the final selected model through backward elimination to determine the best predictive variables with statistically significant influence on driving behaviour. Of note, this analysis was exploratory, so there was no adjustment for multiple comparisons. A single regression model was applied to formally test the associations.

## 2.7 Sample size considerations

The required sample size depended on the prevalence of the outcome in high risk driving (composite score  $\geq 92$  in BYNDS), and the prevalence of the exposure (either leisure activity or personality-trait). Unfortunately, there are no data on the prevalence of risky driving behaviour, especially based on the composite BYNDS scores, in our population; although there is a prevalence for each risky driving behaviours such as not fastening seatbelts, fatigue, speeding, and impaired driving (<sup>113</sup>). There is also no information on the prevalence of different leisure activities among Canadian youth. Thus, for the sample size calculations, the following prevalence was conservatively assumed: a 10% prevalence of high risk driving and 60% prevalence for high-engagement leisure activity. Of note, low outcome prevalence is harder to detect, thus a conservative assumption was made that the prevalence of high risk driving would only be 10%. Accordingly, minimum sample size of 812 survey participants was calculated to detect a relative risk (RR) of 2 (2 was used as the benchmark since it represents a significant RR, i.e., a doubling of risk), with a power of 80%, and at a significance level of 0.0045 (adjusted for multiple comparison of 13 leisure activities). This calculation is based on a simple comparison of independent proportions, assuming a dichotomous outcome and exposure. The planned statistical analysis considered multiple predictors simultaneously.

In summary, the sample size (n=812) definitely expressed the RR=2 as an OR based on the assumptions below:

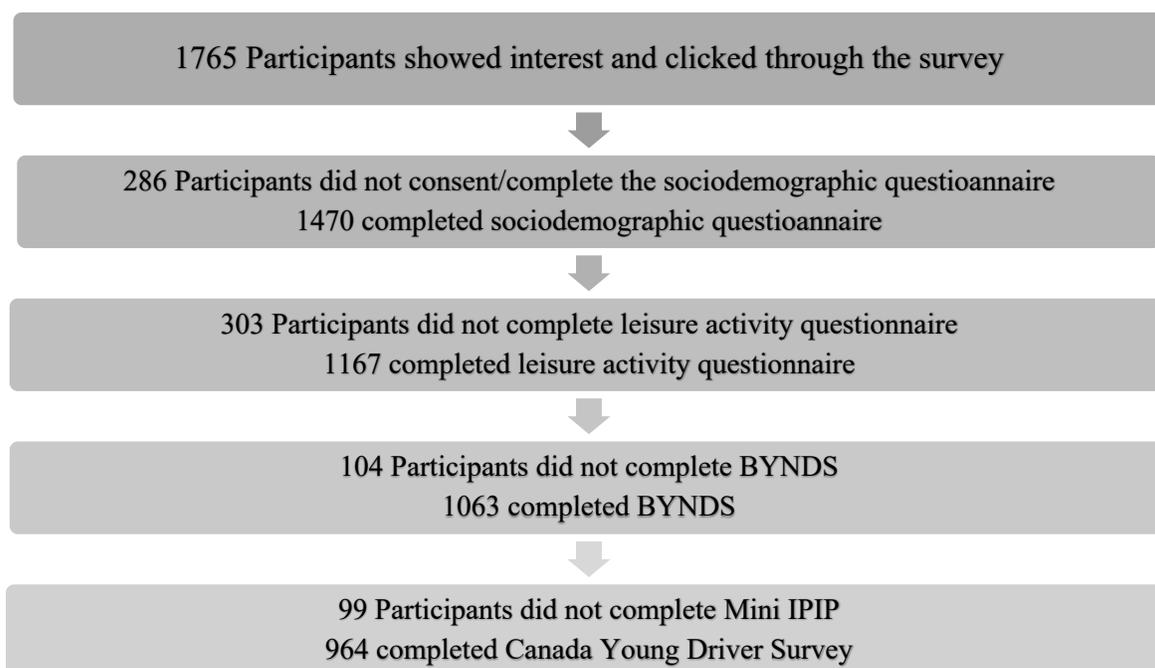
- Prevalence of outcome, i.e., High-risk driver (overall, in exposed and unexposed) = 0.1
- Prevalence of exposure, i.e., High engagement in leisure activity = 0.6
- Prevalence of outcome in exposed = 0.125
- Prevalence of outcome in unexposed = 0.0625
- $RR = 0.125/0.0625 = 2$
- $OR = (0.125 / (1 - 0.125)) / (0.0625 / (1 - 0.0625)) = 2.14$  (note that when the outcome is rare, the OR is very close to the RR)

Thus, this study required a minimum of 812 participants in order to detect an OR of 2.14 (or equivalently an RR of 2) with 80% power.

### 3. Results

On the survey closing day (date), 1,756 individuals responded to the survey and 964 respondents fully completed the survey and had their responses included in the statistical analysis. (Figure 3.1)

**Figure 3.1 Survey response rate.**



The diagram depicts the completion rates at each section of the survey. The order of the instruments in the survey was: Cover letter (consent form), Sociodemographic Questionnaire, Leisure Activity Questionnaire, Behaviour of Young Novice Driver Scale (BYNDS), Personality Trait questionnaire (Mini IPIP).

#### 3.1 General description of study population

This section presents a descriptive summary of sociodemographic, personality trait and level of leisure activity information from the 964 surveyed drivers.

##### 3.1.1 Sociodemographic characteristics in study participants

Most of the 964 participants, aged  $18.34 \pm 2.31$ , were male, beginner drivers (i.e., 16-19 years old), living with both parents and had less than a high school diploma. They were predominantly both employed and a student at the same time and had high family socioeconomic status. Most had a

driving license with restriction, owned their cars, drove independently for less than a year, and had low driving exposure. The sociodemographic characteristics and the comparison between the three groups of risky driving behaviour are presented in Table 3.1.

### 3.1.2 Personality traits in the study population

Table 3.2 represents the personality trait of the 964 participants and the comparison between the three driver groups. For each of the five personality traits considered in this research the mean scores and standard deviations were calculated. On average, participants scored highest on the personality dimension of imagination ( $14.94 \pm 3.12$ ) followed by agreeableness ( $14.46 \pm 3.04$ ), conscientious ( $12.75 \pm 3.09$ ) and neuroticism ( $11.39 \pm 3.84$ ).

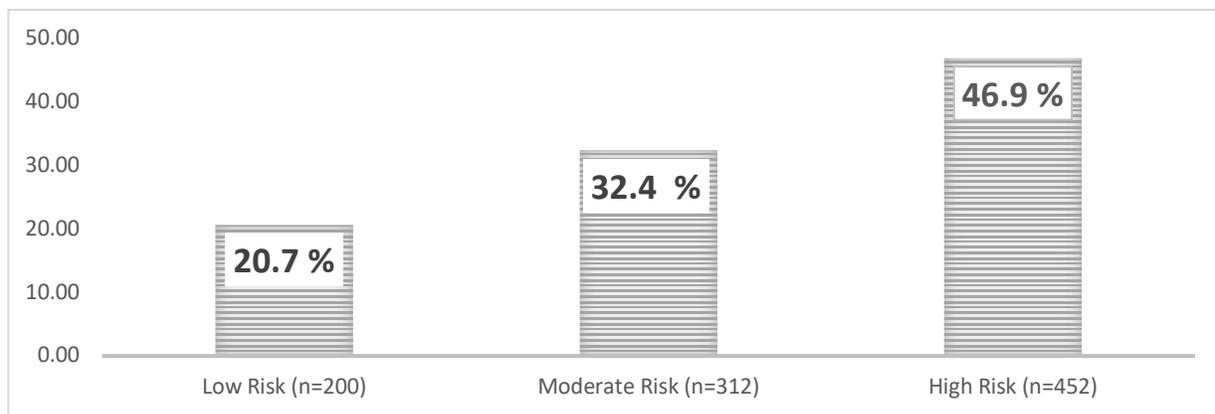
### 3.1.3 Level of engagement in leisure activities in the study participants

The majority of participants in all three groups (low, moderate and high risk groups) had low engagement levels in playing musical instruments and/or listening to music, video games, sports, movies, spending time with friends, spending time with family, alcohol, drugs, art, TV, writing/reading, and volunteering, whereas most participants (72.2%) had high engagement in social media (Table 3.3).

### 3.1.4 Driving behaviour profile in study population

Based on the total score of the BYNDS questionnaire, drivers were grouped into three risky driving categories: low risk (score  $<71$ ), moderate risk (71-91), and high risk ( $>91$ ). In this study, the majority of respondents were categorized as high risk drivers (46.9%), followed by moderate risk drivers (32.4%). (Figure 3.2)

**Figure 3.2 Driver category distribution in the study population**



## **3.2 Characteristics of driving behaviours and corresponding differences among driver groups**

### **3.2.1 Sociodemographic characteristics in driver categories**

Low risk drivers, aged  $17.38 \pm 2.11$  years were mostly found to be categorized as: “other” (i.e. non-males) gender category, beginner drivers, living with both parents, high family socioeconomic status, less than a high school diploma, and a “student”. With respect to driving profile, they predominately held a driving license with restriction, did not own a car, and drove independently for less than a year with low driving exposure.

The majority of moderate risk drivers aged  $18.51 \pm 2.39$  years were male beginner drivers, living with both parents, had less than a high school diploma, were “both employed and student”, and had high family socioeconomic status. Their driving profile shows that they predominantly held a driving license with restriction, had their own car, and drove independently for less than 1 year with low driving exposure.

High risk drivers,  $18.75 \pm 2.23$  years old, were mostly male beginner drivers, were living with both parents, had high family socioeconomic status, had some post-secondary education, and were “both employed and student”. They predominately had a driving license with restriction, owned their car, drove independently for 1-3 years, and had low driving exposure. (Table 3.1)

#### **3.2.1.1 Association between sociodemographic and driving behaviours**

Chi-square test was used to explore the relationships of sociodemographic factors and risky driving behaviors. Most sociodemographic factors including gender, age, living status, education level, employment status, independent driving duration, vehicle ownership, driving exposure, and driver license status were statistically significant in association with driving behaviours with a p-value of  $<0.0001$ , which was consistent with the hypothesis that there is an association between sociodemographic factors and risky driving behaviours. Socioeconomic status was the only sociodemographic factor with no significant association with risky driving behaviour.

As is shown in table 3.1 high risk drivers were more likely than low risk drivers to be male, young adult drivers, have “some post-secondary education”, and were “both employed and a student”. Moreover, they were more likely to live alone or with friends/roommates compared to the low risk drivers. High risk drivers tended to have been driving for more than 3 years, while low risk drivers

tended to drive for less than a year. High exposure to driving for more than 20 hours per week was more prevalent time among high risk drivers compared to low risk drivers. In comparison with low risk drivers, high risk drivers were more likely to have their own cars.

**Table 3.1 Socio-demographic characteristics of study population and driving behaviour categories**

Variables	Group			P-Value*	All participants (n=964)
	Low Risk (n=200)	Moderate Risk (n=312)	High Risk (n=452)		
<b>Gender</b>					
Male	86 (43.0%)	180 (57.7%)	331 (73.2%)	<0.0001	597 (61.9%)
Other**	114(57.0%)	132 (42.3%)	121 (26.8%)		367 (38.1%)
<b>Driving Status (Based on age)</b>					
Beginner (16-19 years old)	176 (88.0%)	222 (71.2%)	297 (65.7%)	<0.0001	695 (72.1%)
Young Adult (20-24 years old)	24 (12.0%)	90 (28.8%)	155 (34.3%)		269 (27.9%)
<b>Living Status</b>					
Family (Both parents)	145 (72.5%)	202 (64.7%)	260 (57.5%)	0.0125	607 (63.0%)
Family (Single parent)	28 (14.0%)	51 (16.3%)	83 (18.4%)		162 (16.8%)
Friend(s) or Alone	20 (10.0%)	39 (12.5%)	81 (17.9%)		140 (14.5%)
Partner	7 (3.5%)	20 (6.4%)	28 (6.2%)		55 (5.7%)
<b>Educational level</b>					
Less than high school diploma	146 (73.0%)	142 (45.5%)	168 (37.2%)	<0.0001	456 (47.3%)
High school graduated	15 (7.5%)	66 (21.2%)	99 (21.9%)		180 (18.7%)
Some postsecondary	39 (19.5%)	104 (33.3%)	185 (40.9%)		328 (34.0%)
<b>Employment Status</b>					
Employee	11 (5.5%)	58 (18.6%)	116 (25.7%)	<0.0001	185 (19.2%)
Student	109 (54.5%)	105 (33.7%)	100 (22.1%)		314 (32.6%)
Both (Employee and student)	78 (39.0%)	147 (47.1%)	233 (51.5%)		458 (47.5%)
Unemployed	2 (1.0%)	2 (0.6%)	3 (0.7%)		7 (0.7%)
<b>Driving Independently Duration</b>					
<1 year	156 (78.0%)	138 (44.2%)	144 (31.9%)	<0.0001	438 (45.4%)
1-3 years	35 (17.5%)	112 (35.9%)	172 (38.1%)		319 (33.1%)
>3 years	9 (4.5%)	62 (19.9%)	136 (30.1%)		207 (21.5%)
<b>Socioeconomic Status ***</b>					
Low	2 (1%)	3 (1%)	2 (0.4%)	0.6063	7 (0.7%)
Moderate	30 (15%)	35 (11.2%)	54 (11.9%)		119 (12.3%)
High	168 (84%)	274 (87.8%)	396 (87.6%)		838 (86.9%)
<b>Vehicle owned by driver</b>					
Yes	39 (19.5%)	164 (52.6%)	346 (76.5%)	<0.0001	549 (57%)
No	161 (80.5%)	148 (47.4%)	106 (23.5%)		415 (43%)
<b>Driving Exposure (Hour/Week)</b>					
Low (<11)	193 (96.5%)	248 (79.5%)	277 (61.3%)	<0.0001	718 (74.5%)
Moderate (11-20)	4 (2%)	38 (12.2%)	111 (24.6%)		153 (15.9%)
High (>20)	3 (1.5%)	26 (8.3%)	64 (14.2%)		93 (9.6%)
<b>Driver license class</b>					
With restriction	181 (90.5%)	224 (71.8%)	284 (62.8%)	<0.0001	689 (71.5%)
Without restriction	19 (9.5%)	88 (28.2%)	168 (37.2%)		275 (28.5%)

\* Based on qui square

\*\*Other\*\* includes female and transgender spectrum

\*\*\*Low SES= No home and No Car; Moderate SES= ≤ 2 cars and No home; High SES= Home AND/OR car>2

### 3.2.2 Personality trait in driver categories

The majority of participants in all three groups (low, moderate, and high risk drivers) scored average in all five personality trait categories, i.e. extroversion, agreeableness, conscientiousness, neuroticism, and imagination. (Table 3.2)

#### 3.2.2.1 Association between personality traits and driving behaviour

Extroversion was the only personality trait associated with driving behaviours (p-value < 0.0001). Although low, moderate and high-risk drivers were predominately scored average on all personality traits, high risk drivers tended to have higher scores on extroversion compared to low risk drivers (23.9% vs. 11.0% respectively) (Table 3.2). No statistically significant association was found between other personality traits (i.e., neuroticism, agreeableness, conscientiousness, and imagination) and driving behaviours. However, there was a trend for “high risk” drivers to score lower in agreeableness, conscientiousness, neuroticism, and imagination (Table 3.2).

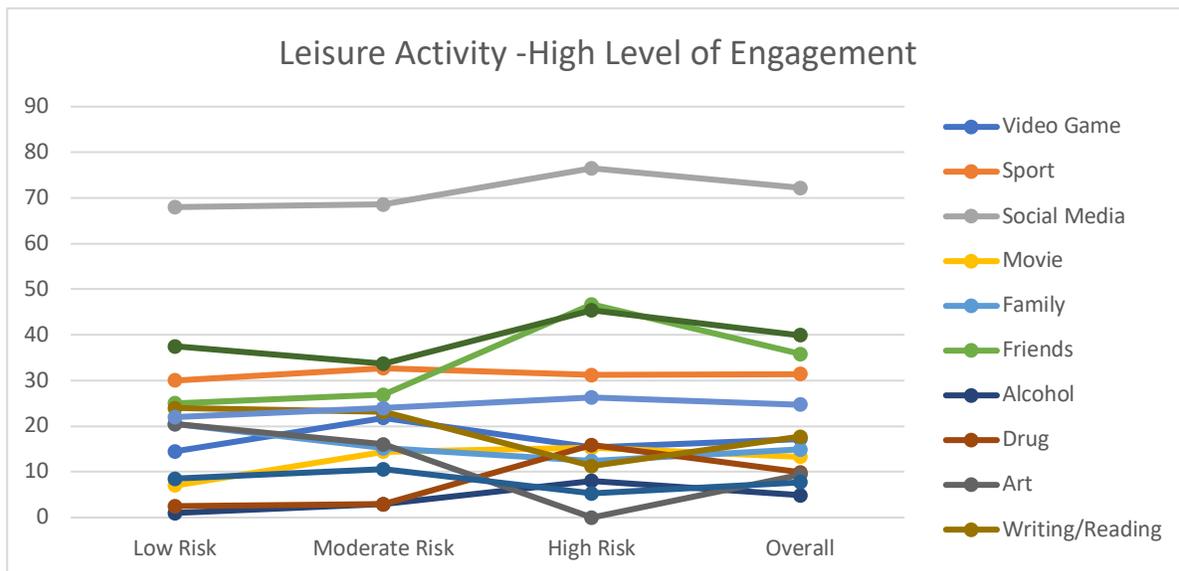
**Table 3.2 Distribution personality traits in the study population and driving behaviour categories**

Category	Group			p-value	All participants (n=964)
	Low Risk (n= 200)	Moderate Risk (n= 312)	High Risk (n= 452)		
<b>Extroversion trait score (Mean±SD)</b>	11.27±3.89	12.13±3.88	12.87±4.15		12.30±4.06
<b>Extroversion trait category</b>				<0.0001	
Low	57 (28.5%)	67 (21.5%)	74 (16.4%)		198 (20.5%)
Average	121 (60.5%)	196 (62.85)	270 (59.7%)		587 (60.9%)
High	22 (11.0%)	49 (15.7%)	108 (23.9%)	179 (18.6%)	
<b>Agreeableness trait Score (Mean±SD)</b>	14.77±2.81	14.58±2.97	14.24±3.18		14.46±3.04
<b>Agreeableness trait category</b>				0.1003	
Low	22 (11.0%)	44 (14.1%)	86 (19.0%)		152 (15.8%)
Average	145 (72.5%)	218 (69.9%)	295 (65.3%)		658 (68.3%)
High	33 (16.5%)	50 (16.0%)	71 (15.7%)	154 (16%)	
<b>Conscientiousness trait Score (Mean±SD)</b>	13.01±3.06	12.89±2.92	12.54±3.20		12.75±3.09
<b>Conscientiousness trait category</b>				0.2375	
Low	26 (13.0%)	42 (13.5%)	85 (18.8%)		153 (15.9%)
Average	132 (66.0%)	205 (65.7%)	277 (61.3%)		614 (63.7%)
High	42 (21.0%)	65 (20.8%)	90 (19.9%)	197 (20.4%)	
<b>Neuroticism trait Score (Mean±SD)</b>	11.72±3.78	11.36±3.78	11.27±3.92		11.39±3.84
<b>Neuroticism trait category</b>				0.3554	
Low	28 (14.0%)	45 (14.4%)	79 (17.5%)		152 (15.8%)
Average	142 (71.0%)	222 (71.2%)	293 (64.8%)		657 (68.2%)
High	30 (15.0%)	45 (14.4%)	80 (17.7%)	155 (16.1%)	
<b>Imagination trait Score (Mean±SD)</b>	15.22±3.05	15.12±3.06	14.70±3.18		14.94±3.12
<b>Imagination trait category</b>				0.3755	
Low	22 (11.0%)	36 (11.5%)	70 (15.5%)		128 (13.3%)
Average	148 (74.0%)	235 (75.3%)	327 (72.3%)		710 (73.7%)
High	30 (15.0%)	41 (13.1%)	55 (12.2%)	126 (13.1%)	

### 3.2.3 Level of engagement in leisure activities in the driving categories

As is shown in Figure 3.3, participants in all three groups (high, moderate or low risk) spent time on social media more than any other activity. Sixty eight percent of low risk drivers, 68.6% of moderate risk drivers, and 72.2% of high risk drivers spent more than 60 minutes of their daily time on social media. The majority of participants in all three groups had low engagement levels in playing musical instruments and/or listening to music, video games, sports, movies, spending time with friends, spending time with family, alcohol, drugs, art, TV, writing/reading, and volunteering. However, it appears like slightly more low risk drivers engaged in art, reading/writing, family, and volunteering compared to high risk drivers, while slightly more high risk drivers engaged in watching movies, alcohol, drug, music, sport, and TV compared to low risk drivers (Figure 3.3).

**Figure 3.3 Percentage Distribution of high engagement in leisure Activities in driving behaviour groups**



#### 3.2.3.1 Association between leisure activities and driving behaviour

Among all leisure activities, the engagement level of music, video games, social media, movies, family, friends, drug- and alcohol involvement, and volunteering, were all found to have statistically significant association with driving behaviours ( $p < 0.05$ ). Compared to low risk drivers, high-risk drivers were more likely to be highly engaged in music (45.4% vs. 37.5%), movies (15.3% vs. 7.0%), social media (76.5% vs. 68.0%), leisure activities involving alcohol (8.0% vs. 1.0%) or drugs (16.0% vs. 2.5%), and spending time with friends (46.7% vs. 25.0%) while they tended to have low engagement in art (88.0% vs. 79.5%), reading/writing (88.7% vs. 76.0%), volunteering (94.7% vs.

91.5%), and spending time with family (87.6% vs. 79.5%). (Table 3.3) These results support the hypothesis that there is an association between leisure activities and risky driving behaviour. It is therefore worthwhile to look at the possible correlations and independent influence of leisure activities on driving behaviour in more detail. To that end, Proportional Odds Logistic Regression (POLR) analysis was conducted which will be discussed in next section.

**Table 3.3 Distribution of study population according to Leisure activity**

Variables	Group			P-value*	All participants (n=964)
	Low Risk (n= 200)	Moderate Risk (n= 312)	High Risk (n= 452)		
<b>Video game engagement level</b>					
Low	171 (85.5%)	244 (78.2%)	383 (84.7%)	0.0329	798 (82.8%)
High	29 (14.5%)	68 (21.8%)	69 (15.3%)		166 (17.2%)
<b>Social media engagement level</b>					
Low	64 (32.0%)	98 (31.4%)	106 (23.5%)	0.0179	268 (27.8%)
High	136 (68.0%)	214 (68.6%)	346 (76.5%)		696 (72.2%)
<b>Movie engagement level</b>					
Low	186 (93%)	267 (85.6%)	383 (84.7%)	0.0126	836 (86.7%)
High	14 (7%)	45 (14.4%)	69 (15.3%)		128 (13.3%)
<b>Family engagement level**</b>					
Low	159 (79.5%)	289 (84.4%)	396 (87.6%)	0.0275	820 (85.1%)
High	41 (20.5%)	52 (15.2%)	56 (12.4%)		144 (14.9%)
<b>Friends engagement level***</b>					
Low	150 (75.0%)	228 (73.1%)	241 (53.3%)	<0.0001	619 (64.2%)
High	50 (25.0%)	84 (26.9)	211 (46.7%)		345 (35.8%)
<b>Alcohol engagement level</b>					
Low	198 (99.0%)	303 (97.1%)	416 (92.0%)	<0.0001	917 (95.1%)
High	2(1.0%)	9 (2.9%)	36 (8.0%)		47 (4.9%)
<b>Drug engagement level</b>					
Low	195 (97.5%)	294 (97.1%)	380 (84.1%)	<0.0001	869 (90.1%)
High	5 (2.5%)	18 (2.9%)	72 (15.9%)		95 (9.9%)
<b>Art engagement level</b>					
Low	159 (79.5%)	262 (84%)	452 (100%)	0.0159	873 (90.6%)
High	41 (20.5%)	50 (16%)	0 (0.0%)		91 (9.4%)
<b>Writing/Reading engagement level</b>					
Low	152 (76.0%)	240 (76.9%)	401 (88.7%)	<0.0001	793 (82.3%)
High	48 (24.0%)	72 (23.1%)	51 (11.3%)		171 (17.7%)
<b>Volunteering engagement level</b>					
Low	183 (91.5%)	279 (89.4%)	428 (94.7%)	0.0239	890 (92.3%)
High	17 (8.5%)	33 (10.6%)	24 (5.3%)		74 (7.7%)
<b>Music engagement level</b>					
Low	125(62.5%)	207 (66.3%)	247 (54.6%)	0.0038	579 (60.1%)
High	75 (37.5%)	105 (33.7%)	205(45.4%)		385 (39.9%)
<b>Sport engagement level</b>					
Low	140 (70.0%)	210 (67.3%)	311 (68.8%)	0.8057	661 (68.6%)
High	60 (30.0%)	102 (32.7%)	141 (31.2%)		303 (31.4%)
<b>TV engagement level</b>					
Low	156 (78.0%)	237 (76.0%)	333 (73.7%)	0.472	726 (75.3%)
High	44 (22.0%)	75 (24.0%)	119 (26.3%)		238 (24.7%)

\* Based on qui square

\*\* Engagement levels did not include time spent with family at home doing their own tasks

\*\*\* Engagement levels did not include the activities done with friends during school time

### **3.3 Proportional Odds Logistic Regression (POLR) analysis**

As noted in section 2.6.2.2, we applied the Proportional Odds Logistic Regression analysis to formally test the aforementioned associations with estimates of the magnitude and direction of association in the form of an odds ratio. Given that no highly correlated variables were found, goodness of fit processing was not applied. (Refer to tables B.1, Appendix B). Therefore, first, all the potential predictors from personality traits, leisure activities and sociodemographic factors were examined in a POLR, i.e. a full model (below, Section 3.3.1). Afterwards AIC stepwise selection was applied to identify the best model, i.e. a parsimonious model that is neither an over-fit nor under-fit (See Section 3.3.2, below). Of note, in both models, ORs for the predictive variables show the probability of change in the ranking order from low-risk driving behaviour to moderate- and high-risk driving behaviour.

#### **3.3.1 Full Model**

In the Full model, those predictor variables which significantly improve the model are reported (i.e. those that when removed are found to result in a significant decrease in the model fit, are reported) Other predictors or variables with no significant influence on risky driving behaviour were also included which helps to get more accurate coefficients in the models and discriminate between the target (high- and moderate- risk driver) and reference category (low-risk driver) and against other important variables.

##### **3.3.1.1 Predictive variables in positive correlation with risky driving behavior- Full Model**

As shown in table 3.4, car ownership, high /moderate driving exposure, male gender, driving for more than 3 years, being both student and employee, high neuroticism, highly engaged in drug-involved leisure activity, spending time with friends, and spending time on social media were all positively correlated with risky driving behaviours. For those who had their own cars, the odds of being a high and moderate risk versus low risk driver were 3.1 times higher than for those who did not own their cars (OR=3.12). Driving for more than 20 hours per week put the individual 2.5 times more at risk of risky driving behaviour than those who drove less than 11 hours per week (OR=2.49). Male drivers were 2.5 times more likely to be high risk drivers than other genders (OR=2.47). When it comes to employment status, the odds of being a high risk driver among those who were students and employed at the same time was 1.6 times as large as the odds for those who were just a student

(OR=1.56). In term of personality trait, risky driving behaviour was 78% more likely in those with high neuroticism than those with average neuroticism (OR=1.78). Among leisure activity, risky driving behaviour was 2.2 times more common in those with high drug engagement than those with low engagement (OR=2.23). Spending time with friends more than 4 times a week also was a significant predictor for risky driving behaviour (OR=1.94). And lastly being highly engaged on social media for more than 60 minutes daily put individuals 1.8 times more at risk of risky driving behaviour (OR=1.82).

**Table 3.4 Factors with significant influence on risky driving behaviour- Full model**

Variable	OR	OR Range	Reference Variable
<b>Sociodemographic characteristics</b>			
Car ownership (Yes)	3.12	2.28- 4.27	Driver Car Status (No)
Driving Exposure (High)	2.49	1.48- 4.28	Driving Exposure (Low)
Gender (Male)	2.47	1.80- 3.40	Gender (Other)
Driving Exposure (Mod)	2.44	1.58- 3.81	Driving Exposure (Low)
Duration of driving independently >3 years	1.93	1.09- 3.43	Duration of driving independently 1-3 years
Employment status (Both employed and student)	1.56	1.13- 2.13	Employment status (Student)
<b>Personality Traits</b>			
Neuroticism Trait (High)	1.78	1.19- 2.68	Neuroticism Trait (Average)
<b>Leisure activities</b>			
Drug Engagement Level (High engagement)	2.23	1.29- 3.10	Drug Engagement Level (Low engagement)
Friend Engagement Level (High engagement)	1.94	1.43- 2.65	Friend Engagement Level (Low engagement)
Social Media Engagement Level (High engagement)	1.82	1.33-2.48	Social Media Engagement Level (Low engagement)

\*variables ordered from highest to lowest odds ratio in each category (CI=95%) (P-value < 0.05)

### 3.3.1.2 Predictive variables with protective effect on risky driving behavior- Full Model

Educational level “less than high school”, driving independently for less than a year, highly engaged in reading/writing, volunteering, and playing video games were protective factors for risky driving behaviour. In other words, the drivers with less than high school education were 35% less likely to engage in risky driving compared to those with a high or secondary school diploma (OR=0.65). Risky driving behaviour was 44% less likely in those who drove independently for less than a year compared to those who drove above one year (OR=0.56). Drivers with high engagement in reading and writing had 38% lower odds of being risky drivers than those with lower engagement

(OR=0.62). High engagement in volunteering activities put an individual at a 40% lower likelihood of risky driving behaviour (OR=0.60). Finally, those who played video games more than 9 hours per week had odds 0.56 times as great to be a risky driver than those who played less than 9 hours (Table 3.5).

**Table 3.5 Factors with significant protective influence against risky driving behaviour- Full model**

Variable	OR	OR Range	Reference Variable
<b>Sociodemographic characteristics</b>			
Education Status (Less than high school)	0.65	0.42- 0.98	Education Status (High /secondary school diploma or equivalent)
Duration of driving independently (<1 year)	0.56	0.38- 0.81	Duration of driving independently (1-3 years)
<b>Leisure activities</b>			
Reading/Writing Engagement Level (High)	0.62	0.44- 0.88	Reading/Writing Engagement Level (Low)
Volunteering Engagement Level (High)	0.60	0.37- 0.98	Volunteering Engagement Level (Low)
Video Game Engagement Level (High)	0.56	0.38- 0.82	Video Game Engagement Level (Low)

\*variables ordered from highest to lowest odds ratio in each category (CI=95%) (P-value < 0.05)

### 3.3.1.3 Final Full Model Equation

$$Y = 3.12 X_1 + 2.49 X_2 + 2.47 X_3 + 2.44 X_4 + 2.23 X_5 + 1.94 X_6 + 1.93 X_7 + 1.82 X_8 + 1.79 X_9 + 1.56 X_{10} - 0.65 X_{11} - 0.62 X_{12} - 0.60 X_{13} - 0.56 X_{14} - 0.56 X_{15} + (\text{Other Variables}) *$$

(Predictive variables' order is based on strength of association)

### Outcome variable

Y= Risky driving behaviour

### Predictive variables

#### Sociodemographic

X<sub>1</sub>= Car ownership, OR= 3.12 (CI 95%, 2.28-4.27)

X<sub>2</sub>= Driving Exposure (High), OR = 2.49 (CI 95%, 1.47-4.28)

X<sub>3</sub>= Gender (Male), OR= 2.47(CI 95%, 1.79-3.4)

X<sub>4</sub>= Driving Exposure (Moderate), OR=2.44 (CI 95%, 1.58-3.81)

X<sub>7</sub>= Duration of driving independently (>3 years), OR= 1.93 (CI 95%, 1.09-3.42)

X<sub>10</sub>= Employment status (Both Employed and student), OR= 1.56 (CI 95%, 1.13-2.13)

X<sub>11</sub>= Education Status (Less than High school), OR= 0.65 (CI 95%, 0.42-0.98)

X<sub>15</sub>= Duration of driving independently <1 year, OR= 0.56 (CI 95%, 0.38-0.81)

#### **Leisure activities engagement level**

X<sub>5</sub>= Drug Engagement Level (High engagement), OR= 2.23 (CI 95%, 1.28-3.99)

X<sub>6</sub>= Friend Engagement Level (High engagement), OR= 1.94 (CI 95%, 1.42-2.65)

X<sub>8</sub>= Social Media Engagement Level (High engagement), OR= 1.82 (CI 95%, 1.33-2.48)

X<sub>12</sub>= Reading/Writing Engagement Level (High engagement), OR= 0.62 (CI 95%, 0.43-0.88)

X<sub>13</sub>= Volunteering Engagement Level (High engagement), OR= 0.60 (CI 95%, 0.36-0.98)

X<sub>14</sub>= Video Game Engagement Level (High engagement), OR= 0.56 (CI 95%, 0.38-0.81)

#### **Personality trait**

X<sub>9</sub>= Neuroticism trait (High), OR= 1.79 (CI 95%, 1.19-2.68)

\*Other Variables are non-highlighted variables found in the Tables in Appendix B.

### **3.3.2 Parsimonious model (Stepwise AIC selection model)**

The current study practised fitting the final selected model through backward elimination to determine the best predictive variables with statistically significant influence on driving behaviour.

#### **3.3.2.1 Predictive variables in positive correlation with risky driving behavior- Parsimonious Model**

From the leisure activity perspective, participants who were highly engaged in drug-involved leisure activity, spending time with friends, on social media, and watching movies were respectively 2.0, 1.9, 1.8, and 1.5 times more likely to be self-reported as high risk and moderate risk drivers, . In term of personality traits, in addition to neuroticism, high extroversion and low imagination also became significant risk factors for risky driving behaviour in the stepwise model. For sociodemographic characteristics, the stepwise model included no new coefficients compared to the Full Model (see 3.3.1.1) (Table 3.6).

### 3.3.2.2 Predictive variables with protective effect on risky driving behavior- Parsimonious Model

Protective variables were similar to those in the Full model. Among leisure activities, high engagement in reading/writing, volunteering, and playing video games were found to be protective factors against risky driving behaviour with virtually similar coefficients and interpretations (Table 3.7).

**Table 3.6 Factors with significant influence on risky driving behaviour- Parsimonious model**

Variable	OR	OR Range	Reference Variable
<b>Sociodemographic characteristics</b>			
Car ownership (Yes)	3.01	2.21- 4.11	Car ownership (No)
Driving Exposure (High)	2.58	1.54- 4.42	Driving Exposure (Low)
Driving Exposure (Moderate)	2.57	1.69- 3.97	Driving Exposure (Low)
Gender (Male)	2.51	1.85- 3.42	Gender (Other)
Duration of driving independently (>3 years)	2.11	1.26- 3.57	Duration of driving independently (1-3 years)
Employment status (Both employed and student)	1.58	1.16-2.16	Employment status (Student)
<b>Personality trait</b>			
Neuroticism Trait (High)	1.83	1.23- 2.74	Neuroticism Trait (Average)
Extroversion Trait (High)	1.60	1.09- 2.36	Extroversion Trait (Average)
Imagination Trait (Low)	1.53	1.02- 2.34	Imagination Trait (Average)
<b>Leisure activities</b>			
Drug Engagement Level (High)	2.09	1.22- 3.72	Drug Engagement Level (Low)
Friend Engagement Level (High)	1.98	1.47- 2.69	Friend Engagement Level (Low)
Social Media Engagement Level (High)	1.83	1.35- 2.49	Social Media Engagement Level (Low)
Movie Engagement Level (High)	1.52	1.01- 2.31	Movie Engagement Level (Low)

\*variables ordered from highest to lowest odds ratio in each category (CI=95%) (P-value < 0.05)

**Table 3.7 Factors with significant protective influence on risky driving behaviour- Parsimonious model**

Variable	OR	OR Range	Reference Variable
<b>Sociodemographic characteristics</b>			
Education Status (Less than High school)	0.64	0.42- 0.97	Education Status (High (secondary) school diploma or equivalent)
Duration of driving independently <1 year	0.55	0.38- 0.79	Duration of driving independently 1-3 years

<b>Leisure activities</b>			
Reading/Writing Engagement Level (High)	0.61	0.43- 0.86	Reading/Writing Engagement Level (Low)
Volunteering Engagement Level (High)	0.59	0.37- 0.97	Volunteering Engagement Level (Low)
Video Game Engagement Level (High)	0.57	0.39- 0.81	Video Game Engagement Level (Low)

\*variables ordered from highest to lowest odds ratio in each category (CI=95%) (P-value < 0.05)

### **3.3.2.4 Final Parsimonious Model Equation**

$$Y = 3.01 X_1 + 2.58 X_2 + 2.56 X_3 + 2.51 X_4 + 2.11 X_5 + 2.09 X_6 + 1.98 X_7 + 1.83 X_8 + 1.83 X_9 + 1.60 X_{10} + 1.58 X_{11} + 1.53 X_{12} + 1.52 X_{13} - 0.64 X_{14} - 0.61 X_{15} - 0.60 X_{16} - 0.56 X_{17} - 0.55 X_{18}$$

### **Outcome variable**

Y= Risky driving behaviour

### **Predictive variables**

#### **Sociodemographic**

X<sub>1</sub>= Car ownership (Yes), OR=3.01 (CI 95%, 2.21-4.11)

X<sub>2</sub>= Driving Exposure (High), OR=2.58 (CI 95%, 1.54-4.41)

X<sub>3</sub>= Driving Exposure (Moderate), OR=2.56 (CI 95%, 1.68-3.96)

X<sub>4</sub>= Gender (male), OR=2.51 (CI 95%, 1.85-3.42)

X<sub>5</sub>= Duration of driving independently (>3 years), OR=2.11 (CI 95%, 1.25-3.57)

X<sub>11</sub>= Employment status (Both employed and student), OR=1.58 (CI 95%, 1.16-2.16)

X<sub>14</sub>= Education Status (Less than high school), OR=0.64 (CI 95%, 0.42-0.97)

X<sub>18</sub>= Duration of driving independently <1year, OR=0.55 (CI 95%, 0.38-0.7)

#### **Leisure activities**

X<sub>6</sub>= Drug Engagement Level (High engagement), OR=2.09 (CI 95%, 1.21-3.71)

X<sub>7</sub>= Friend Engagement Level (High engagement), OR=1.98 (CI 95%, 1.46-2.68)

X<sub>8</sub>= Social Media Engagement Level (High engagement), OR=1.83 (CI 95%, 1.34-2.49)

X<sub>13</sub>= Movie Engagement (High engagement), OR=1.52 (CI 95%, 1- 2.31)

X<sub>15</sub>= Reading/Writing Engagement Level (High engagement), OR=0.61 (CI 95%, 0.42-0.85)

X<sub>16</sub>= Volunteering Engagement Level (High engagement), OR=0.60 (CI 95%, 0.36-0.96)

X<sub>17</sub>= Video Game Engagement Level (High engagement), OR=0.56 (CI 95%, 0.38-0.81)

#### **Personality traits**

X<sub>9</sub>= Neuroticism Trait (High), OR=1.83 (CI 95%, 1.23-2.73)

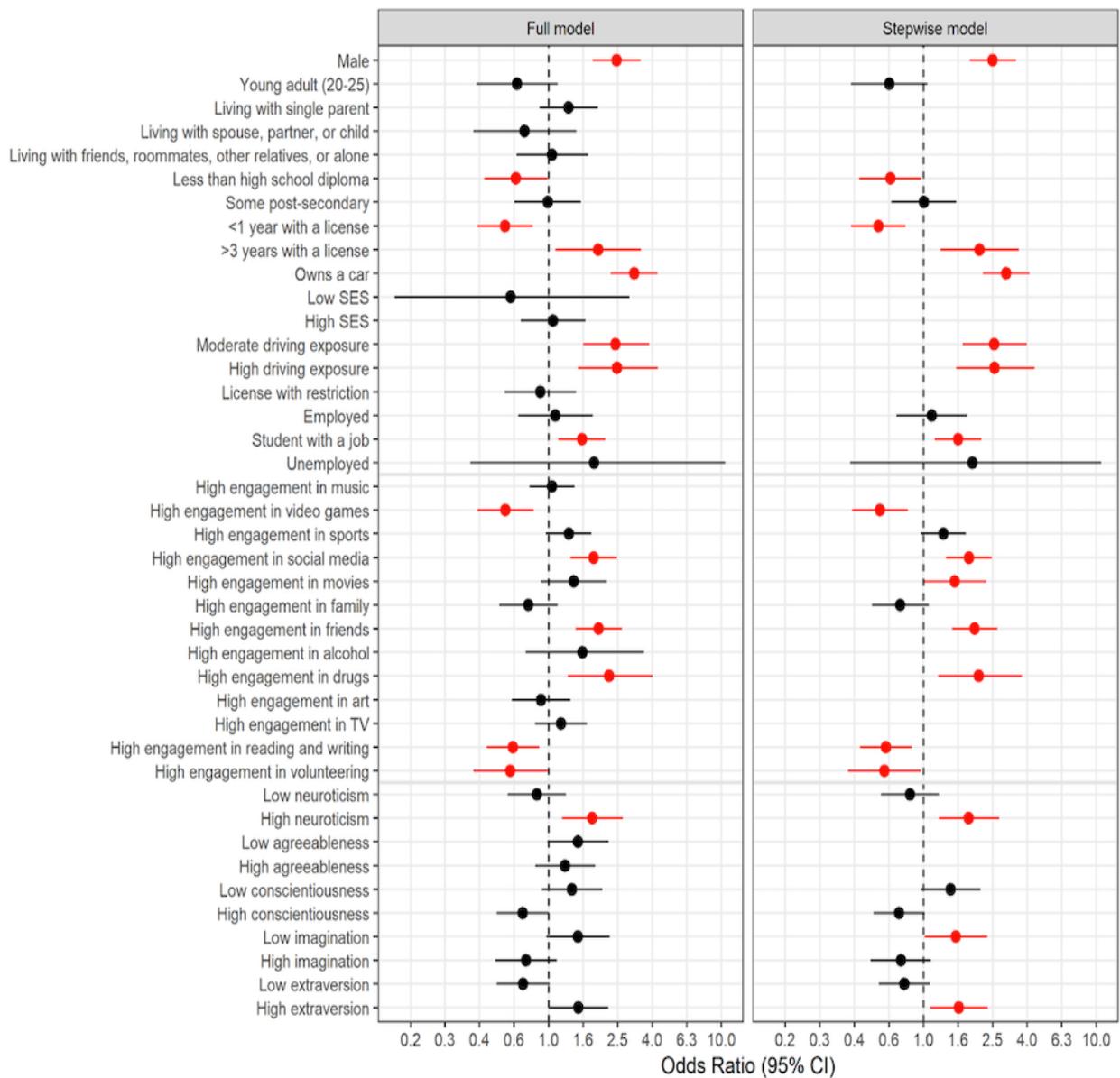
X<sub>10</sub>= Extroversion Trait (High), OR=1.60 (CI 95%, 1.09-2.35)

X<sub>12</sub>= Imaging Trait (Low), OR=1.53, (CI 95%, 1.01-2.34)

To investigate the correlation between the different variables (sociodemographics, personality traits and leisure activities) and risky driving behaviours, both the full and stepwise selection models were performed. Figure 3.4 illustrates the full model and stepwise model side by side for the sake of comparison and some differences were noted. Among all variables, high engagement in movies, low imagination, and high extroversion were correlated with risky driving behaviours according to the stepwise selection model while no significant corresponding correlation was found based on the full model.

Figure 3.4 Forest plot - Full vs. Stepwise selection Models.

Red line: significant correlation (P-value < 0.05).



## **4. Discussion**

In many Western countries, adolescent risk behaviors are among the top public health priorities and numerous prevention programs have been developed to reduce young people's engagement in risky behaviours (<sup>197</sup>). As youth grow and reach their developmental competencies, there are contextual variables that promote or hinder the process. These are frequently referred to as protective and risk factors. Various risk and protective factors influence young people's attitudes and behaviours. By definition, risk factors are any factors associated with the increased likelihood of an undesired behaviour or outcome, while protective factors reduce the likelihood of a bad outcome or help individuals avoid potentially harmful behaviour, and/or promote an alternative pathway (<sup>198</sup>). A growing body of cross-cultural evidence indicates that various psychological, social, and behavioural risk and protective factors affect individual's health, especially during adolescence (<sup>199,200</sup>). This study employed a survey-based cross-sectional design to determine the driver characteristics associated with risky driving, i.e. the linkages between risky driving behaviours and various leisure activities, and the potential predictors of risky driving behaviour among young drivers in Canada. The findings showed that 46.9% respondents in this study self-reported with high risk driving behaviour which is concerning. Based on results, some of the sociodemographic variables, personality traits, and leisure activities were risk factors for risky driving behaviour and will be discussed individually in next sections.

### **4.1 Sociodemographic factors and driving behaviour**

The first objective of this study explored the relationship between sociodemographic factors and risky driving behavior among young drivers in Canada. The findings supported the study hypothesis that sociodemographic factors affect driving behaviour in both positive and negative ways. Ten sociodemographic variables considered for evaluation will be discussed individually below.

#### **4.1.2 Age and driving behaviour**

In the unadjusted analyses, young adult drivers (aged 20-24 years) had a higher likelihood of risky driving behaviour than beginner drivers (aged 16-19 years). However, in the adjusted analyses (i.e. the full model and the parsimonious models), age was not found to be an independent predictor for risky driving behaviour.

The majority of previous studies have either evaluated crash rates (not necessarily risky driving behaviour) in this age group, or compared all young drivers (16-24 years of age) with older drivers (25 years or older). Few studies compared very young or beginner drivers (16-19) with young adult drivers (20-24 years of age). The previous studies revealed that risky driving is more prevalent among young drivers (< 25 years) than in older drivers ( $\geq 25$  years). Young drivers are more likely to speed, run red lights, make illegal turns, ride with an intoxicated or a drinking driver, and drive after drinking alcohol (<sup>150,201</sup>). Tubman-Ben-Ari et al., studied 320 participants aged 18-60 years and showed that the younger the drivers were, the more recklessly and aggressively they would drive (<sup>150</sup>). Oppenheim et al., studied 527 Israeli drivers aged 20-55 years and found that the driving violation rate decreased as driver age increased (<sup>201</sup>). A meta-analysis by Zhang et al., also showed that, across studies that included different age ranges, there was a negative correlation between driving violations and age (i.e. as age increases, violation rates decrease) (<sup>202</sup>). The Organization for Economic Co-operation and Development, in its 2014 and 2017 reports stated that crash and near-crash rates are several times higher in younger drivers (<sup>203,204</sup>). Simon-Morton et al., studied 279 adolescent drivers and their parents and found that, during their first 18 months of holding a license, adolescent drivers experienced more crashes and near-crashes in comparison to their parents (<sup>19</sup>). A study, based on data from New Jersey Traffic Safety Outcomes data warehouse, found that older novice drivers were involved in fewer accidents than younger novice drivers in the short term (within 3 months of obtaining their license), but more accidents in the mid-term (within 3 years of obtaining their license). This supports the theory that the higher rate of accidents among younger novice drivers is potentially due to behavioral factors, not driving ability (<sup>205</sup>). Interestingly, although most risky drivers are young people, they are not new drivers. This suggests that driver inexperience alone does not account for driving or crash risk. Lack of driving experience combined with a penchant for risky driving behaviors, a tendency to underestimate the dangerous consequences of such behaviors, and a tendency to overestimate driving skill, contributes to the high crash rate among young drivers (<sup>206</sup>). This creates a discrepancy as age is a significant predictor of crash risk (or risky driving behaviour) in previous studies, whereas the findings of this study showed that age did not play a role in affecting driving behaviour within this young driver population). This may arise from the fact that comparison group participants from previous studies included a broader age spectrum (young, middle, and/or old age) while the current study focused on a narrower age range (16-24 years old). Moreover, the current study included multiple confounders and variables that could refine the results in this age range.

A Canadian study of 47,356 drivers aged 16 years and older with driving experience showing that risky driving behaviours (such as cell phone distraction, aggressive behaviour, fatigue while driving and not wearing a seat belt) were more common among 20-24 years old drivers in comparison to those younger than 20 years of age <sup>(109)</sup>. There was no explanation by the author. The discrepancy can simply be attributed to the fact that, looking at age in isolation, high risk behaviours are more prevalent in the 20-24 years age group than in the 16-19 years age group. When considering other factors (current study), age did not play a role in predicting risky behaviour

#### **4.1.2 Gender and driving behaviour**

In this study, low-risk drivers were mostly non-male participants (57%). Moderate- and high-risk drivers were mostly men (57.7 % and 73.2 % respectively). In the adjusted models, male gender was still a strong, and independent predictor of risky driving behaviour in young drivers. The results of this study are consistent with many previous studies that also found male gender to be strongly associated with risky driving <sup>(150,201,209)</sup>.

Tubman Ben-Ari et al., studied 320 Israeli drivers aged 18-60 years old, and found that male drivers drove more recklessly and angrily <sup>(150)</sup>. Oppenheim et al., evaluated 527 online questionnaires from Israeli drivers of 20-55 years old and found that drivers who identified as male had more driving violations <sup>(201)</sup>. Similar findings were mentioned in a study of 1907 Romanian drivers <sup>(210)</sup>. Another study by Renner et al., compared 98 juvenile traffic offenders with 149 driving licence applicants and found a higher prevalence of male gender in offenders <sup>(209)</sup>. There is evidence of a gender difference when it comes to attitudes towards risky driving. A study by Glendon et al., of 133 high school students aged 16-17 years showed that male drivers had more risky driving attitudes <sup>(210)</sup>. Nabi et al., studied 13,447 French drivers and found that males had more negative attitudes towards enforced driving laws <sup>(27)</sup>. Generally, males tend to engage in high-risk activities more than females <sup>(211)</sup>. Some studies found that young male drivers are more prone to engage in risky driving behaviors such as driving fast and committing more violations <sup>(212,213)</sup>. This has been explained in the literature by biological theories especially by the effect of testosterone (male sex hormone) which has been related to sensation seeking <sup>(214)</sup>. Recently, some studies have explored the influence of the on risk taking behaviours of different adult gender groups. That is social expectations in terms of behaviors depending on the individual gender group <sup>(215)</sup>. Evidence also showed that motivation can even change drivers' intention towards speeding and overtaking while driving. For example, young men

drive over the speed limits more often in the presence of peers to “show-off” (117,216). Peers and society can establish norms and perceived behaviour which influence behaviours directly in young people (217). Taubman-Ben-Ari et al., in a study measuring the effect of family climate on driving safety in children found that female drivers tend to listen to their parental advice regarding safe driving (85). This may also come as no surprise since male drivers have less risk perception and enjoy risky driving behaviour more than females. In addition, gender norms about masculinity already influential during adolescence do not favour safe driving (212).

The combination of attitude, perception of social norms, behavioural control (over-confidence), and emotion can lead to more risky behaviours in males, according to the Theory of Planned Behaviour. This difference can be partly explained by social expectations and norms, which play a significant role in shaping gender stereotypes. According to social role theory, men and women behave as per normative expectations (217). Moreover, risky behaviour in presence of peers could also be described by Normative Social Behavior theory and Evolutionary Psychology (218). The former explains the role of peers’ influence and settled norms in behaviour formation and the latter talks about males learning to perform specific behaviours to attract more attention and appear masculine (see also Background, Section 1.2.4.) Other gender-related characteristics may also explain why males are prone to risky driving. Generally, in this age group, young females drive fewer hours per day, prefer not to drive recklessly or ride with unsafe drivers, prefer not to joyride as much as men do, and are more concerned with not hurting others (15). Moreover, it has been shown that females in the age range of current study, typically mature ahead of male peers which lead to a higher level of differentiation of self (i.e. can express their emotions while being able to control their impulses, able to devise a well-defined plan, and make a planned decision). However, it does not mean that young female drivers are necessarily safe. In addition, more reckless driving in young male drivers can be attributed to a higher sensation seeking (90). Based on evidence, young male drivers have higher perceptual-motor skills and less safety skills in driving compared to young female drivers which results in a higher rate of reckless driving in young males. Stereotypical male machismo attitudes and behaviors that are prevalent across nationalities and cultures are one of the leading causes of higher accident risk in males (215).

### **4.1.3 Employment and driving behaviour**

In the current study, while most low-risk drivers were full time students (54.5%), moderate- and high-risk drivers were mostly students and employed at the same time (47.1% and 51.5% respectively). The adjusted and non-adjusted analysis showed that there was a significant correlation between driving behaviour and employment status. Being “both employed and student” was found to be a strong independent predictor of risky driving behaviour among the participants than can be attributed to work-related fatigue and stress, and more inflation of their general over-confidence and self-efficacy in performing risky behaviours including risky driving behaviours.

Hughes et al. studied 47,356 drivers aged 16 years and older in Canada and showed that employed drivers were more distracted by their cellphones, drove while fatigued, and drove faster and more aggressively than unemployed drivers. There was no explanation for the potential reason but a suggestion that some intervention in the workplace like stress reduction, expectation modification to avoid work on the road, and a change in drinking culture of post-work meetings with clients or colleagues may mitigate the aforementioned risky driving behaviours. However, in that study, the association between employment status and risky driving behaviour was not statistically significant (<sup>109</sup>).

Another aspect of employment which could be considered in young adults is being involved in work at a young age. The majority of our young participants (aged 18.34±2.31 years) were both employed and students at the same time. Being involved in work may have other benefits for youth: income, interest in gaining independence, social activity. This situation may reflect the ‘transition proneness’ concept in Problem Behaviour Theory (<sup>216, 217</sup>) which, as mentioned before, explains risky behaviours in youth as a way for them to show that they are grown-ups. When people start working at an early age, they try to mimic adults’ behaviours such as driving behaviour and they are influenced by their work environment (<sup>218</sup>). As noted above, it should be borne in mind that being a student and employee at the same time may cause driver fatigue due to lack of sleep, prolonged mental activity, and long periods of stress and anxiety as well as more driving exposure, (i.e. work or school trips), which may also influence risky driving behaviour (<sup>109</sup>).

### **4.1.4 Living status and driving behaviour**

The participants in this study were mostly living with both their parents. There was a significant correlation between living status and driving behaviour indicating that high risk drivers tended to live alone or with a roommate, which was expected as these risky drivers were also older. However, after

adjustment for other factors in regression analysis, this variable had no independent effect on risky driving behaviour.

It is noteworthy that the living status variable in the current study emphasized family structure. In other words, in the current study the “living status” variable indirectly evaluated the influence of family structure on youth behaviour. Living status or family structure is among the least examined sociodemographic factors in the literature in terms of its relation to driving behaviours. Aligning with our finding, a longitudinal study by Reeder et al., investigated the impact of psychological and social factors, including living status, on driving behaviours. They followed a New Zealand cohort every two years from birth until the age of 15, then at the ages 18 and 21 years. The analysis of 840 participants revealed that youth living in a single parent family at age 15 did not differ significantly with respect to traffic convictions compared to those who were living with both parents <sup>(219)</sup>. However, in another longitudinal study following participants from age 13 to 17 years (first year of driving performance), Shope et al., assessed sociodemographic predictors of driving behaviour in 865 American adolescents and found that living situation “other than living with both parents” (e.g., single parents, relatives, etc.) was a predictor of crashes and traffic offences in young males <sup>(220)</sup>. The discrepancy may be attributed to the fact that Reeder, like the current study, examined several factors such as health-risk behaviour, family and background, social competence, and other psychological and social measures and adjusted their findings, while Shope et al., did not.

Family structure has the potential to influence driving behaviour, as it can also positively or negatively affect the quality of the relationships between parents and children due to supporting, monitoring, and role modelling functions. According to psychosocial theories (e.g., Normative Social Behavior Theory and Social Cognitive Theory, Problem Behaviour theory), young people are directly influenced by their parents, and the quality of interaction is key. The parent-child interaction can positively or negatively affect young people’s driving through parental monitoring, reward/punishment feedback from parents, and norm acquisition from observing parents. Most previous research has supported the idea that increased parental support and control are strongly associated with lower levels of adolescent risk behavior <sup>(218)</sup>. Tubman-Ben-Ari et al., reported that young drivers who had less risky driver parents were less likely to be risky drivers <sup>(150)</sup>. Schmidt et al., studied 432 participants aged 17-22 years from Ontario, Canada and found that youth were influenced by their parents’ aggressive driving, distraction, and speeding <sup>(221)</sup>. Scott-Parker et al., studied 165 drivers aging 17-24 years old and found that parents’ norm and anticipated parental

rewards for avoiding risky driving were positively associated with risky driving in young drivers whereas anticipated parent punishment was negatively associated with risky driving<sup>(81)</sup>. A study by Brookland et al., on 3,992 newly licenced drivers aged 15-17 years old also showed that, adolescents who experienced ‘Active delay’ in getting driving license by their parents had lower crash rates<sup>(87)</sup>. Carpentier et al., describes how parental monitoring can exert positive influence on their children’s driving behaviour<sup>(80)</sup>. There is a huge body of literature on the effects of parents’ role modeling and monitoring on the driving behaviour (like other aspects of life) of their youths whereby they can exert a positive influence on the driving behaviour of their children<sup>(80-82)</sup>.

Although the interaction is obviously a by-product of family structure (i.e., living status), the effect of family structure on child’s behaviours may be mediated by the quality of parent-child relationship. In other words, the quality of interaction as interpersonal behaviour is the factor that really matters as it exerts a direct influence on young people. Examining the effect of parental role modelling or monitoring, is beyond the scope of this study. It is noteworthy that the peer influence may prevail over parent effect in this age group. Further investigation of young drivers in Canada with a more robust design is warranted to study the role of different living structures, quality of parent-child interaction, and influence of mother and/or father on youth driving behaviour.

#### **4.1.5 Education and driving behaviour**

The current study found that higher education is positively associated with risky driving. In this study, most low- and moderate-risk drivers had less than a high school diploma which may be due to their average age. In contrast, most high-risk drivers had some post-secondary education. The regression analysis showed that having less than a high school diploma education had an independent protective effect on risky driving behaviour.

Consistent with results, Hughes et al., found that young drivers (age 16 and above) in Canada with some post-secondary education drove more often while fatigued, drove faster, drove more aggressively, and were more distracted with cellphones while driving compared to young drivers with less than post-secondary education<sup>(109)</sup>. Atombo et al., reported mixed findings: for some risky driving behaviours (such as speeding), higher education had a protective effect, while for others (like dangerous overtaking), higher education increased the tendency to take more risk<sup>(222)</sup>. A study by the Center for Mental Health in Schools at UCLA highlighted the role of schools in adolescents’ risk-taking behaviours (such as sexual health and risky driving). This study found that there was a

reduction in risk taking behaviours in students when schools punished risky behaviour and/or offered programs and services designed to respond to risk-taking behaviours <sup>(223)</sup>. Therefore, the risky behaviour monitoring programs (e.g., educate and/or focus more on punishment in reaction to risk-taking behaviours) at schools may be protective and be a reason that those with less than high school education tend less likely to be involved in risky driving behaviours. High school students with less self-confidence to attempt risky driving due to less experience and less knowledge compared to post-secondary students can be another plausible reason why individuals with higher education are more liable to take risks <sup>(224)</sup>. According to the Theory of Planned Behaviour, less confidence (less behavioural control) along with a high perception of the consequences of risky driving (leading to a negative attitude toward risky driving) may prompt youth to “follow the rules” and be less involved in risky driving behaviour. In addition to driver age, it is not surprising that education has an independent association with risky driving behaviour given the fact that education plays a fundamental role in human, social and economic development of youth. The extent to which education is linked to health-related behaviours is subject to ongoing debate <sup>(223)</sup>.

#### **4.1.6 Driving License class (with or without restriction) and driving behaviour**

The findings demonstrated that most participants in the current sample (71.5%) and also in each driver group had a restricted driving license. Moreover, there was a much higher proportion of unrestricted drivers falling under the high risk group (37%) compared to low risk drivers (9%); however, after adjusting for other factors, there was no significant, independent effect of driving licence type (with or without restriction) on risky driving behaviour.

Several recent studies assessed the importance of graduated driving licensing (GDL) programs and found that GDL programs decrease crash and violation risks in young novice drivers <sup>(227-229)</sup>. A study in Nova Scotia, Canada, showed both a beneficial short term (first year) impact (i.e., decreasing crash rates in drivers aged 16 – 18 years) after starting a GDL system in the 1990s as well as a positive long-term effect (accident reduction) almost a decade after adopting GDL programs in all provinces and territories in Canada <sup>(230)</sup>. The British Columbia Injury Research and Prevention Unit reported that BC’s GDL program reduced the crash rate in young drivers by targeting some risky driving behaviour like cell phones, drug/alcohol impaired driving, and driving with multiple peer-aged passengers <sup>(228)</sup>. Ehsani et al., studied the crash rate difference in young drivers (aged 16-18 years) who drove independently from the beginning versus those who experienced GDL before being

permitted to drive independently at the same age. Despite driving independently for a longer period of time, the result showed more risky driving pattern in the former group (<sup>229</sup>). Needless to say, GDL imposes certain restriction and limitation on novice drivers making them behave as less risky drivers due to fear of losing their license which, in turn, leads to reduced crash rate in young drivers. GDL, like other protocols and programs, have to be dynamic and need to be revised and updated to match the most recent societal needs in terms of new restrictions and/or method of curbing law breaking habits (<sup>231,232</sup>).

The plausible reasons for the findings in the current study (no significant association between license status and risky driving behaviour) could be due to the fact that the drivers with unrestricted licenses in the current study had also all gone through GDL programs. Therefore, it is unclear how risky their driving would have been if they had not completed these programs. Another reason could be the distribution rate of unrestricted and restricted license in the total sample and the driver groups which may warrant a more specific study to investigate this topic.

#### **4.1.7 Duration of driving independently and driving behaviour**

In the current study, the duration of driving independently was significantly correlated with risky driving behaviour. Those who drove independently more than three years were more likely to fall under the high-risk driver group. After adjusting for other factors, the association of driving independently for more than three years remained positively correlated with a higher tendency of high-risk driving behaviour. Moreover, driving independently for less than a year, had a protective effect on risky driving behaviour.

A survey-based study on 511 Chinese drivers with different age groups demonstrated that driving experience (assessed by the duration of holding a driving license and the amount of daily driving hours) directly predicted accident risk, i.e. the more experienced drivers were more likely to be involved in traffic crashes and receive tickets (<sup>233</sup>). These results may reflect on the point that in young drivers, driving independently for a longer period of time may negatively affect their driving behaviours in that the more they drive independently, the more they may drive recklessly.

It is plausible that the more experienced drivers may perceive some risky driving behaviours, such as speeding, less hazardous. In other words, the more experience a young driver has with driving, especially when nothing bad happens, the more likely they are to reduce their assessment of the risk involved leading to less risk perception (<sup>233</sup>). Normative Social Behavior theory also posits the

influence of settled norms by family and friends on a person's behaviours. Transitioning from driving with restrictions to driving independently occurs simultaneously with a reduced parental influence and an increased influence from peers. Accordingly, there tends to be more incidents of risky driving behaviour when driving independently<sup>(234)</sup>. Moreover, the more a young driver drives independently, the riskier the driving behaviours become. The perception is that they have more experience and confidence in managing risky behaviours and managing possible hazardous outcomes<sup>(233)</sup>. According to the Theory of Planned Behaviour<sup>(235)</sup>, the weight of the subjective norm (increased influence of peers coupled with decreased parental presence) and an increase in behavioural control may over time account for why young drivers who drive for more than three years tend to be more risky drivers. Of note, when young drivers become adult drivers, the elements of Theory of Planned Behaviour may be weighted differently.

This finding may be important in guiding prevention programs to address youth driving independently for more than three years. However, it does not mean that the less experienced drivers should be neglected.

#### **4.1.8 Driving exposure and driving behaviour**

The majority of drivers in the low-, moderate- and high-risk groups ranked low in their mileage driven exposure. This might be attributed to the timing of the survey during the school year, i.e., they would have had less time to drive than during the summer. However, high exposure, defined as driving more than 20 hours per week, was more prevalent among high risk drivers compared to low risk drivers. Driving exposure (moderate and high) was found to be a strong predictor for risky driving behaviour. Scott-Parker et al., in a study of 476 drivers (aged 17-25 years) reported that more driving experience was significantly associated with more risky driving<sup>(175)</sup>. Evidence in different age ranges also showed congruent results. Mekonnen et al., studied driving exposure (driving hours per week and kilometers per year) and driving behaviour in 361 professional drivers who had a driving professional license (mean age  $34 \pm 7.97$  years) and concluded that drivers with more driving exposure (20,000 km versus 10,000 km per year) were twice as likely to engage in risky driving behaviours. The bivariate analysis of this study also showed that those who drove 10-20 hours per week were more likely to perform risky driving behaviours compared to those with fewer hours<sup>(236)</sup>. Oppenheim et al., surveyed 527 drivers (mean age  $29.2 \pm 7.5$  years) about traffic violence and predictive factors (including driving exposure) and found that greater driving exposure (annual

kilometers driven) was associated with higher rates of traffic violations <sup>(201)</sup>. Tao et al., in a study on 511 Chinese drivers (mean age 34.2±8.8) showed that more experienced drivers (years of driving and driving hours per day) were involved in more traffic accidents and received more tickets. However, after adjusting for other factors, there was no significant effect of driving exposure on risky driving behaviours <sup>(234)</sup>. The literature suggests that driving exposure is positively associated with risky driving in all age groups. Consistent with this literature, the current study provides evidence of an association between driving exposure and risky driving behaviours among young drivers.

This association can be explained by the Theory of Planned Behaviour. The more driving experience youth acquire, the more confidence they feel in controlling the outcome (increased behavioural control). Further, the more often youth have their peers (most influential reference group at this age) in their cars while driving (subjective norms), the less they perceive the hazardous outcome of risky behaviours (positive attitude towards risky driving behaviours). Therefore, more driving exposure may prompt young drivers to perform more risky driving behaviour. It is important to consider that this increase in confidence and propensity to take risks while driving may persist into adulthood. As such, it may be beneficial to continuously monitor risky driving behaviours for all age groups through self-reporting and objective measures. This could potentially lead to implementation of promotion programs (such as speeding, aggressive driving, distracted driving) for experienced drivers in order to improve overall road safety.

#### **4.1.9 Driver car status and driving behaviour**

In the current study, most high-risk drivers (76.5%) owned their cars while most low-risk drivers (80.5%) did not. Further analysis showed that car ownership was an independent risk factor for risky driving behaviours. The finding is consistent with the results of a study by Brookland et al., that surveyed 3992 newly licenced drivers (aged 15-17 years) and found that drivers who owned their cars tended to be riskier drivers and experience more crashes than those who drove their parents' vehicles <sup>(87)</sup>. Fewer legal restrictions, less parental control, and peer influence make drivers who own their cars more prone to risky driving behaviours. Moreover, car ownership may give young drivers a feeling of independence and increases confidence (rooted in the nature of ownership) which, in turn, leads to imitating adult problem behaviours in driving <sup>(237)</sup>. However, a study conducted by Mousavi Bazzaz et al., on 514 drivers aged 18-85 years old showed that more expensive cars (i.e. > \$30,000 USD) were associated with lower accident rates, perhaps because drivers who own these vehicles

drive more cautiously in order to avoid car damage and financial loss <sup>(238)</sup>. Parents should seriously consider that the result of granting vehicle ownership privileges to their children could be a higher level of risky driving behaviour. Parents could adopt some preventive measures (e.g. provide more education and discussion about the outcome of risky behaviours) in advance, before providing access to the family vehicle. For the young drivers who own their vehicle, parents could also provide more parental guidance and actively monitor attitudes to prevent risky driving behaviors from developing.

#### **4.1.10 Socioeconomic status and driving behaviour**

Most participants in this study, across all driving behavior groups, scored high for socioeconomic status and the current study did not find a significant relationship between socioeconomic status and driving behavior even after adjusting for other factors.

Hansen et al., surveyed 360 students (aged 12-16 years) and found that a lower socioeconomic status (including factors such as family income and parents' employment status), was linked to risky behaviours (like criminal behaviours) in youth, regardless of their gender <sup>(105)</sup>. In another study, Hughes et al., used a national survey database to study 47,356 drivers (aged above 16 years) who had driven a motor vehicle in the previous 12 months and found that high household income was associated with aggressive driving <sup>(111)</sup>. Another study, by Hoskin et al., showed that drivers in all age groups with high and medium socioeconomic status reported more risky driving behaviour, intention to speed, and positive attitudes toward speeding than drivers of low socioeconomic status <sup>(239)</sup>. Machado-Leon et al., studied 492 Spanish drivers from all range groups (above 18 years) and found that the higher income per household that drivers had, the more likely they did not respect speed limits, safe distancing, and passing rules <sup>(236)</sup>. The attitudes of high socioeconomic drivers toward risky driving might be a reflection of their perception of their wealth, a sense of entitlement that comes from being part of a privileged group. A qualitative study interviewing people from a variety of professions in Iran showed that individuals with higher income may buy sophisticated high-powered vehicles as a symbol of prestige and this could lead to more positive attitudes toward speeding, risky driving and related behaviors <sup>(240,241)</sup>. The present study found no association between socioeconomic status and risky driving behaviour. This discrepancy could be due to the difference in driver age groups (young novice drivers compared to drivers in all age groups). Another plausible reason may be due to the limitations of the socioeconomic status scale used in this study, which was designed to avoid the need for parental consent. Another possible reason (if the accuracy and validity

of the scale is relevant) may be that most participants in the current study had high socioeconomic status and there was insufficient range in socioeconomic status to show a difference. Alternatively, the findings from the current study may indicate socioeconomic status may not play an independent role in predicting risky driving behaviour in this age group (after adjusting for other factors such as car ownership).

## **4.2 Personality traits and driving behaviour**

The second objective of this study explored the relationship between personality traits and risky driving behavior in young drivers in Canada. The level of risky driving behaviour varied across the big five personality traits. Overall, the findings indicated that different personality traits can influence driving behaviour. Young people with high extroversion, high neuroticism, and low imagination tended to perform more risky driving behaviours. Each of the five personality traits dimension will be discussed below.

### **4.2.1 Extroversion and driving behaviour**

Extroverted people are characterized by being excitable, sociable, talkative, and assertive, with high amounts of emotional expressiveness. These outgoing people gain energy in social situations (140-143). Most participants in all driving behaviour groups (low to high risk drivers) scored average on extroversion. However, extroversion was significantly associated with driving behaviour. After adjusting for other factors in the proportional regression analysis, highly extroverted drivers were 1.6 times more likely to perform risky driving behaviour compared to drivers with average scores for extroversion.

Previous studies on risky driving also found that drivers who scored high on extroversion (extroverts) reported higher levels of risky driving behaviour than drivers who scored low on extroversion (introverts) (242-245). Stephens et al., surveyed 101 British drivers (17-78 years of age) and found that extroverted drivers were more likely to report high rates of traffic violations (intentional deviation from traffic rules) and accident rates. Of note, violations predominated in younger drivers aged 17-25 years, while errors and lapses of judgement showed no significant difference between age groups. (242). Wang et al., found that extroversion was associated with maladaptive driving behaviour, a term used for an anxious, unsafe, reckless and angry driving style, based on a study of 296 Chinese drivers, aged 20-56. In Wang study, drivers who reported more

violations were also more extroverted. <sup>(243)</sup>. Renner et al., compared 95 young traffic offenders (in a driver improvement training program) with 78 young “control group” drivers (both groups aged 18-30 years) and found a significant relation between extroversion and risky behaviour in young male offenders compared to male controls <sup>(244)</sup>. Anitei et al., interviewed 100 18-25 year old undergraduate students and found that the enjoyment of violence (a construct in the driving behaviour questionnaire assessing the intentional and deliberate aggressive behaviour to cause harm to others, such as sudden braking being tailgated) was predicted by high extroversion and low agreeableness <sup>(245)</sup>.

Not all studies report a relationship between extroversion and risky driving. Tao et al., interviewed 511 Chinese participants (mean age 35 years) and found no relationship between risky driving behaviour and extroversion <sup>(233)</sup>. Moreover, Shen et al., in a study that aimed to validate the Positive Driving Behaviour Scale on 421 Chinese drivers (20-60 years of age) found that extroverted personality was associated with positive driving behaviour such as not blocking or obstructing other drivers, as they would “avoid using left lane to facilitate the speed of traffic flow”. However, it should be mentioned that Shen did not specifically evaluate the association of extroversion with risky driving behaviour <sup>(246)</sup>. Recently, Akbari et al., conducted a meta-analysis that included 22 studies with a total of 11211 participants to assess the correlation of personality characteristics (five personality traits, sensation seeking, and driving anger) with risky driving behaviour. They concluded that risky driving behaviour was not correlated with extroversion <sup>(247)</sup>. The inconsistent results in literature may be explained by differences in methodology, different age groups, use of different tools to measure personality, different definitions of risky driving, and failure to adjust for other variables.

It is unclear why extroversion is associated with risky driving behavior. Assertiveness, one of the main characteristics of the extroversion trait, involves social ascendancy and forcefulness of expression so may be of importance. Assertive people tend to take charge, seek to influence others, take control and try to lead others <sup>(248)</sup>. It may be that such dispositions contribute to lower the extroverted driver’s threshold for aggression, at least in traffic situations <sup>(249)</sup>. Extroversion concerns the quantity and intensity of energy directed outwards into the social world <sup>(250)</sup>. Having a high baseline energy level may increase the risk of becoming easily frustrated, which, in turn, may increase the amount of aggressive behavior. Extroverts also tend to seek self-stimulation more rapidly and intensively than introverts, which may increase aggressive behavior, insofar as aggressive driving is a form of self-stimulation <sup>(251)</sup>. Another possibility is “activity” (i.e., the person’s pace of living), another facet of extroversion. Active people are always busy and “on the go” and may attempt to

manage several tasks simultaneously<sup>(252)</sup>. The frustration-aggression theory postulates aggression is often a result of frustration. As such, it is conceivable that extroverted drivers finding themselves in time pressured situations may be more likely to feel that their personal mobility needs are frustrated, making them prone to react with aggression<sup>(253-255)</sup>. In summary, the current study contributes to the literature by showing that extroversion is an independent risk factor for risky driving behaviour in young drivers in Canada.

#### **4.2.2 Neuroticism and driving behaviour**

Individuals who score high on neuroticism are more likely to be moody and experience such feelings as anxiety, worry, fear, anger, frustration, envy, jealousy, guilt, depressed mood, and loneliness<sup>(138-141)</sup>. In the current study, the participants mostly scored average in neuroticism personality trait. Although the result of chi square test showed no significant association between neuroticism and risky driving behaviour, the regression model revealed a positive independent effect of neuroticism on driving behaviour. Young drivers with high levels of neuroticism were 1.8 times more likely to perform aberrant driving behaviour.

Most previous research is consistent with the current finding. A self-report survey-based study on 101 British drivers aged 17-78 years found that drivers with higher scores for neuroticism had significantly more lapses in driving judgment, which was attributed to prompt reactions to the external stressors (e.g., anxiety, fatigue) and attenuation of cognitive functions (e.g. reaction time and memory)<sup>(242)</sup>. An anxious driving pattern was significantly correlated with high neuroticism in a study of 100 undergraduate students aged 18-25 years<sup>(245)</sup>. Another study among 312 college students (median age 19 years), found that the loss of concentration while driving and loss of vehicle control was more often reported in neurotic drivers<sup>(146)</sup>. Of 296 Chinese drivers aged 20-56 years, drivers with high neuroticism tended to have a maladaptive driving style defined as an anxious, unsafe, reckless, and angry driving style. The risky driving behaviour in anxious drivers could be due to a reduced level of confidence in both their own driving ability as well as that of other road users, which reinforces the driver's stress. Moreover, neurotic drivers have higher thrill-seeking, anger and aggression, and distress and frustration intolerance<sup>(243)</sup>. A recent meta-analysis reported that neuroticism have a significant, positive influence on risky driving behaviour<sup>(247)</sup>. However, not all research concludes that neurotic drivers are prone to risky driving.

Renner et al., compared the personality traits of ninety-eight juvenile traffic offenders (16.8% female) with a control group of 149 applicants for driving licences (43.6% female) and found no relationship between neuroticism and risky driving behaviour <sup>(245)</sup>. Plausible reasons for this disagreement with the findings of the present study and literature may arise from the selection bias that the control group (recruited from a driving school and who were applicants for driving license) was not an appropriate comparison group, second the female to male distribution difference in the case (16/79) and control (33/44 ) group.

The present findings that neuroticism is positively associated with risky driving behaviour can be explained by the personal characteristics of neurotic individuals. First, individuals who score high on neuroticism are generally prone to psychological distress and are particularly vulnerable to stress. Neuroticism has been identified as a strong predictor of driver stress <sup>(256)</sup> possibly because it is associated with ineffective coping strategies <sup>(257)</sup>. Reactions to stress include decreased cognitive and performance capacities <sup>(258)</sup>, and highly neurotic individuals may be more stress reactive than others in traffic <sup>(259)</sup>. Second, high scores on neuroticism may be linked to anger. Moodiness and being temperamental are central aspects of neuroticism, and emotionally unstable individuals are more prone to anger than emotionally stable individuals <sup>(260)</sup>, and anger is closely linked to aggressive driving <sup>(261)</sup>. Third, neurotic individuals may frequently experience impatience, tension, nervousness and irritation <sup>(262)</sup>. In a traffic context, impatience and elevated irritation may lower the driver's threshold for aggressive behavior. To deal with drivers' impatience and irritation and aggressive driving behaviour, injury prevention stakeholders could develop training that promotes emotion regulation in driving setting for drivers who commit relevant offences.

#### **4.2.3 Agreeableness and driving behaviour**

The personality trait of agreeableness has characteristics such as altruism, trust, affection, kindness, less “showing-off”, and other prosocial behaviours <sup>(138-141)</sup>. The current study found no significant correlation between agreeableness and driving behaviour. On the contrary, a wealth of literature has found a negative association between agreeableness and risky driving behaviour. Stephens et al., in a study of 101 British drivers aged 17-78 years stated that low levels of driving violations was linked to higher scores for conscientiousness and agreeableness <sup>(242)</sup>. Wang et al., in a study on 296 Chinese drivers aged 20-56 years, found that drivers with low agreeableness were more likely to be involved in risky driving behaviour <sup>(243)</sup>. Anitei et al., indicated that, among one

hundred second year undergraduate psychology students aged 18-25 years, drivers with low agreeableness experienced more “enjoyment of violence” (i.e. aggressive behaviours performed intentionally that cause harm to other road users) in their driving behaviour <sup>(245)</sup>. Tubman-Ben-Ari et al., assessed the correlation between four driving styles (i.e. reckless, anxious, angry, and careful) and the big five personality traits on 320 Israelis aged 18-60 years. They found that agreeableness was inversely correlated with angry and reckless driving styles. Moreover, the higher the agreeableness level, the more likely drivers were to adopt a careful driving style <sup>(150)</sup>. A study in China, by Shen et al., on 421 drivers (20-60 years), showed that the agreeableness personality trait was associated with less risky driving behaviours <sup>(246)</sup>. Dahlen et al., studied 312 college students (median age 19 years) and reported that reduced agreeableness was associated with the loss of vehicle control <sup>(146)</sup>. Akbari’s meta-analysis (2019) of 22 studies investigating the correlation between personality characteristics and driving behaviour found that agreeableness was inversely correlated with risky driving <sup>(247)</sup>. A possible explanation why altruism is inversely associated with risky driving is that drivers scoring higher on altruism are expected to consider the interests of others and show more active concern for others in traffic and thus reduce risky driving behavior <sup>(260)</sup>.

The inconsistency between current findings and the majority of literature may be largely due to the narrow range of scores. However, the current finding may draw attention to personality traits other than agreeableness and conscientiousness when it comes to risky driving in young individuals. The incongruence between the current findings and the literature may be attributed to differences in the age range of participants and to the selection bias. Participants in previous studies were recruited from a broader age range, e.g., 18-60 years, than the current study. In the studies restricted to a smaller age range, like Anitei et al., participants were recruited from a certain population subgroup such as “college students”, or “second year undergraduate psychology students” which limits the generalizability of their results. In contrast, the current study included a less selected population of young drivers (i.e., those who had access to the internet and Facebook). Moreover, most other studies did not adjust for the potential confounding effect of other variables such as sociodemographic factors.

#### **4.2.4 Conscientiousness and driving behaviour**

The conscientiousness personality trait has high levels of thoughtfulness, with good impulse control and goal-directed behaviours. These people are also organized and mindful of details <sup>(138-141)</sup>.

In the present study there was no significant correlation between conscientiousness and driving behaviour. Consistent with this finding, Dahlen et al. surveyed 312 US college students and also reported that conscientiousness was not significantly associated with risky driving behaviour <sup>(146)</sup>. Similarly, risky driving behaviour was not associated with conscientiousness in the Akbari et al.'s meta-analysis <sup>(247)</sup>.

However, as with agreeableness, a great deal of literature showed that more conscientious drivers reported less risky driving behaviours. Shen et al. used a validated questionnaire to study 421 Chinese drivers (20-60 years) and showed that conscientiousness was associated with positive driving behaviours such as not blocking an oncoming car or slowing down to help a driver trying to overtake <sup>(246)</sup>. Stephens et al., in a study of 101 British drivers aged 17-78 years, found that low levels of driving violations (intentional deviation from traffic rules) was associated with higher scores for conscientiousness and agreeableness. Moreover, the more conscientious a driver was, the lower the tendency to experience lapses (attention or memory failure) and errors (unintentional failure of achieving desired outcome through planned behaviour) <sup>(242)</sup>. Wang et al.'s study of 296 Chinese drivers aged 20-56, found that conscientiousness negatively predicted angry and risky driving styles and positively predicted careful driving style <sup>(243)</sup>. Anitei et al. studied the association of personality traits (according to the Big Five model) and risky driving behaviour (using the Aggressive Driving Behaviour assessment tool) among 100 second year undergraduate psychology students aged 18-25 years. They found that low conscientiousness was a predictor of anger in driving behaviour (manifesting angry behaviour in certain traffic situations or towards other road users' behaviours) <sup>(245)</sup>. Tubman-Ben-Ari et al. examined the association between four driving styles (i.e. reckless, anxious, angry, and careful) and the big five personality traits in 320 Israelis aged 18-60 years. They found that the lower the conscientiousness score drivers had, the more tendency they would have reckless, angry, and anxious driving styles <sup>(150)</sup>. Also, the less likely they were to driver carefully <sup>(150)</sup>.

The dissimilarity between current findings and some studies mentioned above may be largely due to the narrow range of scores. In addition, given that the role of personality traits may vary by age, focusing on specific age group in the current study may lead to this incongruent finding. The nature of conscientiousness (i.e., impulse control, planning ahead, thoughtfulness) and its effect on behaviour may be subject to changes over time due to the acquisition of experience and skills with age <sup>(263)</sup>.

#### 4.2.5 Imagination (Openness) and driving behaviour

People with strong imagination are adventurous and creative (<sup>138-141</sup>), imagination is also associated with sensation-seeking (<sup>242</sup>). Close to 70% reported average imagination in each risk group. In the current study, low imagination was associated with an increased likelihood of risky driving. The odds of risky driving behaviour in young drivers in Canada with a low imagination was found to be 1.54 times higher than those in drivers with an average imagination. This finding is consistent with a series of previous studies that demonstrated that the “openness to experience” personality is negatively correlated with risky driving behavior and positively associated with a more positive driving behavior. Anitei et al., in a study of 100 second year undergraduate students (mean age 20.68) demonstrated that low openness was a predictor of negativism in driving defined as “refusal to drive in a cooperative and understanding manner” (e.g., extra caution while passing a bicycle, promptly stopping for a pedestrian waiting to cross the street) as measured by the Aggressive Driving Scale (<sup>245</sup>). Using the 35-item Driving Survey, Dahlen et al., in a study of 312 college students with median age of 19 years old found that low openness was significantly associated with risky driving behaviour such as driving without a seatbelt, and unsafe passing (<sup>144</sup>). Monteiro, et al., interviewed 311 drivers aged  $29.8 \pm 9.81$  years in Brazil and also found that openness was inversely correlated with risky driving (<sup>262</sup>). Wang et al. surveyed 296 drivers aged 20-56 years (mean age 35) to assess the relationship between personality traits (Big Five Inventory), driving styles (Careful, Anxious, Risky, and Angry or High-velocity), and driving behaviour (Ordinary Violations, Aggressive Violations, Errors, Lapses, and Positive Behavior). After adjusting for other factors, Wang et al., found that openness was correlated positively with a risky driving style and, at the same time, was inversely correlated with angry and high-velocity driving styles. Overall, Wang et al., concluded that openness had an independent positive influence on positive driving behaviours (<sup>243</sup>). Employing the same tools, Shen et al., in a study on 421 Chinese drivers aged 20-60 years (mean age=40.34) also concluded that openness was associated inversely with some dimensions of risky driving behaviour (Ordinary Violations, Aggressive Violations, Errors, Lapses) and was positively related with positive driving behaviour (<sup>246</sup>).

Based on literature different studies seems to show inconsistent results – some showing a positive and some a negative relationship between openness with risky driving. A study by Stephens et al., on 101 UK drivers aged 17-78 years, found no association between openness and driving errors, lapses

or violations (<sup>242</sup>). Akbari et al., (discussed in previous sections) showed no significant relationship between openness with risky driving behaviour (<sup>247</sup>) but in their discussions could not provide any plausible reasons for this finding.

In summary, this study lends more support to the positive influence of openness on positive driving behaviour that may be attributed to some of the characteristics of open people, e.g., focusing on tackling new things, and high creativity and imagination skills. Youth with high openness to experience might opt for other positive outlets like leisure activities and avoid negative or health related risky behaviours (like risky driving) to tame their adventure-seeking motivations. Future research can investigate this association in more depth to examine which aspects of openness are associated with driving behaviour.

Overall, a person's personality includes several personality traits. Therefore, it is noteworthy to conduct further detailed research projects to evaluate a person's personality as a whole and its interaction and association with risky driving behaviour.

### **4.3 Leisure activity and Driving Behaviour**

The main objective of this study explores the relationship between leisure activity and risky driving behavior among young drivers in Canada. Before listing the influence of leisure activities on driving behaviour, it's noteworthy to mention that there may be an association between leisure activities and other predictive factors such as sociodemographic factors and personality. For example, in a survey of 1,719 participants (mean age 34.57 years), Ardahan et al., found a relationship exists between sport and outdoor activities, and education status, age, income and employment status (<sup>264</sup>). Therefore, the current study investigated the influence of leisure activities while adjusting for important confounders such as sociodemographic factors and personality characteristics.

In this study, most participants had a low level of engagement in leisure activities, which might be due to the time period when the survey was deployed (i.e., March to May – during the school year). Of note, levels of engagement were defined by the number of hours or times a week that were allocated to a leisure activity – with unique cut-off values for each leisure activity as described in the method section. The study found that leisure activities can influence driving behaviour in positive and negative ways. Young people who were highly engaged in leisure activities that involved drug use, spending time with friends, watching movies, and social media use tended to display a high level of risky driving behaviour, while those more engaged in reading and writing, playing video games,

and volunteering displayed less risky driving behaviour. The 13 types of leisure activity considered for evaluation are discussed individually below.

### **4.3.1 Video game and Driving Behaviour**

With the popularity of high-tech devices (computer, tablet, and smartphone) and ever improving internet access, playing online or offline games has become a popular activity in recent years, especially among young people. People usually play video games for entertainment, excitement, when seeking a challenge, when coping with emotions, and to escape from reality <sup>(265)</sup>. The video games provide a means to fulfill gamers unsatisfied needs or motivations, virtually <sup>(265)</sup>. Although some studies have demonstrated beneficial effects of playing video games on psychological and physical health <sup>(266,267)</sup>, most research on video games has focused on the negative effects on gamers. It has been suggested that excessive video gaming is associated with reduced sleep time, insomnia, displacement of healthy leisure activities <sup>(269,270)</sup>, attention problems, poor academic performance, lower self-esteem, lower satisfaction with daily life <sup>(270)</sup>, anxiety, depressive symptoms, deterioration of interpersonal relationships, family conflicts, along with youth's risky behaviour, violence or crimes <sup>(271,272)</sup>. The present study showed that playing video games was not a widespread activity among youth in Canada at the time of the survey deployment. Most participants scored low ( $\leq 9$  hours per week) for video game engagement in all three driver risk groups. This level of engagement is lower than reports from other countries such as United States, China, Germany and Saudi Arabia <sup>(274-277)</sup>. For example, 41.6 percent of respondents in the U.S. admitted to playing video games for more than 20 hours a week, while another 11.4 percent claimed to spend between 12 and 20 hours a week gaming <sup>(277)</sup>. This might be due to the time of survey deployment in relation to the school year and scheduled examinations in Canada. Another explanation might be that different scales were used to measure video-game engagement in each study. Surprisingly, in the current study, playing video games was inversely associated with risky driving behavior: After adjustment for other factors, participants with high engagement in playing video games ( $\geq 9$  hours per week) were less likely to be risky drivers than those who played less often (adjusted OR=0.56).

There is some evidence that action video games may improve reaction time and visuomotor-control tasks in real driving situations (with a reduction in crash rate) <sup>(97)</sup>. Although this could affect driving behaviour by boosting the confidence of control and driving ability, the evidence of positive influence of video games on driving behaviour is per se very limited. An observational study of 103

drivers (mean age = 23.3 years) showed that those who played prosocial video games (e.g., ‘Emergency 4’ game in which an emergency physician has to manage accident scenarios) were less likely to drive recklessly and more likely to care more about other drivers on the road (<sup>108</sup>). Conversely, Fischer et al., in a study that included three related experiments, examined the correlative and causal effect of playing racing video games and risky driving behaviours (categorized as competitive, stunt/obtrusive, and cautious driving behaviours). First, their interview-based study of 190 German drivers aged 16-45 years (Mean age =  $23.43 \pm 4.65$  years) indicated that playing racing games was positively associated with increased competitive driving and stunt/obtrusive driving, and negatively associated with cautious driving behaviour (<sup>277</sup>). An experimental study of 83 drivers aged 19-42 years ( $M=23.86 \pm 4.40$  years), found that participants who played racing games for 20 minutes before being tested in a driving simulator had a higher level of arousal/excitement and priming accessibility to risk-promoting thoughts than those who played a neutral game like soccer. Lastly, they studied 69 participants (age 19-35; mean age =  $23.6 \pm 4.14$  years) during 15 computer-simulated critical driving situations and found that playing racing games was significantly associated with risk taking behaviour in critical traffic situations in male, but not female, participants (<sup>278</sup>). Aljied et al., conducted two experiments on Canadian students enrolled in a psychology course at the University of Ottawa. First, on 52 participants (mean age  $19.25 \pm 2.17$  years), they found no significant correlation between playing videogames and overall driving performance in simulated driving situations. Second, to assess driving skills (such as road information processing and vehicle handling when lane changing, tailgating, lateral control, and passing other cars) they studied 39 drivers aged 18-24 years and found that playing videogames was associated with risky driving behaviour such as speeding and poor performance in lateral control maneuvering (<sup>101</sup>).

The current study found that video game playing was not associated with risky driving. Evidence is mounting that playing video games may be one way for people to sharpen a number of cognitive skills (<sup>279,2281</sup>). The present findings could be attributed to the fact that video games especially action games (mostly played among the participants) can act as an outlet for youth to express their anger, aggressiveness, stress, sensation seeking (<sup>284,283</sup>). Thanks to the current technology, video games simulate real-world driving closely enough that they can prompt gamers to interpret and analyze real world traffic situations more quickly. Playing video games obliges young drivers to react suddenly and take risks. Despite the fact that video game driving can translate the real-world driving skills, a dilemma still remains. On the one hand, the resulting improved technical skills might cause young

drivers (who now believe that they drive better than average drivers) to be more willing to take risks due to their excessive confidence and overestimation of driving self-efficacy. On the other hand, the learned skills can help a driver respond with appropriate reactions, even if risky, when presented with real world unexpected hazardous events. It is worth mentioning that the current study also investigated all types of video games (not just racing games). In analyzing the distribution of driver groups among the various video games types, the high risk driver numbers seemed to significantly trend up in race, action, simulation, and sport types while conversely trend down in adventure and strategy types. The results suggest that more detailed or stratified analyses are warranted for the association between risky driving behaviour and the various types of videogames.

### **4.3.2 Sport and Driving Behaviour**

In the current study, the majority of participants in the three risky driving groups scored low for sports engagement and no association was found between driving behaviour and sport engagement. Although there was no association between sport and driving behaviour in the current study, it is well known that physical activity in childhood and adolescence lead to healthy lifestyles and cognitive and executive function improvements. Interestingly, physical activity also has a positive effect on perceptual, cognitive, and physical abilities that are considered important for driving performance and safety. For instance, aerobic fitness is associated with improved cognitive function (especially executive control, i.e., ignore conflicting information and focus on the desired task) <sup>(284)</sup>, and people with good physical fitness show greater efficiency in information processing <sup>(285,286)</sup>, enhanced attention capacity in dual-task situations <sup>(287)</sup>, and better performance on tasks that require visual-spatial processing <sup>(288)</sup>.

A great deal of evidence has investigated the association of physical activity/sport engagement with other health-related risky behaviours such as alcohol consumption, smoking, drug use, and risky sexual behaviour. The findings are mixed. In a review of 108 studies, Sallis et al., <sup>(289)</sup> found no clear associations between alcohol consumption and physical activity. Some studies have reported that the least physically active adolescents are at risk of drinking more alcohol <sup>(290)</sup> or using more cannabis <sup>(291)</sup>. Conversely, other studies have found that physically active adolescents drink more alcohol <sup>(292)</sup> and use “snuff” more commonly <sup>(293)</sup> than less physically active adolescents.

Few studies examined the effect of physical activity engagement on driving. Wayne et al., conducted an experimental study to understand the impact of organized sports on the driving skills

of 100 novice drivers (age 15-29 years) under real-world driving conditions in the Westside of Los Angeles. The main outcome was that practicing organized sports of any kind, solo or team sports, either in the past or present, was associated with enhanced driving skills <sup>(282)</sup>. Another experimental study on 24 drivers (50% male; mean age 20.4±1.93 years; mean driving experience 4.7 years) evaluated whether the spatiotemporal skills acquired through high level sports can transfer to driving skills. Using an emergency-braking test, they showed that athletes (i.e., those participating in their university athletic team) achieved significantly longer collision time lags (lapse of time between when the lead car braked and the time-to-collision with the lead car) in simulated driving situations. This advantage of athletes was attributed to both their body movements and reaction times as well as their ability to respond with a desirable performance in a given situation. <sup>(294)</sup>. Matos et al., conducted an experimental study of 32 novice drivers (mean age 19.1±1.9 years) divided into “team sports players” (at least three years of sports practice) and “non-team sports players” to study the association of physical activity with the capacity of novice drivers to detect peripheral lights on the left or right of the front panel. Using this *Peripheral Detection Task* during on the road driving sessions, they found that team sports players scored higher than non-team sports players and concluded that people who play sports have better peripheral vision than those not engaged in sports <sup>(295)</sup>. Thus far, it seems the existing evidence has resulted from examining the effect of sport on driving skills but not driving behaviour.

Enhancing and improving driving skills has the potential to positively or negatively affect driving behaviour. In a driving setting, these skills can either elicit over confidence by tempting the driver to multitask (using cellphone) and take risks (speeding and driving aggressively) or help young drivers to plan ahead and process road information more efficiently in order to avoid taking risks. The current finding, indicating no association between sports engagement and driving behaviour, is novel.

### **4.3.3 Social media and Driving Behaviour**

Social media sites such as Facebook, Twitter, and YouTube offer opportunities for users to interact and share information with friends and family and with people who have similar interests. Over recent years the number of people using such sites has increased dramatically. Young adults (ages 18 to 29 years) are the group most likely to use social media – fully 90% do <sup>(296)</sup>. Along with the benefits such as improved socialization, communication and enhanced learning opportunities, the use of social media can introduce risks <sup>(297)</sup>.

In our study, social media was the only activity among all leisure activities with a high level of engagement in all three risky driving groups. Given that recruitment for the study occurred through social media, the high engagement rates may be due to selection bias. Participants reported that they spend at least 60 minutes a day on social media. Confirming the stated hypothesis, the current study found a significant association between risky driving behaviour and social media engagement. After adjustment for other predictive factors, the current study found that participants who are highly engaged on social media (more than 60 minutes daily) were more likely to report risky driving behaviour (OR = 1.8). Existing evidence is lacking in studying the direct association of social media with risky driving behaviours. A great deal of literature is limited to texting and driving. However, recently, the cellphone has become the prevailing platform for entertainment and information. Social media apps which are accessible on cell phones are considered to be an important cause of distraction while driving <sup>(298)</sup>. A substantial amount of evidence <sup>(298-303)</sup> has accumulate from studies investigating distracted driving by cellphone (especially texting but not specifically social media) which is beyond the scope of this section. A study on 935 college students (aged 18-62 years, 74% female) investigated Social Learning theoretical factors and cell phone use behind the wheel. They showed that, while driving, 25% and 39% of participants ‘sometimes’ used their cellphone to check their social media (Twitter, Instagram, Snapchat) mostly while moving and stopped, respectively despite the fact that almost all (98%) of respondents agreed or strongly agreed that using a cellphone is risky while driving <sup>(304)</sup>.

Social media presents youth with different behaviours and role-models, even when they are not directly exposed to an environment <sup>(305)</sup>. Exposure to risk content in media affects adolescents' behavior <sup>(306)</sup> but does not affect all youth in the same way. Many adolescents who use social media experience identity formation that may impact the way they perceive and behave <sup>(309)</sup>. Theories, such as social cognitive theory, evolutionary psychology, and identity theory, clarify how social media can change youth's behaviour. Social cognitive theory explains how children adjust their behaviours to match that of others through watching and imitating their behaviours <sup>(308)</sup>.

Evolutionary psychology shows how a behaviour presented and introduced by media can attract a huge audience when found attractive by youth and even when it is a risky behaviour, youth want to emulate the behaviour in order to attract more attention <sup>(309)</sup>. Identity theory explains that a person's self-identity can determine the way they express themselves through their behaviours and the social group(s) they belong to. As such, social media can dictate a specific type of behaviour to youth as the

characteristic behaviour of special social groups they identify with, e.g., road racers<sup>(310)</sup>. Media frequently presents models of risk taking and aggressive behaviours. Social Learning Theory and Cultivation Theory both suggests that the more an adolescent or emerging adult observes people engaging in risky driving behaviors in the media, the more likely they are to be influenced by and emulate that behaviour since they identify with and want to belong to the group portrayed in the media<sup>(311)</sup>. “The primary proposition of cultivation theory states that the more time people spend 'living' in the television world, the more likely they are to believe social reality aligns with reality portrayed on television”<sup>(312)</sup>. A growing body of research has shown that risk-glorifying portrayals in the media have a significant impact on risk taking behaviour<sup>(272,298)</sup>. A study by Havernearam et al., showed that passive media content and passive media exposure (such as watching a social media commercial) have an impact on risky and aggressive driving and normalize violation of traffic laws. Drivers who view positive media messages report lower levels of aggression and risk-taking behaviour. In contrast, the tendency to violate norms increases when being presented with negative media content<sup>(312)</sup>. Therefore, understanding the influence of mass media content upon driver’s behaviour is essential when developing safe driving strategies.

#### **4.3.4 Watching Movie engagement and Driving Behaviour**

The majority of participants in the three driving risk groups scored low on their watching movie engagement levels. The current study found an association between driving behaviour and movie engagement in that participants with a high level of movie high engagement had an increased likelihood of risky driving (OR = 1.5).

There is limited evidence in the literature on the association of movie engagement with risky driving behaviour. Most evidence concerns the influence of the type of movie on behaviour. Chrysalis et al examined the impact of watching movies that depicted dangerous driving on the perception of driving risk and driving behaviors by assessing 1356 college students (aged 17 to 25 years). They found that watching movies depicting dangerous driving resulted in more positive attitudes towards risky driving behaviors<sup>(104)</sup>. Another study on 150 drivers (aged 19 to 26 years) showed a strong correlation between risk driving and media exposure (including movies). The drivers reported a decrease in risky and aggressive driving after viewing positive media content about driving while tending to drive more aggressively and engage in risky driving when presented with a negative media message content<sup>(314)</sup>. There are several reasons why watching movies can influence youth driving

behaviour. The Werther effect states that negative information can lead to increased expression of maladaptive behavior<sup>(304)</sup>. For example, a rise in suicide rate ensues from an increased frequency of exposure to media presenting a suicidal attempt or complete suicide, within a week after the exposure<sup>(315)</sup>. Moreover, according to the General Aggression Model, media exposure has an impact on cognition, emotion, and behavior because of its priming effect (whereby exposure to certain influences subconsciously stimuli a response to a subsequent stimulus), and its capability to provide role models for society, especially youth<sup>(304)</sup>. Normative Social Behaviour theory, Social Cognitive Theory, Evolutionary Psychology, and Identity Theory can all help explain the findings of the present study. Normative Social Behaviour theory posits that youth develop behavioural norms according to the behaviour of people around them (or from media role models) and this, in turn, influences their future behaviour<sup>(40)</sup>. Based on Social Cognitive Theory, youth watch and render others' behaviours and adjust their own behaviours accordingly. Media can present youth with role models for driving behaviour. Movies often portray men as more attractive for women based on their behaviours, including driving. Adolescents who identify with a movie characters may be particularly prone to engage in the same risky behaviour as portrayed by that character. This role modeling can influence a youths' subsequent behaviours according to evolutionary psychology<sup>(316)</sup>. Finally, according to identity theory, each person gives him/herself a personal identity and also belongs to certain groups. Consequently, people try to behave in a way that expresses the group he/she belongs to and the identity he/she gives him/herself. Movies can play an important role in demonstrating how a specific identity or group is expected to behave<sup>(43)</sup>. It remains important to undertake causal research to evaluate the effect of types of movies and duration of watching movies, and the corresponding effect size on risky driving behaviour.

#### **4.3.5 Family-involved activity and Driving Behaviour**

In the current study family engagement was inversely associated with risky driving behaviour. Those who spend less time with families tended to show more risky driving behaviour. However, after adjusting for other factors, family engagement did not have a significant independent influence on driving behaviour. One contextual factor that may have great influence on adolescents is family. The parent-adolescent relationship is particularly important in behavioural science. Parental support of basic psychological needs is essential for positive psychosocial adaptation (i.e., maintaining oneself in harmony with the changing psychosocial circumstances that leads to a sense of well-being)

in children and adolescents (317). Family activities afford an opportunity for parents to connect with their children emotionally, to monitor their social and academic activity and to convey values and expectations (318). Research shows that young drivers, who have strong parental role models with open lines of communication that provide positive feedback about safe driving and convey specific and clear messages/limits about traffic safety, report less risk taking, less aggressive driving and more commitment to safe driving (47). In addition to parental driving style, considerable research has revealed the relationship between parent-child conflict and negative consequences for adolescents. For example, it has been found that conflicts between parents and adolescents are related to antisocial behaviors (319). The parent-adolescent relationship has an important impact on adolescent risk-taking behaviors. The more conflict between parents and adolescents, the riskier taking behaviors adolescents will take in the future (320). Similar to other health-related behaviors, adolescent driving is strongly influenced by parenting styles and models of behavior (90,321).

Wilson et.al have shown in a study in British Columbia, Canada, that parents have substantial influence on their children's driving behaviour. They found that parental driving records from the four years prior to their child's licensure can predict child's driving behaviour in the first three years after licensure (88). Miller et al., studied 130 drivers (age 17-24 years) first in driving class and again after a year of driving. They found that children's driving behaviour is more influenced by their mother's speeding offences than by their father's speeding. In contrast, children (especially sons) are more influenced by their father's angry driving and daughters are more influenced by anxious driving patterns of both parents (90). Ferguson et al., compared driving records of young drivers (18-21 years) with that of their parents. They found that when both parents have collisions, the effect is synergistic and multiplicative on children's risky driving, explained by the fact that these children have no protective influence from either of their parents (47). Moreover, Jafarpour et al. also mentioned in his narrative study that youth become less risky drivers in the presence of their parents, meaning that the presence of parents can influence youth's driving behaviour (15).

Family activities may give youth the opportunity to observe how their parents drive (role-modelling effect) or to drive while in the presence of their parents (controlling effect). Parental role-modeling can be described by Normative Social Behaviour Theory and by Social Cognitive Theory. According to Normative Social Behaviour Theory, parents influence their children by establishing norms, especially through their own behaviours (See background, section 1.2.4). Social Cognitive

Theory explains that behaviour in adolescents and youths is formed through watching how others (e.g., parents) act and adjusting their own behaviour accordingly (See background, section 1.3.2).

The discrepancy in the findings of the current study may be due to the fact that the survey did not enquire about detailed information like time spent in a vehicle with parents. Another possible reason that the current study did not find an independent association between family activities and risky driving could be because it is a cross sectional study reflecting a single point in time, whereas parental role-modeling begins in childhood. Moreover, the parental controlling and monitoring influence may be restricted to the time when parents are present, because peers are the prevailing reference group for adolescents and young people. The current finding also supports the negative influence of friends on driving behaviour (refer to 4.3.6). In other words, since the principal reference group for adolescents and young adults is friends and peers (rather than parents and family), those groups may be expected to exert more influence on driving behaviour in a cross-sectional study of youth. Despite the null finding in this study, it is still important to note the importance of continuous parental role modelling and influence on children's driving behaviours, beginning in childhood (even though parental influence may be reduced in adolescents and young adults). For example, Loubean et al., studied 31 seventh and eighth grade students and demonstrated the importance of parental influence on wearing bicycle helmets <sup>(86)</sup>.

#### **4.3.6 Friend-involved activity and Driving Behaviour**

The question of whether and how peers influence an individual's behaviour has been widely investigated. A large body of evidence suggests that individuals who are physically or socially close to a subject influence his/her behaviour and choices <sup>(322-325)</sup>. In particular, the peers and friends with whom adolescents spend time have a significant role in shaping their risky behaviours <sup>(326-329)</sup>. Peer effects have often been mentioned as a leading explanation for why people engage in risky or unhealthy activities such as smoking <sup>(327)</sup> and drug/alcohol use <sup>(327,328)</sup>. The current study showed that risky driving behaviour in young drivers in Canada was significantly influenced by their friends. Participants who spent time with their friends more than 4 times a week were more likely to report risky driving behaviour than those who spent less time with friends (OR = 1.9). Consistent with these findings, Horvath et al studied 398 participants (17-24 years old) and found that pressure from peers, either direct or indirect, can influence young drivers' behaviours such as speeding. Direct pressure, in this study, referred to distractions, disturbances or even arguments among driver and passengers,

while indirect pressure described the driver's perception of his/her passengers' expectations in terms of driving behaviour <sup>(329)</sup>. McNabb et al., studied the scenario when friends drive to the same destination in separate vehicles with a leader vehicle and some followers. They found that the drivers following engaged in riskier driving behaviours in comparison to their usual driving pattern (e.g., driving faster, ignoring pedestrians, etc.). Of note, the lead vehicle was driving safely and at speed limit and was not exposed to the potentials for risky behaviours. Therefore, the risky driving behaviours in the follower vehicles were not attributed to the social contagion effect <sup>(330)</sup>. An interview-based study (32 interviews) showed that the way friends relate to each other can affect youth driving behaviours. For instance, if friends feel equal and have a sense of responsibility towards each other, their driving becomes less risky. In contrast, when the goal of their relationship is leisure and pleasure, they take more risks when driving <sup>(331)</sup>. Adolescents are highly susceptible to peer influences, where perceived and actual peer behaviors can influence risk behaviors <sup>(332)</sup>. Prior research demonstrates that having friends who engage in risky driving predicts future risky driving for newly licensed adolescent drivers <sup>(17)</sup> and impaired driving among adolescents <sup>(333)</sup>. Further, according to a study of 71 teen-parent groups (teens were 17-19 years old) by Merrikhpour et al., when teens are "hanging around", those who were passengers can distract the driver. They also note that teen drivers tend to believe that his/her peers are more likely to get distracted than himself/herself <sup>(49)</sup>. According to Identity Theory, when children find themselves belonging to a group, they define a specific social identity for themselves which, in turn, influences their behaviour <sup>(334)</sup>. In addition, friends (peers) influence each other, by establishing norms (normative social behaviour theory - section 1.2.4), acting as role models (social cognitive theory - section 1.3.2), and when an adolescent adapts certain behaviour to show their friends that they are "grown-up" (problem behaviour theory - section 1.2.4). Given this theoretical background, the conclusion of the current study, that spending time with friends has a negative influence on driving behaviours, is not surprising. This finding spotlights the role of peers in risky driving behaviour in youth and is worth considering when developing preventive strategies and educational programs.

#### **4.3.7 Alcohol-involved activity and driving behaviour**

In the current study, the frequency of alcohol consumption was low (less than 4 times per week) in all groups of participants. There was a significant association between alcohol consumption and risky driving behaviour in that those with a high frequency of alcohol consumption were more

involved in risky driving behaviour. However, after adjusting for other factors, the current study found that alcohol had no independent effect on driving. A large body of literature demonstrates that alcohol adversely affects driving behaviour (<sup>335-342</sup>), although the effect of overall drinking habits on driving behaviour has received less attention.

Many studies show that alcohol significantly impairs driving skills such as braking, steering, distance calculation, overtaking ability, and choosing an appropriate speed for the conditions. Lane position, line crossing, number of crashes, speed deviation and time at maximum speed are also impaired by alcohol (<sup>337</sup>). Drunk driving increases the risk of serious accidents. Compared to sober drivers, drinking drivers are twice as likely to be involved in traffic crashes, even after consuming relatively small amounts of alcohol (<sup>338</sup>). The latest findings from the Centers for Disease Control and Prevention (CDC, 2016, USA) indicate that a quarter of young adults involved in fatal MVCs had been drinking alcohol (<sup>339</sup>). A systematic review of cohort studies that followed up the general population of 15 to 19 years old for at least three years and assessed the outcomes at aged 20 or above revealed that late adolescent drinking was associated with early adulthood physical and mental health, and social consequences like early death among men, mainly due to motor vehicle crash (<sup>343</sup>). Because of the strong association between alcohol consumption and collision risk, driving after alcohol drinking is forbidden by law in most countries (<sup>344</sup>). Legal strategies such as making drunk driving a criminal offence and laws that make it illegal to drive with blood alcohol content above a certain limit (legal limit) can be effective deterrents of drinking and driving when they are enforced.

Despite laws against drinking before late adolescence, youth might start drinking earlier due to reference group role modeling, intrinsic factors, or coping with underlying mental health issues. Youth with more frequent alcohol use may be inclined to incur more driving violations (<sup>345</sup>). Part of a secondary use of data of a longitudinal birth cohort conducted by MacArthur et al., was to assess the association between the number of drinks consumed during the last 6 months by 15 year old participants and the prevalence and distribution of multiple risk behaviours, i.e. substance use, injuring self, unsafe sexual behaviour, and vehicle-related risk (including *Car passenger risk*, being a passenger and either knowing that the driver had consumed alcohol or the driver did not have a licence to drive without supervision; *Scooter risk*, riding a motorbike or scooter off road or without a license on a public road; and cycling without a helmet) once the participants reached the age of 16 years, in 5067 young participants. MacArthur et al., found that greater alcohol consumption at age 15 was significantly associated with higher prevalence of engagement in vehicle related risk, except

cycling without a helmet. <sup>(346)</sup>. A large study of young Australians (15 to 21 years) found that regular drinking was consistently associated with a range of other health risk behaviours including injuries under the influence of alcohol, tobacco smoking in higher doses, cannabis use and sexual risk-taking <sup>(347)</sup>.

In contrast to previous research, the current study did not find that frequent alcohol use was an independent risk factor for risky driving behaviour. The failure to find association may be due to the narrow range in the frequency of alcohol consumption among the study participants (i.e., lack of power to detect a true difference) or the cut-off values in the survey for low and high engagement was not accurate.

#### **4.3.8 Drug-involved activity and driving behaviour**

In terms of drug engagement, 30.2% participants in the current study used recreational drugs (mostly marijuana) at least once a week and up to 5 times a week, which is concerning. Most participants (91.4%) consumed drugs three times a week or less. The current study found a significant independent effect of drug engagement on risky driving behaviour. Those with high engagement in drug-involved activities were 2.2 times more likely to be risky drivers.

The association between risky driving and the pattern of recreational drug use in daily life has not been as widely studied as the acute effect of drugs on driving performance. In particular, the frequency of risky driving behaviours in youth with different patterns of drug use is poorly studied. The findings of the current study are consistent with a previous study by Bina et al., who evaluated the association between risky driving and lifestyle in 645 Italian adolescents (aged 14-17 years). They found that those who reported risky driving practices were more likely to also report a lifestyle characterized by tobacco smoking and drug involvement <sup>(125)</sup>. Similarly, a nationally representative telephone survey of 900 young drivers (age 14-22 years) from the United States, (found that those who used marijuana in the last 30 days had 36% greater odds of involvement in risky driving behaviours leading to crashes <sup>(348)</sup>).

Given the risks associated with substance use and driving, there is a pressing need to understand young people's views about these behaviours. Theories of reasoned action and planned behaviour <sup>(40)</sup> emphasize attitudes and perceived norms as predictors of engagement in health-related behaviour. In line with these frameworks, research has demonstrated that individuals who perceive drug use as more dangerous and as increasing the level of crash risk are less likely to drive after drug use, whereas

users who believe their driving ability is not impaired by drug use are more likely to drive frequently after using the drug <sup>(349)</sup>. Drug use among youth has been a major issue for decades and the issue of marijuana use among youth in Canada, and the impact of cannabis on road safety, is particularly important given its recent legalization <sup>(350)</sup>. Discouraging drugged driving, particularly after the marijuana legalization, remains a public health priority especially for young adults. Successful education and translation of this knowledge to young people, families and schools is a key strategy to raise awareness, which may result in decreased vehicle crashes among younger drivers. Public education pertaining to the use of cannabis and driving must be based upon current research in order for it to be effective and relevant. The current findings, along with the other evidence, lend support to concerns of a significant adverse influence of drug related activities on risky driving behaviours and of the social norms that may send falsely positive messages regarding the safety of driving after consuming marijuana.

#### **4.3.9 Art and driving behaviour**

In this study, the majority of drivers from all risk groups scored low for art engagement as a leisure activity, although low risk drivers were more engaged in art than high risk drivers (20.5% and 12% respectively). After adjusting for other factors there was no independent effect of art on driving behaviour.

No study on the relation between art engagement and risky driving behaviour was found to date. However, there are studies on the association of art engagement and alcohol consumption or other risky behaviours. Elpus et al., found that studying art can decrease risk of suspension from school, decrease alcohol and marijuana use, and make children more optimistic <sup>(351)</sup>. Moreover, McCamy et al. (2014) reported on a preventative program teaching art to children and teens (9-16 years old) that was associated with decreased risk taking behaviours (such as biking without helmet) <sup>(352)</sup>. Another study suggested that pro-social art decreased risky and antisocial behaviour in at-risk children (students with risk factors such as a low socioeconomic status, living with a dysfunctional family, experiencing language barriers, living in a disadvantaged neighborhood or struggling in school) <sup>(353)</sup>. These protective effects of art may be because young people who engage in art activities may be better able to control their violence and impulsivity. For instance, the Ministry of Children, Community and Social Services of Ontario, Canada states that participating in art can decrease aggressive behaviours and violence <sup>(354)</sup>.

The current findings are novel as no previous study examined the effect of engagement in art activities on driving behaviour. However, this finding would not obviate a more robust research to evaluate specifically the effect of art activities on risky driving behaviour.

#### **4.3.10 Reading/Writing and driving behaviour**

The majority of participants in the current study had low levels of engagement in reading/writing but reading/writing had a significant independent protective effect on risky driving behaviour. Drivers with high engagement in reading/writing had 38% lower odds of being risky drivers than those with lower engagement (OR = 0.62). No previous study that specifically investigated the relation between risky driving and reading or writing activity found any evidence to link them. However, other beneficial effects of reading and writing are demonstrated in the literature <sup>(356-358)</sup>. Reading for pleasure and writing in a journal can have a positive impact on health and well-being. Reading for pleasure lowers stress and reduces depression. A survey-based study found that people who read for pleasure (but not necessarily people who read for school or work purposes) had fewer feelings of stress than non-readers. People who read for pleasure found the relaxing effects of enjoying a good book were greater than if they watched television, flipped through social media feeds, or read other types of material, such as newspapers or textbooks. A growing body of research indicates that reading changes the mind and the brain connections <sup>(356)</sup>.

In 2009, a group of researchers measured the effects of yoga, humor, and reading on the stress levels of students in demanding health science programs in the United States. The study found that 30 minutes of reading lowered blood pressure, heart rate, and feelings of psychological distress just as effectively as yoga and humor did <sup>(357)</sup>.

According to Riordan and Wilson, bibliotherapy is “the guided reading of written materials to gain understanding or to solve problems relevant to a person’s therapeutic needs.” The phenomenon of bibliotherapy (from the Greek words: books and therapy) was coined by Samuel Crothers in 1916 when he recognized the therapeutic benefits of literature. As an adjunct to psychotherapy, bibliotherapy allows people reading or listening to stories to identify with the significant characters. Readers may experience an emotional catharsis as the characters in the story express themselves. Other benefits of bibliotherapy include instilling moral values, shaping behavior, improving and enabling the growth of critical thinking skills, and overall strengthening of personal character <sup>(359)</sup>. There is evidence that reading can also decrease anxiety. Olsen et al., point out that bibliotherapy can

be employed by nearly every helping profession, with almost every age group and population <sup>(360)</sup>. However, it is noteworthy that the content of reading matters. Stevens et al., studied 134 undergraduate students and found that reading violent stories significantly increased aggressive thoughts <sup>(361)</sup>.

Writing, particularly expressive writing, can also have a positive effect on mental health. Pennebaker and Beall's seminal study demonstrated that writing about a stressful experience improves indicators of physical health <sup>(352)</sup>. A meta-analysis evaluating more than 400 studies that tested the effects of expressive writing on various outcomes in different populations identified a beneficial effect on physical, psychological and overall functioning outcomes including work-related outcomes, social relationships, cognitive functioning, and school performance <sup>(363)</sup>.

In summary, the current finding is novel in terms of showing the influence of reading and writing activities on driving behaviour. Plausible reasons for a protective effect of reading and writing on risky driving behaviour may be explained through its ability to reduce stress and anxiety, improve mental well-being, and to shape social values and behaviours. This reasoning might suggest that other creative leisure activities, like art, should also have an effect on driving behaviour. The reason the current study found a significant effect for reading/writing but not for art engagement (previous section) might be because of the relatively small amount of time attributed to art engagement in the study group, or the fact that leisure activities may influence behaviour to different extents during different eras of life.

#### **4.3.11 Volunteering and Driving Behaviour**

As with reading/writing, the majority of participants in this study had low engagement in volunteering activities. Volunteering was found to be an independent protective factor against risky driving behaviour. Participants who were highly engaged in volunteering activities were less likely to report risky driving behaviour (OR = 0.60).

No research was uncovered on the relationship between volunteering and driving behaviour. Existing studies focused on other risky behaviours. Pro-social activities such as donating to charity or volunteering service to the community may act as protective factors against risky behaviors <sup>(364)</sup>. A review of literature found evidence that prosocial activities such as volunteering decrease alcohol and substance use <sup>(71,365)</sup>, illegal behaviour and crime involvement <sup>(366)</sup>, and improve social behaviour <sup>(367)</sup>. A longitudinal study surveyed 531 rural teens in grades 10-12, and again in early adulthood

and found that rural teens who volunteered frequently and helped others were less likely to engage in substance use in young adulthood<sup>(368)</sup>. The National Longitudinal Study of Adolescent to Adult Health recruited grade 7–12 students in 1994–1995 (n = 20,745) and followed up with them in 2001–2002 (n = 14,322) and in 2008–2009 (n = 12,288). In 2000–2001, participants were retrospectively asked about their volunteering experience from 12 to 18 years of age. Non-volunteers, Self-volunteers, Adult-required volunteers, and Court-ordered volunteers were compared for rates of illegal behavior, arrest, and convictions in adulthood (>18 years of age). The study found that relative to non-volunteers, self-volunteers reported 11% fewer illegal behaviors, 31% fewer arrests, and 39% fewer convictions by age 18–28 years, and 28% fewer illegal behaviors, 53% fewer arrests, and 36% fewer convictions by age 24–34<sup>(367)</sup>.

The altruistic nature of volunteering prompts adolescents to feel compassion for people and society which translates into them avoiding risky behaviour which could harm other people or themselves<sup>(369)</sup>. Social control theory describes the possible reason for this beneficial effect of volunteering. Based on this theory, there is a bond between children and conventional societal institutions (including schools, churches and volunteering groups). When this bond weakens, the probability of problematic behaviours in children increases<sup>(370)</sup>. Moreover, when children volunteer, they give themselves a social identity of belonging to a community that cares about others. This social identity can form their future behaviour<sup>(371)</sup>, like driving. What is more, volunteering provides children with an opportunity to observe prosocial adult behaviour and learn to adjust their own behaviour accordingly or even adapt prosocial norms from the adults. These effects are described by social cognitive theory and normative social behaviour theory respectively<sup>(365)</sup>. The current finding, of a beneficial effect of volunteering on driving behaviour, is new and extends previous research on the protective influence of volunteering on risky behaviour.

#### **4.3.12 Music and Driving Behaviour**

Low engagement in music leisure activities was reported by the majority of participants in this study. There was an association between music engagement and driving behaviour, however after adjusting for other factors, no significant, independent effect was detected.

Previous literature on the association of music and driving mainly concerns a music genre or the influence of listening to music while driving. Brodsky et al., studied the influence of different genres of music on driving behaviour in 85 novice drivers (17-18 years) and found that listening to music

with hostile or violent content prompted drivers to increase cruising speeds and spend a higher percentage of time exceeding speed limits. Listening to “energetic music was associated with decreased lateral control, increased excursions from the lane, and an increased tendency to stray onto the shoulder” (372). Greitemeyer et al., studied 103 students aged 18-20 years and reported that male drivers who preferred heavy metal music in general were more prone to reckless behaviour such as not fastening their seat belt, driving fast and risky driving. Conversely drivers who preferred music with prosocial lyrics had less risky driving than those who listened to neutral songs (103).

Although people with high engagement in music-related activity might end up listening to music while driving (373, 376), no study on the association between general level of engagement in music and risky driving behaviour was found. The findings of the current study may be because music engagement as a lifestyle variable was investigated and not the setting, such as in-vehicle music.

#### **4.3.13 TV and driving behaviour**

In this study, level of television engagement was low among all participants and there was no association between television engagement and driving behaviour. To the best of our knowledge, there is no research on the relationship between driving behaviour and time spent watching television. However, some associations between television viewing and other risky behaviours have been shown in the literature (377-381). Zilka et al stated that the influence television viewing (alone or with friends) on behavioural reactions is mediated by identification with the TV characters. TV programs with violent-behaviour can prompt adolescents to demonstrate negative and violent reactions (381). Possible reasons for these effects are well explained by normative social behaviour theory: television characters can establish behavioural norms for children, including driving behaviour norms (382). Further, according to social cognitive theory, children who watch TV characters will adjust their own behaviours to model the behaviour of the TV characters (383). Finally, Evolutionary Psychology explains that children who watch TV learn what specific behaviours are attractive for each gender and they adapt these behaviours and express them as their own (384).

There is an interaction between television viewing and personality traits. Weaver et al studied 119 undergraduate students and found that personality trait and media preferences have a strong relationship. Those who scored high for neuroticism preferring information/news and dramatic TV programs, whereas those who scored high for extroversion preferred comedy and adventure movies (385). However, as noted above, there is no research on the overall level of engagement in TV viewing

and risky driving. The current study failed to show any significant association between the level of engagement in watching TV and risky driving behaviours.

### **Leisure activities Summary**

Based on psychosocial theories, many types of leisure activities can influence driving behaviour through role modeling, peer effect, a changing of the subjective norm, establishing a social identity, and improving mental health (by offering an outlet for stress, anxiety, and aggression). However, the current finding revealed that few leisure activities independently affected risky driving behaviour. There are several plausible reasons why different leisure activities which could potentially affect driving behaviors according to psychosocial theories, appear to exert a varying influence on driving behaviours. In this study, some leisure activities were more prevalent than others and the effect of more common leisure activities may significantly outweigh the dominant effects of other less common activities. Different leisure activities may have different effects on driving behaviour because of the differences in the nature of the activities and their depth and strength of influence on perception, attitude, values, and motivation of youth. Further, as noted previously, this study was conducted during the school year which likely restricted leisure time, potentially reducing the influence of leisure activity on driving behaviour. A more robust design, such as a longitudinal study (cohort) or experimental (intervention) design which can monitor participants since early childhood to young adult would provide more insight on these relationships. This proposed study can adopt an overarching approach considering leisure activity, factors related to family, peers, and society, long term personality traits, and risky driving behaviour at different ages.

## **5. Conclusion**

Road trauma is a significant public health issue as well as a burden to the Canadian health system. Driver behaviour is one of the main contributors to road trauma. An in-depth exploration of factors related to negative driving behaviours is helpful to inform effective countermeasures. This thesis investigated the association between leisure activity and risky driving behaviour and expanded our knowledge of the determinants of risky driving among young people in Canada.

The results suggest that risky driving behaviours in young people are common and perhaps more importantly, a substantial minority of young people admit to high risk behaviours such as street racing and running red lights. The presence of these risky driving behaviours clearly suggests the

need for continued driver education, persuasion and law enforcement to minimize the frequency of such behaviours

The current study of adolescents and young adults showed that many sociodemographic factors (gender, age, living status, educational status, duration of driving independently, driver car status, employment status, driving exposure, driving license class) had a statistically significant association with driving behaviour.

Among leisure activities, sport engagement and TV viewing were not associated with driving behaviour, while other leisure activities, such as music, playing video games, social media, watching movies, family activities, spending time with friend, drug involvement activity, alcohol involvement activity, and volunteering were associated with driving behaviour.

Despite its limitations (mentioned in next section), the current study provides interesting results concerning sociodemographics, leisure activity, personality traits, and risky driving. These findings have both theoretical and practical implications. They confirm the important influence of lifestyle on risky driving in a young population. Moreover, this study showed that risky driving is associated with different personality traits. It is hoped that the key findings of this thesis may provide other researchers, road transport planners, decision makers, regulators, and organizations data for developing future research and road safety strategies.

## **5.1 Limitations**

The present study has some methodological limitations that should be considered. As a cross-sectional study, this study revealed associations but not a causal relationship between the outcome and predictors, i.e., the associations identified may be difficult to interpret. Thus, this study represents a step forward which could prompt researchers to design research that would allow for causal inference.

The participants for this survey may not be representative of the general population of young drivers. That is, this study may have a selection bias due to the web-based recruitment approach (using Facebook) and the fact that the survey was only available in English. Moreover, only those who use Facebook and Instagram and were interested in the topic likely participated (i.e., sampling bias). The Facebook approach was opted by the YAC in order to provide a larger catchment area. To minimize the “field of interest” selection bias that can occur with web-based research, the Facebook link was disseminated to all young people living in Canada without filtering against their field of

interest. However, this approach was not entirely successful as social media advertisements filters can also be set by the “end-user” according to their field of interest. To mitigate the effect of sampling bias and improve the response rate, we deployed our survey through social media (Facebook and Instagram), and attached the link of the survey to a video advertisement that was developed in consultation with our youth advisory committee to attract youths’ attention. Note that the content of the video was scripted in a way to mitigate the possible effect of video on participants’ responses. That effect was likely to be minor according to the youth advisory committee’s opinion.

Other potential types of bias in this study include non-response bias, which is introduced when respondents differ from non-respondents, and “under-coverage bias”, which occurs when some members of the population are under-represented in the survey making the results less generalizable and potentially resulting in higher variance for some subgroup estimates because of small sample size<sup>(386,387)</sup>. To avoid non-response bias, YAC members were engaged to make the study more acceptable to the target group; the survey was posted on Facebook/Instagram for three months and there were frequent reminders; and YAC members disseminated the advertisement through other social media pages. Moreover, an incentive was provided for participation which, in turn, may have resulted in a large sample size. The large sample size, in turn, may have lessened the possibility of there being a significant difference between those who responded and who did not.

Reporting bias is another limitation of this study. This study is survey-based and participant responses to the questions may not necessarily reflect their true actions (e.g., driving behaviour, amount of driving, type of leisure, personality). Thus, this study suffers from the commonly reported limitations associated with measures of behaviours based upon self-reporting. Social desirability may cause unreliable responses. This bias was minimized by using an anonymous survey and reassuring participants about confidentiality in the cover letter of the survey. To diminish the effect of recall bias and misclassification, participants were asked to recall their average experience (e.g., average hours of driving in a week, average leisure activities engagement in a week) in the past three months prior to participation.

There was the possibility that survey fraud, multiple submissions by participants, could skew the results. Survey fraud could occur if respondents completed the survey merely for the sake of getting the incentive, not with a desire to contribute to the study. In this case, they may not answer honestly nor accurately. The UBC survey approved tool (REDCap) provided privacy and confidentiality but could not restrict responses from the same IP address. The monetary incentive for

completing the survey was relatively small (a chance at a gift card of \$10) and I believe that multiple responses by the same participant occurred infrequently. Moreover, participants had to provide an email address for the incentive that would tend to limit multiple submission by the same person unless they had several different email addresses. There were no repeat email addresses. The large sample size achieved would also attenuate the possible effect of survey fraud.

Abandonment, an issue with lengthy surveys such as this one, may cause lower response rate. To mitigate this effect, the survey was also designed to be “mobile-compatible” and user friendly with the scaling row frozen while scrolling down to diminish frustration when required to move up and down to be reminded of scaling options. Therefore, tapping to answer the question and scrolling down were all the actions required. Moreover, to mitigate the abandonment bias, the questions and instruments in the survey followed general survey design guidelines such that non-threatening questions (sociodemographics and leisure activities) were first (“warm-up”), followed by the risky driving behaviour questionnaire, which was the most interesting but also the most sensitive section according to YAC’s opinion (as “Peak”), and then personality trait (as “Cool down”).

Satisficing bias occurs when respondents select answer options without much thought, using the least mental activity, in order to satisfy the question requirements, rather than reflecting on answers that best represent their opinion (<sup>388</sup>). To minimize satisficing bias, the survey was made as short as possible by employing accurate and reliable short forms of questionnaires for personality trait (Mini-IPIP), driving behaviour, and socioeconomic status. Moreover, the survey was designed to have a compelling and appealing interface to engage the participants.

Given that we did not test sensitivity analysis, the selection of cut off points for categories in Leisure Activity questionnaire may limit the accurate interpretation of the result. However, the Leisure Activity questionnaire and cut-off points were validated by pilot test prior to the deployment.

## **5.2 Implications**

### **Youth and Parents**

Potential interventions to prevent risky driving behavior in youth can target the driving behavior directly or target one or more of the factors that influence the driving behavior. Non-modifiable factors should not be the target of interventions but can be used to guide and inform interventions to prevent youthful risky driving. Most demographic factors are not possible to change, but they could be considered in decisions about readiness to drive independently. Personality is not

usually considered to be modifiable but is another factor that could be considered by parents when making decisions about their teens' readiness to drive independently.

Risk perception can be changed, thus providing opportunities for intervention. Several things could be done to target young people's perceptions about driving, gleaned from the environment in which they find themselves. Parents could be taught the importance of setting a good driving example and being good role models themselves. Parents can also be taught / encouraged to become more involved with their teens' driving and to set realistic and effective restrictions on their novice teen drivers to enhance their safety.

### **Other stakeholders**

Other stakeholders like schoolboards, policymakers, prevention units, media, vehicle manufacturers/dealers, community groups and safety campaigns organization can also be alerted, educated and become involved. Creative programs that provide opportunities for youth to engage in leisure activities beneficial to driving behaviour are also needed. Incorporating in school curriculums and partnering with other society resources to facilitate and provide incentive (as external motivation) may help to encourage the beneficial leisure activities like reading and writing. Programs can also engage peers and partners to promote safer driving by young people. Public sectors and funding agencies can take on public education and provide grants and financial resource to support the program and research. The media, both advertising and entertainment, could provide good avenues for interventions, since a high level of engagement was observed in target group. Social media platforms can be used as outlets to promote safe driving behaviour.

Public awareness campaigns are major sources of information and should be effectively used to deliver road safety messages and promote the short and long-term benefits of compliance with traffic laws in improving road safety. The communication messages should be tailored to consider cultural and social factors in order to achieve higher success.

### **5.3 Future Research**

Future research can investigate leisure activities in greater detail and adopt more robust designs like cohort (longitudinal) or experimental. Accordingly, the effect magnitude of each leisure activity can be evaluated more accurately. The leisure activities with the higher magnitude of effect (higher odds ratio) in the current study can be placed on top of the priority list. Experimental research

can include a variety of interventions, such as educational sessions, youth clubs, public health measures, engaging parents and stakeholders like campaigns and examined the corresponding effects. Another research project can be validation of the current model and, afterwards, apply to driving licensure to identify potential high-risk drivers. Accordingly, the public authority and insurance companies can provide some recommendation to high risk drivers and their families.

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# Appendix A

**Table A.1 Distribution of driving license classes in driving behaviour categories \***

Variables	Group			All participants n=964
	Low Risk** n=200	Moderate Risk** n=312	High Risk** n=452	
<b>DL (AB)</b>				
Class 7 (Learner)	12 (41.1%)	5 (6.5%)	4 (3.3%)	26 (8.4%)
Class 5 (GDL)	14 (48.3%)	63 (81.8%)	92 (76%)	228 (73.8%)
Class 5 (Full)*	2 (6.9%)	5 (6.5%)	23 (19%)	45 (14.6%)
Other	1 (3.4%)	4 (6.2%)	2 (1.7%)	10 (3.2%)
<b>DL (BC)</b>				
Class 7 (Learner)	42 (71.2%)	13 (15.7%)	3 (2.6%)	77 (21.8%)
Class 7 (Novice)	14 (23.7%)	44 (53%)	78 (66.7%)	191 (54.1%)
Class 5 (Full)*	3 (5.1%)	24 (28.9%)	31 (26.5%)	77 (21.8%)
Other	0	2 (2.4%)	5 (4.3%)	8 (2.3%)
<b>DL (NB)</b>				
Class 7 (Level 1)	2 (66.7%)	1 (12.5%)	5 (45.5%)	4 (13.3%)
Class 7 (Level 2)	1 (33.3%)	3 (37.5%)	0	13 (43.3%)
Class 5 (Full)*	0	4 (50%)	6 (54.5%)	12 (40%)
Other	0	0	0	1 (3.3%)
<b>DL (NF)</b>				
Class 5 (Level1)	1 (50%)	0	6 (46.2%)	3 (12%)
Class 5 (Level2)	0	0	0	7 (28%)
Class 5 (Full)*	1 (50%)	3 (100%)	7 (53.8%)	15 (60%)
<b>DL (NT)</b>				
Class 5 (Full)*	0	0	1 (100%)	1 (100%)
<b>DL (MB)</b>				
Class 5 L (Learner)	2 (22.2%)	4 (21.1%)	0	8 (13.3%)
Class 5 I (Intermediate)	5 (55.6%)	9 (47.4%)	12 (63.2%)	36 (60%)
Class 5 (Full)*	2 (22.2%)	4 (21.1%)	7 (36.8%)	14 (23.3%)
Other	0	2 (10.5%)	0	2 (3.3%)
<b>DL (NS)</b>				
Class 7 (Learner)	1 (9.1%)	0	1 (5.6%)	5 (8.8%)
Class 5 N	7 (63.6%)	9 (75%)	6 (33.3%)	29 (50.9%)
Class 5 R	1 (9.1%)	1 (8.3%)	6 (33.3%)	11 (19.3%)
Class 5 (Full)*	1 (9.1%)	2 (16.7%)	3 (16.7%)	9 (15.8%)
Other	1 (9.1%)	0	2 (11.1%)	3 (5.3%)
<b>DL (ON)</b>				
G1 (Learner's Permit)	55 (57.9%)	14 (13.9%)	13 (8.7%)	116 (23.1%)
G2 (Probationary license)	29 (30.5%)	54 (53.5%)	64 (43%)	221 (44%)
G (Full License) *	8 (8.4%)	32 (31.7%)	69 (46.3%)	157 (31.3%)
Other	3 (3.2%)	1 (1%)	3 (2%)	8 (1.6%)
<b>DL (NU)</b>				
Class 5 (Full)*	0	0	0	1 (100%)
<b>DL (PE)</b>				
Class 5G (Stage 2)	0	1 (50%)	2 (40%)	4 (44.4%)
Class 5G (Stage 3)	0	0	3 (60%)	1 (11.1%)
Class 5 (Full) *	0	1 (50%)	0	4 (44.4%)
<b>DL (QC)</b>				
Class 5 (Learner stage)	2 (50%)	1 (12.5%)	0	3 (9.7%)
Class 5 (Probationary)	1 (25%)	4 (50%)	7 (63.6%)	14 (45.2%)
Class 5 (Full) *	1 (25%)	3 (37.5%)	3 (27.3%)	13 (41.9%)
Other	0	0	1 (9.1%)	1 (3.2%)
<b>DL (SK)</b>				
Class 7 (Learner)	3 (23.1%)	2 (7.4%)	0	6 (6.5%)
Class 7 (Novice 1)	1 (7.7%)	3 (11.1%)	5 (13.9%)	13 (14.1%)
Class 7 (Novice 2)	4 (30.8%)	11 (40.7%)	11 (30.6%)	29 (31.5%)
Class 5 (Full) *	5 (38.5%)	10 (37%)	19 (52.8%)	42 (45.7%)
Other	0	1 (3.7%)	1 (2.8%)	2 (2.2%)
<b>DL (YT)</b>				
Class 5- Full *	0	0	1 (100%)	3 (75%)
Other	0	1 (100%)	0	1 (25%)
<b>Total time of driving (hours per week)</b>	4.50±9.88	9.79±16.42	16.75±31.41	12.53±24.35

\* Class 5 (Full) license is known as a license without restriction, while other classes are licenses with restrictions.

\*\* Total number in our sample: Low risk (n=200), Mod risk (n=312), high risk (n=452); however, in this table, numbers in the respective columns are specific for each province

\*\*\* All participant in our sample (n=964); however, in this table, this column shows the total number of participants in each province.

**Table A.2 Leisure activity subtypes \***

Variable	Subtypes	
Video game type	-Racing games (e.g. Need for Speed™) -Action games (e.g. First-person shooter, GTA™) -Adventure (e.g. Fable™) -Simulation games (e.g. Sims™)	-Strategy (e.g. Strong Hold™) -Sports (e.g. FIFA™) -Other
Sport type	-Collision (hockey, football, martial arts, etc.) -Contact (soccer, basketball, etc.)	-Limited contact (baseball, volleyball, etc.) -No contact (fitness, table tennis, etc.)
Social media type	-YouTube -Facebook -Twitter	-Snapchat -Instagram -Other (Reddit, WhatsApp, LinkedIn, Pinterest, etc.)
Movie type	-Action, Adventure -Horror, Thriller, Mystery -Romance, Drama, Musical -Fantasy, Sci-Fi, Animation	-Comedy -Biography, Documentary, History -Other
Family activity type	-Entertainment (e.g. concerts, games) -Physical recreation (e.g. hiking) -Social events (e.g. parties)	-Spiritual activities (e.g. going to church) -Indoor (e.g. family gathering)
Friend activity type	-Entertainment (e.g. movies, games) -Physical activity (e.g. Sports) -Social activity (e.g. parties)	-Spiritual activity (e.g. going to church) -Unstructured activity (e.g. Hanging out)
Alcohol type	-Wine -Beer, coolers, mixed drinks	-Soft liquor (Under 20% alcohol) -Hard liquor (Greater than or equal to 20% alcohol)
Drug type	-Marijuana (weed, pot) -Opioid (Heroin, Fentanyl) -Stimulants (cocaine, crack, crystal, meth)	-Psychedelics (hallucinogens e.g. LSD, mushroom) -Prescription drugs (other than as prescribed) -Other
Art type	-Visual arts (e.g. drawing, photography, architecture) -Performing arts (e.g. Music, Dancing, Theatre) -Crafting arts (e.g. Pottery, Sculpture)	- Applied arts (e.g. Fashion/interior designing) - Other
Writing type	-Fiction (romance, mystery, sci-) -Non-fiction (poetry, history) -Articles/news	-Philosophy (religion, self-help) -Other
Volunteering type	-Health (e.g. hospitals) -Art and culture (e.g. art galleries) -Sport and recreation (e.g. swimming pools) -Education and research (e.g. school programs)	-Community and social services (e.g. community centers) -Religion (e.g. places of worship) -Other
Music type	-Classical -Pop, Rock, Alternative, Heavy metal -Jazz, Blues	-Traditional, Country, Folk, Ethnic -Rap, Electronic -Other
TV type	-Animation, Cartoon, Sci-Fi -Comedy, Stand-up comedy, Sitcom, Prank -Documentary, Surviving show, Reality show -Sport, Game, Quiz show -News, Talk-show	-Action, Adventure -Horror, Thriller, Mystery -Romance, Drama, Musical -Other or Combined

\*The participants were asked about their first, second and third choices of each leisure activity subtypes

**Table A.3 Distribution of study population according to Leisure activity (Sub type)**

Variables	Group			P-value*	All participants (n=964)
	Low Risk (n= 200)	Moderate Risk (n= 312)	High Risk (n= 452)		
<b>Video game engagement level</b>					
Low	171 (85.5%)	244 (78.2%)	383 (84.7%)	0.0329	798 (82.8%)
High	29 (14.5%)	68 (21.8%)	69 (15.3%)		166 (17.2%)
<b>Video game genre**</b>					
Racing	12 (10.0%)	22 (11.0%)	57 (18.2%)		91 (14.4%)
Action	49 (40.8%)	99 (49.5%)	169 (54%)		317 (50.1%)
Adventure	18 (15.0%)	24 (12.0%)	20 (6.4%)		62 (9.8%)
Simulation	16 (13.3%)	23 (11.5%)	32 (10.2%)		71 (11.2%)
Strategy	19 (15.8%)	22 (11.0%)	21 (6.7%)		62 (9.8%)
Sports	5 (4.2%)	10 (5%)	11 (3.5%)		26 (4.1%)
Other	1 (0.8%)	0 (0.0%)	3 (1.0%)		4 (0.6%)
<b>Sport engagement level</b>					
Low	140 (70.0%)	210 (67.3%)	311 (68.8%)	0.8057	661 (68.6%)
High	60 (30.0%)	102 (32.7%)	141 (31.2%)		303 (31.4%)
<b>Type of sports**</b>					
Collision	15 (11.2%)	57 (27.9%)	100 (32.9%)		172 (26.8%)
Contact	29 (21.6%)	44 (21.6%)	48 (15.8%)		121 (18.8%)
Limited contact	24 (17.9%)	25 (12.3%)	41 (13.5%)		90 (14.0%)
No contact	66 (49.3%)	78 (38.2%)	115 (37.8%)		259 (40.4%)
<b>Social media engagement level</b>					
Low	64 (32.0%)	98 (31.4%)	106 (23.5%)	0.0179	268 (27.8%)
High	136 (68.0%)	214 (68.6%)	346 (76.5%)		696 (72.2%)
<b>Social Media Platform**</b>					
YouTube	37 (18.5%)	78 (25.1%)	97 (21.6%)		212 (22.1%)
Facebook	23 (11.5%)	58 (18.6%)	81 (18%)		162 (16.9%)
Twitter	3 (1.5%)	2 (0.6%)	9 (2.0%)		14 (1.5%)
Snapchat	57 (28.5%)	72 (23.2%)	142 (31.6%)		271 (28.2%)
Instagram	68 (34.0%)	85 (27.3%)	101 (22.4%)		254 (26.4%)
Other	12 (6.0%)	16 (5.1%)	20 (4.4%)		48 (4.9%)
<b>Movie engagement level</b>					
Low	186 (93%)	267 (85.6%)	383 (84.7%)	0.0126	836 (86.7%)
High	14 (7%)	45 (14.4%)	69 (15.3%)		128 (13.3%)
<b>Movie genre**</b>					
Action, Adventure	54 (32.0%)	111 (39.4%)	159 (41.0%)		324 (38.6%)
Horror, Thriller, Mystery	17 (10.1%)	30 (10.6%)	37 (9.5%)		84 (10.0%)
Romance, Drama, Musical	27 (16.0%)	35 (12.4%)	42 (10.8%)		104 (12.4%)
Fantasy, Sci-Fi, Animation	17 (10.1%)	34 (12.1%)	22 (5.7%)		73 (8.7%)
Comedy	39 (23.1%)	58 (20.6%)	101 (26.0%)		198 (23.6%)
Biography, Documentary, History	10 (5.9%)	12 (4.3%)	26 (6.7%)		48 (5.7%)
Other	5 (3.0%)	2 (0.7%)	1 (0.3%)		8 (1.0%)
<b>Family engagement level***</b>					
Low	159 (79.5%)	289 (84.4%)	396 (87.6%)	0.0275	820 (85.1%)
High	41 (20.5%)	52 (15.2%)	56 (12.4%)		144 (14.9%)
<b>Family event**</b>					
Entertainment	56 (32.7%)	84 (32.4%)	125 (35.6%)		265 (33.9%)
Physical recreation	22 (12.9%)	34 (13.1%)	36 (10.3%)		92 (11.8%)
Social events	14 (8.2%)	44 (17%)	72 (20.5%)		130 (16.6%)
Spiritual activities	15 (8.8%)	16 (6.2%)	18 (5.1%)		49 (6.3%)
Indoor activities	64 (37.4%)	81 (31.3%)	100 (28.5%)		245 (31.4%)
<b>Friends engagement level****</b>					
Low	150 (75.0%)	228 (73.1%)	241 (53.3%)	<0.0001	619 (64.2%)
High	50 (25.0%)	84 (26.9)	211 (46.7%)		345 (35.8%)
<b>Friends event**</b>					
Entertainment	38 (20.8%)	45 (15.3%)	80 (18.3%)		163 (17.9%)
Physical recreation	16 (8.7%)	41 (13.9%)	52 (11.9%)		109 (11.9%)
Social events	22 (12.0%)	59 (20.1%)	99 (22.7%)		180 (19.7%)
Spiritual activities	4 (2.2%)	6 (2.0%)	0 (0.0%)		10 (1.1%)
Unstructured activities	103 (56.3%)	143 (48.6%)	205 (47.0%)		451 (49.4%)

<b>Alcohol engagement level</b>					
Low	198 (99.0%)	303 (97.1%)	416 (92.0%)	<0.0001	917 (95.1%)
High	2(1.0%)	9 (2.9%)	36 (8.0%)		47 (4.9%)
<b>Type of alcohol drinks**</b>					
Wine	8 (8.9%)	18 (9.3%)	15 (4.1%)		41 (6.3%)
Bear, coolers, mixed drinks	46 (51.1%)	115 (59.3%)	212 (57.9%)		373 (57.4%)
Soft liquor	14 (15.6%)	8 (4.1%)	15 (4.1%)		37 (5.7%)
Hard liquor	22 (24.4%)	53 (27.3%)	124 (33.9%)		199 (30.6%)
<b>Drug engagement level</b>					
Low	195 (97.5%)	294 (97.1%)	380 (84.1%)	<0.0001	869 (90.1%)
High	5 (2.5%)	18 (2.9%)	72 (15.9%)		95 (9.9%)
<b>Type of drug**</b>					
Marijuana	28 (93.3%)	65 (97%)	173 (89.2%)		266 (91.4%)
Stimulants	2 (6.7%)	0 (0.0%)	11 (5.7%)		13 (4.5%)
Psychedelics	0 (0.0%)	1 (1.5%)	4 (2.1%)		5 (1.7%)
Prescription	0 (0.0%)	1 (1.5%)	6 (3.1%)		7 (2.4%)
Other	0 (0.0%)	0 (0.0%)	0 (0.0%)		0 (0.0%)
<b>Art engagement level</b>					
Low	159 (79.5%)	262 (84%)	452 (100%)	0.0159	873 (90.6%)
High	41 (20.5%)	50 (16%)	0 (0.0%)		91 (9.4%)
<b>Type of art**</b>					
Visual	49 (40.8%)	76 (47.2%)	62 (38%)		187 (42.1%)
Performing	61 (50.8%)	64 (39.8%)	75 (46%)		200 (45.0%)
Crafting	7 (5.8%)	12 (7.5%)	15 (9.2%)		34 (7.7%)
Applied arts	2 (1.7%)	8 (5.0%)	11 (6.7%)		21 (4.7%)
Other	1 (0.8%)	1 (0.6%)	0 (0.0%)		2 (0.5%)
<b>Writing/Reading engagement level</b>					
Low	152 (76.0%)	240 (76.9%)	401 (88.7%)	<0.0001	793 (82.3%)
High	48 (24.0%)	72 (23.1%)	51 (11.3%)		171 (17.7%)
<b>Writing/Reading genre**</b>					
Fiction	75 (52.8%)	90 (39.3%)	96 (38.2%)		261 (42.0%)
Non-fiction	20 (14.1%)	42 (18.3%)	35 (13.9%)		97 (15.6%)
Articles/news	34 (23.9%)	74 (32.3%)	91 (36.3%)		199 (32.0%)
Philosophy	11 (7.7%)	16 (7.0%)	22 (8.8%)		49 (7.9%)
Other	2 (1.4%)	7 (3.1%)	7 (2.8%)		16 (2.5%)
<b>Volunteering engagement level</b>					
Low	183 (91.5%)	279 (89.4%)	428 (94.7%)	0.0239	890 (92.3%)
High	17 (8.5%)	33 (10.6%)	24 (5.3%)		74 (7.7%)
<b>Type of volunteering activities**</b>					
Health	13 (13.1%)	17 (11.8%)	17 (13.1%)		47 (12.6%)
Art and culture	6 (6.1%)	4 (2.8%)	4 (3.1%)		14 (3.8%)
Sport and recreation	10 (10.1%)	26 (18.1%)	35 (26.9%)		71 (19.0%)
Education and research	19 (19.2%)	25 (17.4%)	14 (10.8%)		58 (15.5%)
Community and social services	39 (39.4%)	57 (39.6%)	46 (35.4%)		142 (38.1%)
Religion	12 (12.1%)	15 (10.4%)	12 (9.2%)		39 (10.5%)
Other	0	0	2 (1.5%)		2 (0.5%)
<b>Music engagement level</b>					
Low	125(62.5%)	207 (66.3%)	247 (54.6%)	0.0038	579 (60.1%)
High	75 (37.5%)	105 (33.7%)	205(45.4%)		385 (39.9%)
<b>Type of music**</b>					
Classical	7 (3.6%)	5 (1.6%)	2 (0.4%)		14 (1.5%)
Pop, Alternative, Rock, Heavy metal	112 (58%)	160 (51.9%)	191 (42.8%)		463 (48.9%)
Jazz, Blues	4 (2.1%)	3 (1.0%)	2 (0.4%)		9 (1.0%)
Traditional, Folk, Country, Ethnic	10 (5.2%)	42 (13.6%)	65 (14.6%)		117 (12.3%)
Rap, Electronic	48 (24.9%)	94 (30.5%)	181 (40.6%)		323 (34.1%)
Other	12 (6.2%)	4 (1.3%)	5 (1.1%)		21 (2.2%)
<b>TV engagement level</b>					
Low	156 (78.0%)	237 (76.0%)	333 (73.7%)	0.472	726 (75.3%)
High	44 (22.0%)	75 (24.0%)	119 (26.3%)		238 (24.7%)
<b>Type of TV show**</b>					
Animation, Cartoon	9 (5.8%)	31 (13.3%)	39 (11.1%)		79 (10.7%)
Comedy, Stand-up comedy, Sitcom, Prank	68 (44.2%)	104 (43.9%)	160 (45.7%)		332 (44.8%)
Documentary, Surviving show, Reality show	39 (25.3%)	49 (20.7%)	80 (22.9%)		168 (22.7%)
Sport, Game, Quiz show	11 (7.1%)	22 (9.3%)	29 (8.3%)		62 (8.4%)
News, Talk show	6 (3.9%)	14 (5.9%)	20 (5.7%)		40 (5.4%)

Other	21 (13.6%)	17 (7.2%)	22 (6.3%)		60 (8.0%)
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\* Based on qui square

\*\* The sum of the numbers in each cell may not be consistent with the total number in that category (low, moderate, high and all participants). This is due to the fact that the questions concerning subtypes of leisure activity were optional and participants had right to skip that question.

\*\*\* Engagement levels did not include time spent with family at home doing their own tasks

\*\*\*\* Engagement levels did not include the activities done with friends during school time

**Table A.4 BYNDS subscales' scores in driving behaviour groups**

Subscales Score range (Min-Max)	Score (Mean±SD)				P-value*
	All participants (n=964)	Low Risk (n=200)	Moderate Risk (n=312)	High Risk (n=452)	
Transient violations (13-65)	30.8 ± 11.2	17.2 ± 3.5	26.5 ± 5.0	39.8 ± 8.2	<0.000001
Fixed violations (10-50)	12.8 ± 4.1	10.4 ± 0.9	11.1 ± 1.7	15.0 ± 4.9	<0.000001
Misjudgement (9-45)	12.9 ± 3.5	11.2 ± 2.2	12.2 ± 2.5	14.1 ± 4.0	<0.000001
Risky driving exposure (9-45)	28.9 ± 8.8	17.0 ± 5.1	27.4 ± 5.5	35.1 ± 5.4	<0.000001
Driving mood (3-15)	5.6 ± 2.8	3.6 ± 1.1	4.7 ± 1.8	7.1 ± 3.1	<0.000001
Total BYNDS Score	90.9 ± 23.9	59.4 ± 8.2	81.8 ± 5.8	111.2 ± 16.0	<0.000001

\*P-value shows significant Mean difference in each subscale by all comparisons in the groups (High risk vs. Low risk, High risk vs. Moderate risk, Moderate risk vs. Low risk)

# Appendix B

Table B.1 Bivariate correlation

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
1 Age	1																												
2 Gender	-0.156	1																											
3 Employment Status			1																										
4 Living Status	0.401	-0.062		1																									
5 Education Status	0.603	-0.12		0.359	1																								
6 License Class	0.648	-0.18		0.312	0.57	1																							
7 Driving Independently	0.669	-0.197		0.351	0.669	0.687	1																						
8 Driving Exposure	0.14	-0.169		0.053	0.187	0.18	0.197	1																					
9 Car Status	0.221	-0.216		0.14	0.248	0.259	0.374	0.276	1																				
10 SES	-0.095	0.011		-0.257	-0.013	-0.024	-0.015	-0.009	0.042	1																			
11 Extroversion	-0.039	-0.023		-0.047	-0.02	0.024	-0	0.064	0.12	0.082	1																		
12 Agreeableness	-0.109	0.213		-0.051	-0.032	-0.072	-0.099	-0.045	-0.064	-0.016	0.239	1																	
13 Conscientiousness	0.061	-0.014		0.02	0.1	0.121	0.104	0.028	0.053	0.051	0.048	0.04	1																
14 Neuroticism	-0.09	0.276		-0.008	-0.128	-0.089	-0.125	-0.089	-0.103	-0.036	-0.08	0.013	-0.137	1															
15 Imagination	0.034	-0.051		0.042	0.069	0.034	0.029	-0.021	0.009	-0.008	0.103	0.126	0.001	-0.122	1														
16 Video Game	0.046	-0.221		0.053	0.015	0.014	0.019	0.087	-0.021	-0.035	-0.105	-0.046	-0.149	-0.056	0.034	1													



**Table B.2 Full model variable (CI=95%)**

Variable	est	SE	t	p-value	OR	OR (low)	OR (high)
Driver Car Status (Yes)	1.138	0.16	7.123	0	3.121	2.284	4.275
Driving Exposure (High)	0.91	0.271	3.359	0.001	2.486	1.476	4.282
Gender (Male)	0.904	0.163	5.549	0	2.47	1.797	3.405
Driving Exposure (Moderate)	0.892	0.224	3.985	0	2.439	1.584	3.813
Drug Engagement Level (High engagement)	0.803	0.288	2.79	0.005	2.231	1.289	3.996
Friend Engagement Level (High engagement)	0.665	0.158	4.215	0	1.944	1.429	2.653
Duration of driving independently >3 years	0.658	0.291	2.259	0.024	1.931	1.092	3.426
Social Media Engagement Level (High engagement)	0.598	0.159	3.767	0	1.819	1.333	2.485
Neuroticism Trait (High)	0.58	0.206	2.811	0.005	1.786	1.195	2.683
Employment status (Both Employed and student)	0.442	0.16	2.757	0.006	1.556	1.136	2.131
Education Status (Less than High school)	-0.437	0.215	-2.034	0.042	0.646	0.423	0.983
Reading/Writing Engagement Level (High engagement)	-0.478	0.179	-2.673	0.008	0.62	0.436	0.88
Volunteering Engagement Level (High engagement)	-0.51	0.25	-2.04	0.041	0.6	0.367	0.981
Video Game Engagement Level (High engagement)	-0.577	0.192	-3.009	0.003	0.561	0.385	0.818
Duration of driving independently <1 year	-0.581	0.19	-3.061	0.002	0.559	0.385	0.811
Orange: OR>1 (P-value < 0.05)				Green: OR <1 (P-Value <0.05)			

**Table B.3 Stepwise AIC selection model (CI=95%)**

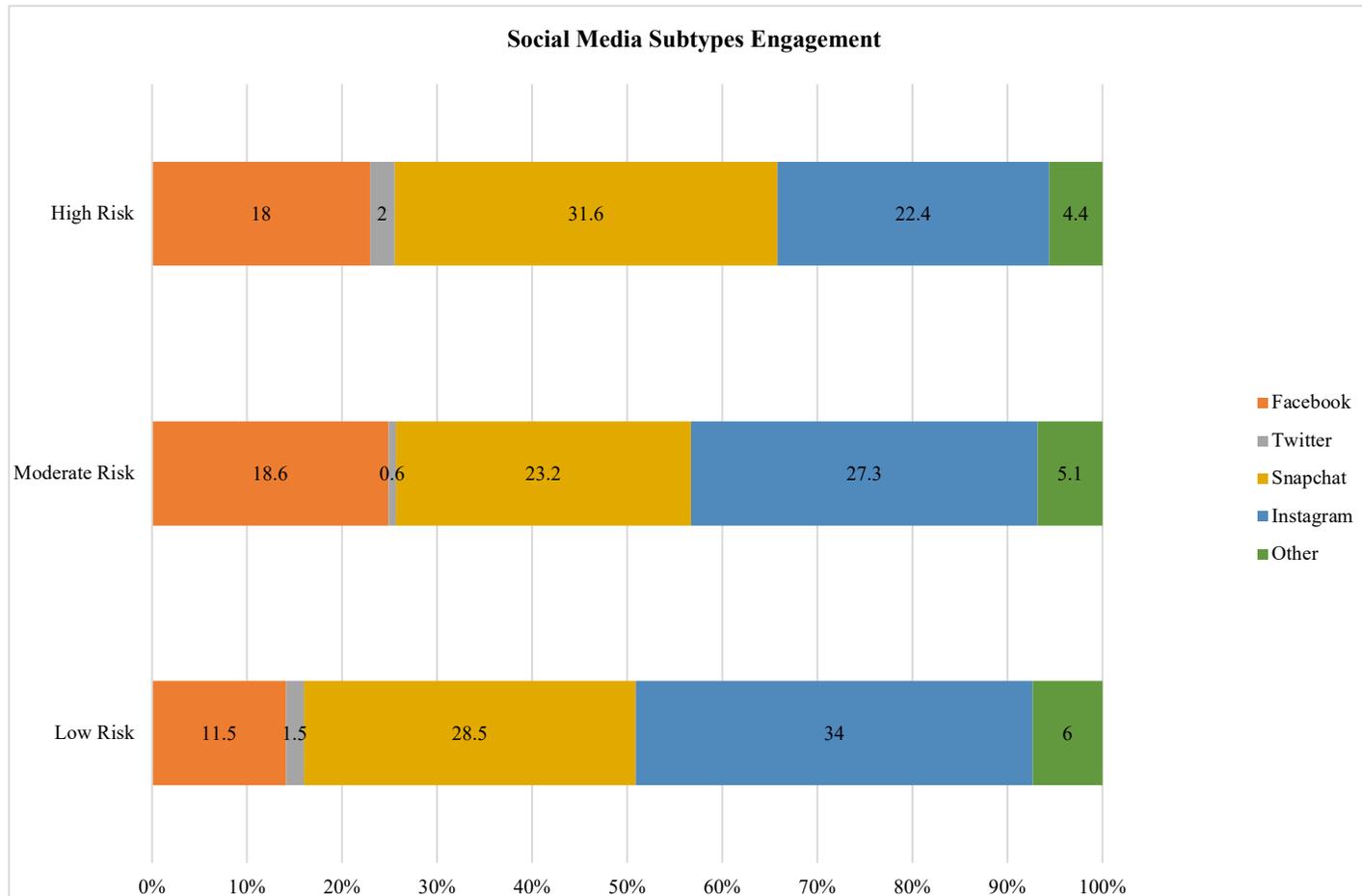
Variable	Estimation	SE	t	p-value	OR	OR (low)	OR (high)
Driver Car Status (Yes)	1.103	0.158	6.987	0	3.014	2.214	4.113
Driving Exposure (High)	0.949	0.267	3.549	0	2.583	1.545	4.418
Driving Exposure (Moderate)	0.942	0.218	4.327	0	2.566	1.687	3.967
Gender (Male)	0.922	0.157	5.891	0	2.515	1.853	3.425
Duration of driving independently >3 years	0.748	0.266	2.813	0.005	2.114	1.257	3.571
Drug Engagement Level (High engagement)	0.738	0.284	2.602	0.009	2.091	1.219	3.718
Friend Engagement Level (High engagement)	0.684	0.154	4.429	0	1.981	1.466	2.686
Social Media Engagement Level (High engagement)	0.606	0.157	3.871	0	1.833	1.349	2.494
Neuroticism Trait (High)	0.604	0.204	2.966	0.003	1.83	1.231	2.737
Extroversion Trait (High)	0.47	0.196	2.402	0.016	1.6	1.094	2.358
Employment status (Both employed and student)	0.461	0.158	2.917	0.004	1.585	1.163	2.16
Imagination Trait (Low)	0.43	0.212	2.023	0.043	1.537	1.017	2.341
Movie Engagement Level (High engagement)	0.418	0.212	1.977	0.048	1.52	1.007	2.312
Education Status (Less than High school)	-0.441	0.21	-2.097	0.036	0.643	0.425	0.971
Reading/Writing Engagement Level (High engagement)	-0.5	0.176	-2.835	0.005	0.606	0.429	0.857
Volunteering Engagement Level (High engagement)	-0.518	0.247	-2.093	0.036	0.596	0.367	0.968
Video Game Engagement Level (High engagement)	-0.58	0.189	-3.062	0.002	0.56	0.386	0.812
Duration of driving independently <1 year	-0.6	0.185	-3.248	0.001	0.549	0.382	0.788
Orange: OR>1 (P-value < 0.05)				Green: OR <1 (P-Value <0.05)			

**Table B.4 Full versus Stepwise selection Model**

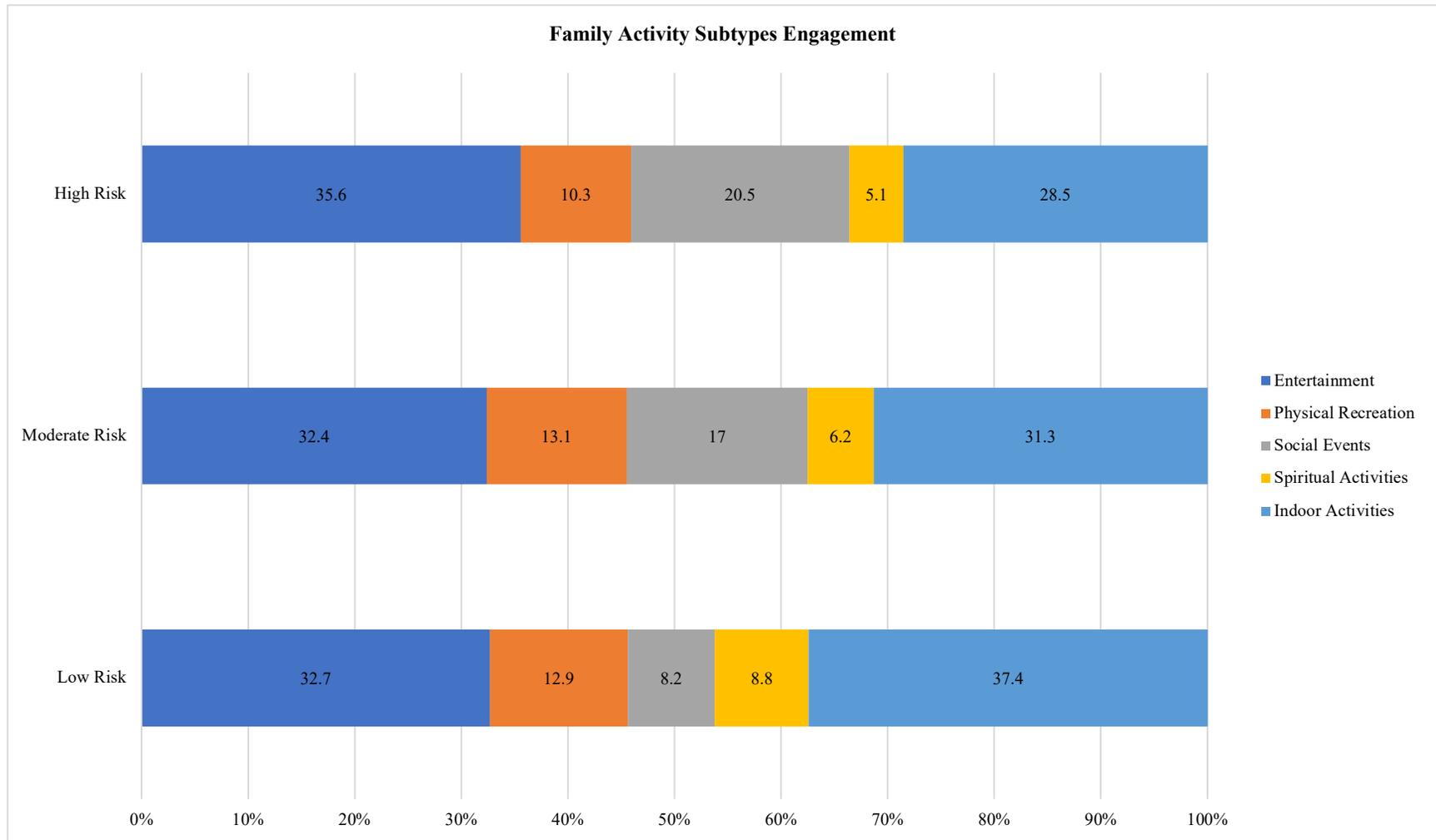
Variable	Full model					Stepwise AIC			
	OR	Lower	Upper	p-value		OR	Lower	Upper	p-value
Gender (Male)	2.47	1.797	3.405	0		2.515	1.853	3.425	0
Education Status (Less than high school)	0.646	0.423	0.983	0.042		0.643	0.425	0.971	0.036
Duration of driving independently <1 year	0.559	0.385	0.811	0.002		0.549	0.382	0.788	0.001
Duration of driving independently >3 years	1.931	1.092	3.426	0.024		2.114	1.257	3.571	0.005
Driver Car Status (Yes)	3.121	2.284	4.275	0		3.014	2.214	4.113	0
Driving Exposure (High)	2.486	1.476	4.282	0.001		2.583	1.545	4.418	0
Driving Exposure (Moderate)	2.439	1.584	3.813	0		2.566	1.687	3.967	0
Employment status (Both Employed and student)	1.556	1.136	2.131	0.006		1.585	1.163	2.16	0.004
Video Game Engagement Level (High engagement)	0.561	0.385	0.818	0.003		0.56	0.386	0.812	0.002
Social Media Engagement Level (High engagement)	1.819	1.333	2.485	0		1.833	1.349	2.494	0
Movie Engagement Level High engagement	1.396	0.902	2.173	0.137		1.52	1.007	2.312	0.048
Friend Engagement Level (High engagement)	1.944	1.429	2.653	0		1.981	1.466	2.686	0
Drug Engagement Level (High engagement)	2.231	1.289	3.996	0.005		2.091	1.219	3.718	0.009
Reading/Writing Engagement Level (High engagement)	0.62	0.436	0.88	0.008		0.606	0.429	0.857	0.005
Volunteering Engagement Level (High engagement)	0.6	0.367	0.981	0.041		0.596	0.367	0.968	0.036
Neuroticism Trait (High)	1.786	1.195	2.683	0.005		1.83	1.231	2.737	0.003
Imagination Trait (Low)	1.474	0.969	2.258	0.072		1.537	1.017	2.341	0.043
Extroversion Trait (High)	1.48	0.997	2.211	0.053		1.6	1.094	2.358	0.016
Orange: significant variables in both models						Blue: significant variables in just stepwise AIC			

## Appendix C

Figure C.1 Percentage Distribution of Social Media Subtypes in drivers' groups



**Figure C.2 Percentage Distribution of Family Activity Subtypes in drivers' groups**



**Figure C.3 Percentage Distribution of Art Activities' Subtypes in drivers' groups**

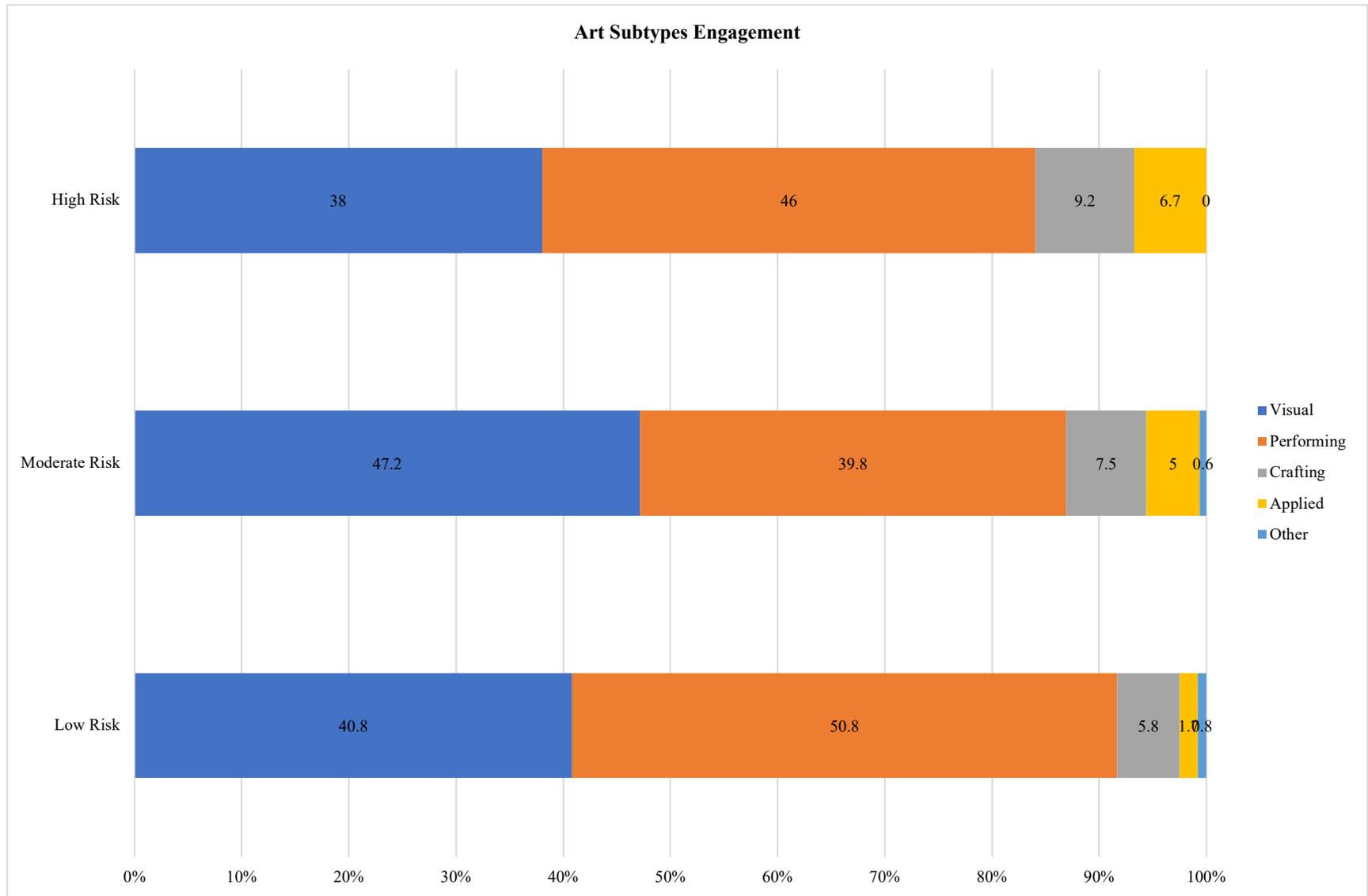
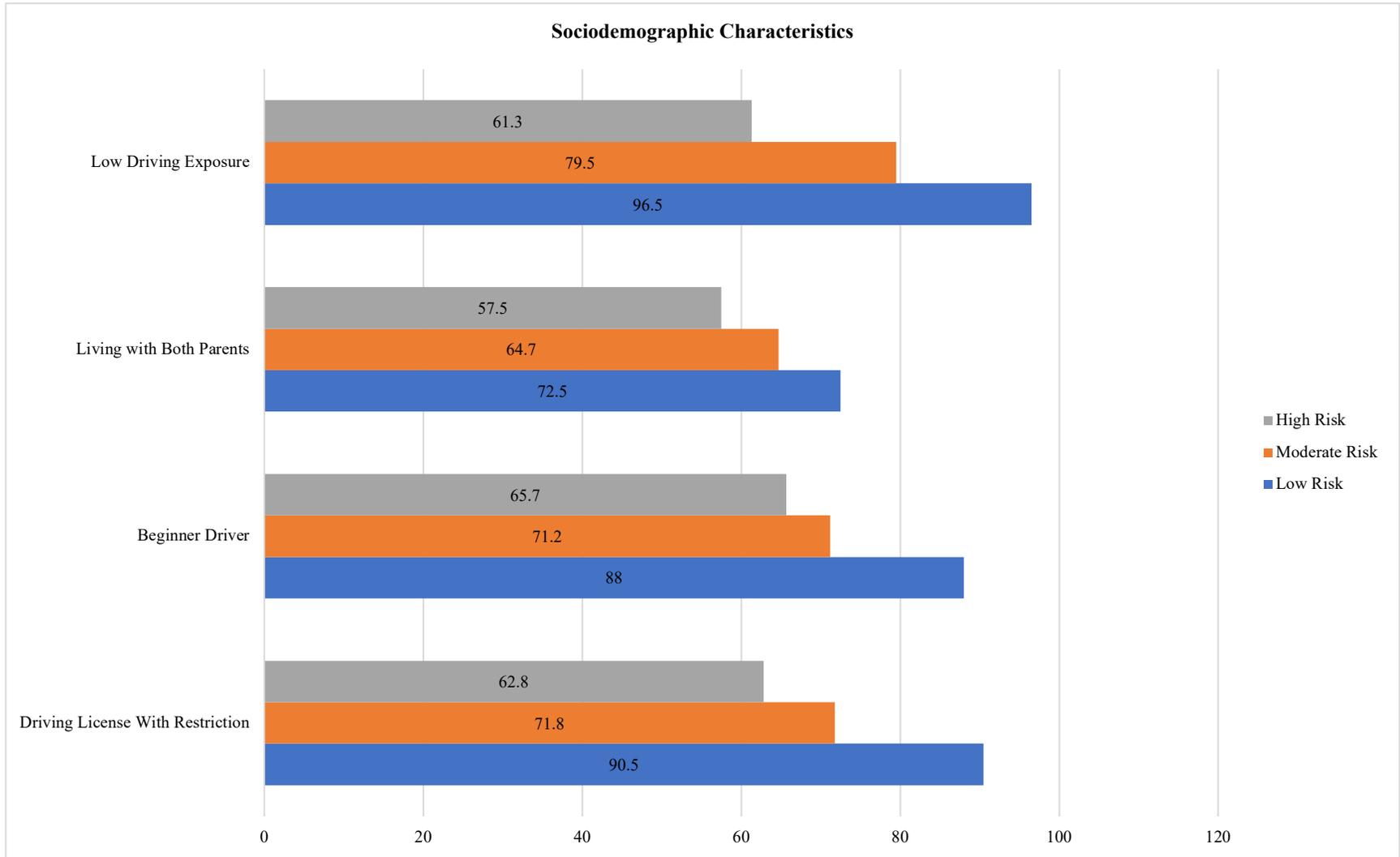


Figure C.4 Percentage Distribution of Sociodemographic Characteristics



### Sociodemographic Characteristics

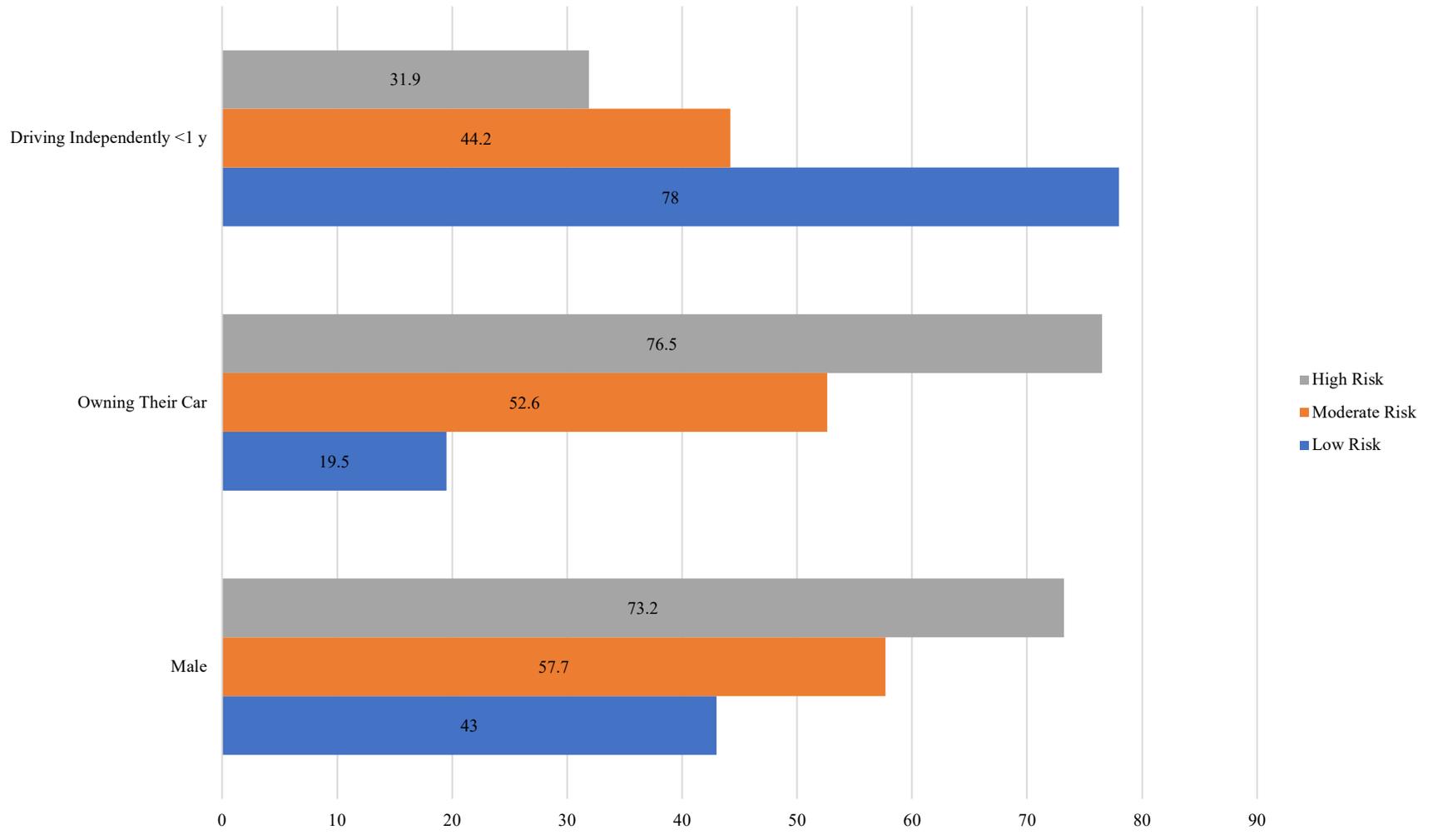
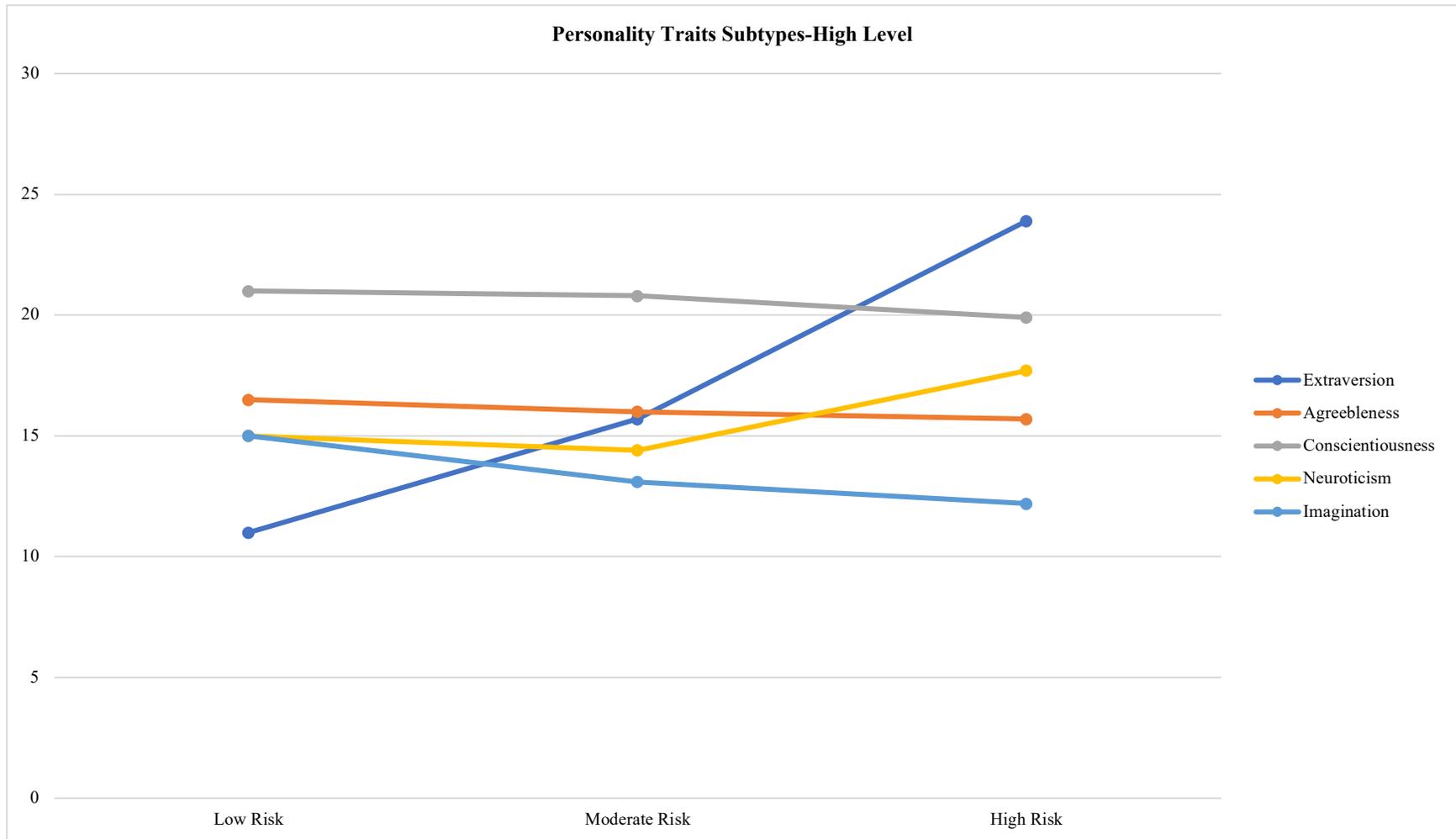


Figure C.5 Percentage Distribution of high level of Personality Traits in drivers' groups



# Appendix D (Canada Young Driver Survey- Sample)

Confidential

Record ID 1  
Page 1 of 16

## Canada Young Driver Survey

Association between Leisure Activity and Risky Driving Behaviour in young Canadians

Hello,

If you are under the age of 25, live in Canada, and have a driving license, you are invited to take part in this online survey. This study is part of a master's thesis in the Department of Experimental Medicine, the University of British Columbia.

Why is this survey important?

Motor vehicle crashes (MVCs) are the leading cause of major injury and death in young Canadians. Risky driving, one of the major causes of car crashes, is thought to be closely associated with leisure time activities and with personality traits.

What is the aim of the survey?

We are conducting an anonymous online survey of young Canadian drivers to examine the relationship between leisure time activities, personality traits and driving behavior.

What are the questions about?

The survey questions ask about different aspects of your personality, driving habits and leisure time activities. There is no right or wrong answer. Please answer as best as you can.

How long will the survey take?

15-20 minutes.

What happens if I would like to leave the survey?

Participation in this survey is completely voluntary. You can leave the survey at any time, however once you save your responses, we have no way to remove them. All information will be kept strictly confidential and cannot be linked back to you personally.

2019/03/13 8:34am

projectredcap.org



Is my personal information safe?

We will not collect any personal information except your email address if you wish to participate in a draw. Your email address will be stored separately and unlinked from the survey responses immediately. Email addresses will be destroyed as soon as the winners of the draw are notified.

What's in it for me?

You will be eligible to have your name put in a draw for one of fifty \$10 gift cards

Please note that completing this survey indicates you have read and understand this research study and agree to participate. If you have any questions about this study, please contact Vahid Mehrnough: [Vahid.mehrnough@vch.ca](mailto:Vahid.mehrnough@vch.ca)

If you have any concerns about your rights or treatment as a research participant, please contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598 or by e-mail at: [RSIL@ors.ubc.ca](mailto:RSIL@ors.ubc.ca). Please reference the study number [H17-00086].

Thank you in advance for your participation.

Sincerely,

Vahid Mehrnough (MSc. Student, Experimental Medicine, University of British Columbia)

Dr. Jeff Brubacher (Associate Professor, Emergency Medicine, University of British Columbia)

Response was added on 2018/03/19 8:08pm.

Do you agree?

Yes

## Sociodemographics

Please complete the survey below.

Thank you!

Response was added on 2018/03/19 8:11pm.

I identify as	<input checked="" type="checkbox"/> Female
What is your age in years?	17 ( The question is expecting an age from 12 to 25)
What is your employment status? (You can choose more than one)	<input checked="" type="checkbox"/> Student
Who do you live with?	<input checked="" type="checkbox"/> Family (both parents)
Please indicate the highest level of your education?	<input checked="" type="checkbox"/> Less than high school diploma
Which province/territory do you reside in?	<input checked="" type="checkbox"/> British Columbia (BC)
What is your driving license status? (British Columbia)	<input checked="" type="checkbox"/> Class 7- Novice
How long have you been able to drive independently?	<input checked="" type="checkbox"/> < 1 year
In the last three months, how many hours a week, on average, did you drive?	5
<b>The following questions are about your socioeconomic status</b>	
How many vehicles does your family own?	<input checked="" type="checkbox"/> > 2
Please specify the type of your family vehicle (e.g. truck, SUV, sedan, MPV, crossover, coupe, convertible, van, hatchback, etc.)	sedan
Do you own your own car (e.g. truck, motorcycle, van, SUV, etc.)?	<input checked="" type="checkbox"/> Yes
Please specify the type of your vehicle (e.g. truck, SUV, sedan, MPV, crossover, coupe, convertible, van, hatchback, etc.)	Sedan
Does your family own their home?	<input checked="" type="checkbox"/> No

## Leisure Activities

Please complete the survey below.

Thank you!

Response was added on 2018/03/19 8:19pm.

### 1- Video games

	None	≤ 4 hours per week	4 - 9 hours per week	9 - 14 hours per week	14+ hours per week
In the last 3 months, how many hours a week did you play video games?	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### What type(s) of video games do you play most often?

	Racing games (e.g. Need for Speed™)	Action games (e.g. first person shooter, GTA™)	Adventure (e.g. Fable™)	Simulation games (e.g. Sims™)	Strategy (e.g. Strong Hold™)	Sports (e.g. Fifa™)	Other
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 2- Sport

	None	≤ 1 hour per week	1 - 3 hours per week	3 - 7 hours per week	7+ hours per week
In the last 3 months, how many hours a week did you play sports?	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

### What type(s) of sport do you participate in most often?

	Collision (hockey, football, martial arts, etc.)	Contact (soccer, basketball, etc.)	Limited contact (baseball, volleyball, etc.)	No contact (fitness, table tennis, etc.)
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

3- Social Media	None	≤ 30 minutes per day	30 - 60 minutes per day	60 - 120 minutes per day	120+ minutes per day
In the last 3 months, how many minutes a day did you spend on social media?	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

What social media/network(s) do you use most often?	Youtube	Facebook	Twitter	Snapchat	Instagram	Other (Reddit, Whatsapp, LinkedIn, Pinterest, etc.)
Top choice	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4- Watch movies	None	≤ 3 hours per week	3 - 6 hours per week	6 - 10 hours per week	10+ hours per week
In the last 3 months, how many hours a week did you spend watching movies?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

What type(s) of movie do you watch most often?	Action, Adventure	Horror, Thriller, Mystery	Romance, Drama, Musical	Fantasy, Sci-Fi, Animation	Comedy	Other (Biography, Documentary, etc)
Top choice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

If other, please specify Historical Drama

**5- Family time**

	Never	Once a week	2-3 times per week	4-5 times per week	5+ times per week
In the last 3 months, how many times a week have you participated in an activity with your family? (N.B. It does not include the time you spent together at home doing your own tasks)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Which type(s) of family activity did you do most often?**

	Entertainment (e.g. concerts, games)	Physical recreation (e.g. hiking)	Social events (e.g. parties)	Spiritual activities (e.g. going to church)	Indoor (e.g. family gathering)
Top choice	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**6-Time with Friends**

	Never	Once a week	2-3 times per week	4-5 times per week	5+ times per week
In the last 3 months, how many times a week have you participated in an activity with your friends? (N.B. It does not include the school time activities)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**What type(s) of activity did you participate in with your friends most often?**

	Entertainment (e.g. movies, games)	Physical activity (e.g. Sports)	Social activity (e.g. parties)	Spiritual activity (e.g. going to church)	Unstructured activity (e.g. Hanging out)
Top choice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**7- Alcohol**

	Never	Once a week or less	2-3 times per week	4-5 times per week	5+ times per week
In the last 3 months, how many times a week did you drink alcohol?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8- Drug use					
	Never	Once a week	2-3 times per week	4-5 times per week	5+ times per week
In the last three months, how many times a week have you used recreational drugs?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9- Art					
	Never	≤ 1 hours per week	1 - 3 hours per week	3 - 7 hours per week	7+ hours per week
In the last three months, how many hours a week did you engage in art activities?	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

What type(s) of art did you engage in most often?					
	Visual arts (e.g. drawing, photography, architecture)	Performing arts (e.g. Music, Dancing, Theatre)	Crafting arts (e.g. Pottery, Sculpture)	Applied arts (e.g. Fashion/interior designing)	Other
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10-Writing and reading					
	None	≤ 1 hour per week	1 - 3 hours per week	3 - 7 hours per week	7+ hours per week
In the last three months, how many hours a week did you spend on reading/writing something? (N.B. It does include reading/writing for a leisure activity and not for school or work)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What type(s) of reading/writing activities did you engage in most often?					
	Fiction (romance, mystery, sci-fi)	Non-fiction (poetry, history)	Articles/news	Philosophy (religion, self-help)	Other
Top Choice	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**11- Volunteering**

	Never	≤ 2 hours per week	2 - 4 hours per week	4 - 6 hours per week	6+ hours per week
In the last three months, how many hours a week did you act as a volunteer?	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**What type(s) of field volunteering did you engage in most often?**

	Health (e.g. hospitals)	Art and culture (e.g. art galleries)	Sport and recreation (e.g. swimming pools)	Education and research (e.g. school programs)	Community and social services (e.g. community centers)	Religion (e.g. places of worship)	Other
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**12- Listening to music**

	Never	≤ 15 hours per week	15 - 30 hours per week	30 - 45 hours per week	45+ hours per week
In the last three months, how many hours a week did you listen to music?	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**What type(s) of music do you listen most often?**

	Classical	Pop, Rock, Alternative, Heavy metal	Jazz, Blues	Traditional, Country, Folk, Ethnic	Rap, Electronic	Other
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**13- Watch TV**

	None	≤ 3 hours per week	3 - 6 hours per week	6 - 10 hours per week	10+ hours per week
In the last 3 months, how many hours a week did you spend watching TV?	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What type(s) of TV do you watch most often?	Animation, Cartoon	Comedy, Stand up comedy, Sitcom, Prank	Documentary, Surviving show, Reality show	Sport, Game, Quiz show	News, Talk show	Other
Top choice	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Second choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

## Driving Behaviour

Please complete the survey below.

Thank you!

Response was added on 2018/03/19 8:24pm.

### Driving Behaviour

How often during the last three months have you taken part in the following behaviours?

	Never	Occasionally	Sometimes	Usually	Almost always
106) You drove over the speed limit in areas where you were unlikely to get caught	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
107) You went 10-20 km/hr over the speed limit (e.g., 72 km/hr in a 60 km/hr, 112 km/hr in a 100 km/hr)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
108) You deliberately sped when passing another vehicle	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
109) You sped at night on roads that were not well-lit	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
110) You went up to 10 km/hr over the speed limit (e.g. 65 km/hr in a 60 km/hr, 105 km/hr in a 100 km/hr)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Driving Behaviour- Cont'd

How often during the last three months have you taken part in the following behaviours?

	Never	Occasionally	Sometimes	Usually	Almost always
111) You went more than 20 km/hr over the speed limit (e.g. 60 km/hr in a 40 km/hr, 100 km/hr in an 80 km/hr)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
112) You raced out of an intersection when the light went green	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
113) You travelled in the left lane on multilane highways	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
114) You sped up when the lights went yellow	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
115)					

You went too fast around a corner

**Driving Behaviour- Cont'd**  
**How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
116) You did an illegal U-turn	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
117) You passed a car on the right	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
118) You used spoke/texted on a handheld cell phone	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
119) Your passengers didn't wear seat-belts	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
120) You drove after taking an illicit drug such as marijuana or ecstasy	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Driving Behaviour- Cont'd**  
**How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
121) You carried more passengers than could legally fit in your car	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
122) You didn't always wear your seatbelt	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
123) You drove without a valid licence because you hadn't applied for one yet or it had been suspended	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
124) You didn't wear a seatbelt if it was only for a short trip	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
125) If there was no red-light camera, you drove through intersections on a red light	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Driving Behaviour- Cont'd**  
**How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
126) You carried more passengers than there were seat belts for in your car	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
127) You drove when you thought you may have been over the legal alcohol limit	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
128) You drove a high-powered vehicle	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
129) You misjudged the speed when you were exiting a main road	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
130)					

You misjudged the speed of an oncoming vehicle

**Driving Behaviour- Cont'd****How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
131) You misjudged the gap in traffic when you were turning left	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
132) You misjudged the stopping distance you needed	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
133) You turned left into the path of another vehicle	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
134) You misjudged the gap in traffic when you were overtaking another vehicle	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
135) You missed your exit or turn	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Driving Behaviour-Cont'd****How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
136) You cut off another vehicle when entering the road	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
137) You didn't always signal when you were changing lanes	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
138) You drove on the weekend	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
139) You drove in the rain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
140) You drove during morning and afternoon rush hour	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Driving Behaviour- Cont'd****How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost all
141) You drove at night	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
142) You drove at dusk or dawn	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
143) You carried your friends as passengers at night	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
144) You drove when you knew you were tired	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
145) Your car was full of your friends as passengers	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Driving Behaviour- Cont'd**  
**How often during the last three months have you taken part in the following behaviours?**

	Never	Occasionally	Sometimes	Usually	Almost always
146) You went for a drive with your friends giving directions to where they wanted to go	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
147) Your driving was affected by negative emotions like anger or frustration	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
148) You allowed your driving style to be influenced by what mood you were in	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
149) You drove faster if you were in a bad mood	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Personality Trait**

Please complete the survey below.

Thank you!

Response was added on 2018/03/19 8:26pm.

**Personality Trait****To what extent you agree with the following statement?****Please answer honestly with respect to how you see yourself in the present moment, not how you would like to be in the future. There are no incorrect answers nor any personality profile that is inherently more desirable than another.**

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
150) I keep in the background (i.e. I do not mingle with others or I consider myself to be shy)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
151) I often forget to put things back in their proper place	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
152) I have a vivid imagination (i.e. clear imagination)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
153) I am not really interested in others (i.e. I like to spend time alone)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
154) I get upset easily	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
155) I talk to a lot of different people at parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
156) I like order	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
157) I do not have a good imagination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
158) I am not interested in other people's problems	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
159) I am relaxed most of the time	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Personality Trait- Cont'd**  
**To what extent you agree with the following statement?**  
**Please answer honestly with respect to how you see yourself in the present moment, not how you would like to be in the future. There are no incorrect answers nor any personality profile that is inherently more desirable than another.**

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
160) I don't talk a lot	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
161) I make a mess of things	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
162) I have difficulty understanding abstract ideas	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
163) I feel others' emotions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
164) I have frequent mood swings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
165) I am the life of the party	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
166) I get chores done right away	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
167) I am not interested in abstract ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
168) I sympathize with others' feelings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
169) I seldom feel blue (i.e. I rarely feel sad or down)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Draw

Please complete the survey below.

Thank you!

Response was added on 2018/03/19 8:26pm.

170) If you are interested to be in a draw for one of fifty \$10 online gift cards? (If so, you will be asked to provide your email address)

Yes  
( (Note: Your email address is unlinked to your survey results ) )