School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

A needs assessment of the pedestrian safety-focused awareness campaigns, Case study: Musanze-Rwanda

Jean Clement Murenzi

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Traffic Safety

SUPERVISOR :

Prof. dr. Kris BRIJS

MENTOR :

dr. Nora REINOLSMANN

2020
2021

UHASSELT
KNOWLEDGE IN ACTION

www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

A needs assessment of the pedestrian safety-focused awareness campaigns, Case study: Musanze-Rwanda

Jean Clement Murenzi

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Traffic Safety

SUPERVISOR :

Prof. dr. Kris BRIJS

MENTOR :

dr. Nora REINOLSMANN

PREFACE

The idea of researching the effectiveness of the pedestrian safety awareness campaign was motivated by a tremendous effort Rwanda put in improving the road safety awareness campaign's quality and extending its duration from one week to 52 weeks in 2019. Since the pedestrians' safety in developing nations has been documented to be the lowest on the planet. This study focused on revealing the facts that will serve in designing effective behaviour interventions in RWANDA. I would like to express my gratitude to VLIR-OUS for sponsoring my master's studies, which helped me gain the knowledge necessary to conduct this study. I am grateful for the University of Hasselt for providing a well thought out program of Transport Sciences: Road Safety in the South. Thanks to the UHASSELT coordination, it was an incredible journey that led me to meet road safety professionals and learn a lot from them. I would also like to thank my master's thesis supervisor, Professor Kris Brijs and my master's thesis mentor Nora REINOLSMANN for their best guides. Their professional support and encouragement helped me shape my research idea into quality scientific research along the research process. I recognize the efforts of my local supervisor Dr Ir. Alphonse NKURUNZIZA, who guided and supported me in the data collection process.

SUMMARY

The main objective of this study was to conduct a needs assessment for the Pedestrians safety-focused awareness campaign. Violation of give-way to pedestrians at zebra crossings, cell phone use while driving, drunk driving, exceeding the speed limit, crossing the road outside zebra crossings, cell phone calling while walking, cell phone texting while walking, listen to music from ear phone while walking and checking any content from the cell phone while walking were initially assumed to inflict the vehicle pedestrian's crash.

The theoretical model of planned behavioural analyses began with an exploratory factor analysis CFA. CFA was performed using maximum probability extraction and Promax rotation in SPSS software. Subsequently, the factors (constructs) in AMOS were analysed to perform the divergent validity tests (MSV <AVE, ASV <AVE), the convergent validity tests (AVE> 0.5, CR> AVE) and the reliability tests. (CR> 0.6). the confirmatory factor analysis was performed in AMOS to ensure the variables' fitness (observed variable and construction variable) in the formed models of planned behaviour theory. Finally, the fit TPB model generated the desired output explaining how behavioural attitudes, social norms and perceived behavioural control determine the intention that leads to behavioural performance. This study's scope was limited to apply the TPB model to a single pedestrian risk behaviour and driver risk behaviour: crossing the road outside pedestrian crossings and violating pedestrian right-of-way. PLUM ordinal regression analysis was done. Firstly, it explained how much the vehicle-pedestrian crash risk would change if the road user shifts from one level of performing a risky behaviour to the next upper or lower. Levels are ranked in terms of how often road users perform risky behaviours). Secondly, how much vehicle-pedestrians crash risk varies s the demographic factors and how much the change in the demographic factors' levels would predict the probability of getting involved in risky behaviours that endanger the pedestrians.

It was intended to use the theory of planned behaviours model (TPB model) on pedestrians' risky behaviours, and drivers contributed the most to the occurrence of vehicle-pedestrian crashes. The goal was to understand the underlying psychological process that results in those risky behaviours. The TPB models on crossing the road outside zebra crossings and violation of yielding to pedestrians lead to determining the underlying factors that should be addressed. It was found that the behavioural change interventions would not successfully change the behaviour by making the pedestrian intention more favourable toward road crossing using zebra crossings. Improving the perceived behavioural control of pedestrians towards crosswalks at crosswalks in the presence of the rewarding explicit motivations to cross elsewhere would reduce crossings' frequency outside the crosswalk. The TPB model of yielding to pedestrians' behaviours indicated that the positive intention towards yielding to pedestrians would often make the driver yield to pedestrians. The intention to yield to the pedestrians could be influenced by targeting the driver's social norms towards yielding, such as making them believe that their family members disapprove of violating yielding to pedestrians and that when they yield to, they receive appreciation from the pedestrians.

The PLUM ordinary regression analysis; indicated the effect of pedestrian behaviours while walking on the risk of vehicle pedestrians' crashs. Listed from the most dangerous to the least dangerous are texting while walking increase the risk of a pedestrian-vehicle crash by 1.48 if the walking trips in which they text increase by 20% of their walking trips. Cell phone-talking increases the risk of a pedestrian-vehicle crash by 1.28 if the walking trips in which they talk on cell phone increase by 20% of their walking trips. Crossing the road through zebra crossing and listening to ear phone music—only texting and talking on the cell phone on the road- was significantly increased the risk of being hit by a vehicle. For the driver, cell phone use while driving increases the risk of pedestrian-vehicle collision by 1.84 ($P<0.01$) if the number of trips they use a cell phone at least once increases by 25% of the trips they

drive. Exceeding speed limits increases the risk of pedestrian-vehicle collision by 1.46 ($p<0.05$) if the number of trips in which they exceed the speed limit at least once increases by 25% of the trips they drive. Moreover, drunk driving (significantly increases the risk of pedestrian-vehicle collision by 1.84 ($p<0.05$) if the number of trips they drunk drive changes from never to once per year, or changes from once per year to more than once per year). Violation of yielding to pedestrians was found to increase the risk of hitting a pedestrian insignificantly

The demographic factors were found to play an essential role in influencing the risk of a vehicle-pedestrian crash. This study found that the gender of teen pedestrians insignificantly influences the involvement in risk behaviours nor their risk of being hit by a vehicle. The pedestrian's age is a significant predictor of the pedestrian's risk of being hit by a vehicle and their involvement in risky behaviours. The older high school students were more prone to use the cell phone while walking (between two teen pedestrian separated by two years of age; the elder is 1.42 times ($p<0.01$), 1.5 times ($p<0.05$), 1,34 times ($p<0.05$)and 1.33 times ($p<0.01$) more likely to text while walking, talk on the cell phone, check the cell phone on the road and to be hit by a vehicle respectively. However, between two teen pedestrians separated by two years of age, the younger is 1.24 ($p<0.05$) times more likely to cross outside zebra crossing than older high school students. The demographic factors of the drivers' age and their driving experience (years of driving) were insignificant predictors of the driver's risks to hit a pedestrian or to get involved in the behaviours that endanger the pedestrians.

This study had the limitations; the 1st one was the lack of previous studies on Rwanda's road safety behaviours. The second limitation of the insufficient open-source of Rwandan road safety statistical data. It was later realised that the two first limitations could have been minimised if the pilot study had been conducted. Measures to prevent the spread of COVID-19 limited the possibility of acquiring a more significant sample and forced to postpone this study completion deadline.

The practical recommendations were addressed to the Ministry of Education of Rwanda and the traffic department of the Rwandan national police. The author presented the following to the Rwandan Ministry of Education and Rwanda education Board: the involvement of the Ministry of Education risky behavioural change among youth is highly needed; it could be done by providing the road safety education as part of the primary and secondary schools curriculum. The author highlighted that cell phone use while walking the top of the priority list of risky behaviours that the road safety education program should cover. The road safety education materials should be prepared in such a way that students gain the capability of resisting the temptation of using a cell phone while walking instead of just requesting them not to use the cell phone while walking, the technique of implementations intentions is one of the techniques that may help to prepare and deliver that education. Furthermore, a suggestion was addressed to the Ministry of Education to encourage the academic researchers in Rwanda to study Road safety issues in Rwanda. To the traffic department of the Rwandan national police, the 1st proposition was to consider avoiding nonspecific road safety campaigns. Secondly, it was recommended that evaluating the effectiveness should be done by comparing the number of traffic rules offenders before and after the behavioural change interventions (not a change in the number of traffic crashes). Finally, the recommendation is to make more detailed traffic data available to the public to have a minimum traffic safety situation.

The study was concluded by indicating that a simple representation of the reality only used a few variables. Other variables that could be even more critical to the pedestrian's crashes might not have been included; however, all the models used in this study indicate only the relationship between fewer variables and should be viewed as representative of the included variables. It was indicated that this study's results serve to achieve this research's objective and serve input of further research on behaviour intervention on pedestrians' safety in Rwanda. According to this study results, the conclusion highlighted that self-report near-crash data are appropriate surrogate measures of road crash risks.

List of abbreviations

A	
ANPAER	Association Nationale des Proprietaires des Auto-Ecoles au Rwanda
ASV	average shared squared variance
AVE	Average variance extracted
B	
BAC	Blood alcohol content/ concentration
C	
CAST	Campaigns and Awareness-raising Strategies in Traffic Safety
CFI	The comparative fit index
CI	Confidence Interval
CMIN	chi-square statistics
COZC	Crossing outside zebra crossing
CR	composite Reliability
D	
DD	Drunk driving
DF	Degree of freedom
DIGP AP	Deputy Inspector General of Police in charge of Administration and Personnel
DMV	Direct motivation to violate (explicit rewarding motivation to violate)
Drivex	Driver's experience
E	
ESL	Exceeding speed limits
Exp_B	odds ratio
G	
GNI	Gross National Income
GOF	goodness of fit
H	
HGV	Heavy goods vehicle
I	
IBM	International Business Machines Corporation
IBSR-BIVV	Belgian Road Safety Institute
K	

km^2	Square kilometre
kph	Kilometre per hour
L	
LB	Lower boundary
M	
MaxR(H)	maximum Reliability
MFI	Model fit index
ML	Maximum likelihood
MSV	maximum shared variance
N	
N	population size
NCC	National Commission for Children in Rwanda
O	
OR	odds ratio
P	
p	*p*-value
P_Tlk	Cell phone talk
PBC	Perceived behavioural control while walking
P-Cont	cell phone content checking while walking
PLUM	Polytomous Universal Logit Model
P-Msc	Cell phone music listening while walking
P-Tlk	Cell phone talking while walking
P-Txt	Texting while walking
PU	Cell phone use while driving
R	
R^2	variance explained by the independent variable
REB	RWANDA EDUCATION BOARD
RMSEA	root mean square error of approximation
RTDA	Rwanda Transport Development Agency (RTDA)
S	
S. e	Standard error
SEM	Structural equation model
Sig	Significance level

SN	Social Norms
SPSS	Statistical Package for Social Sciences
SRMR	Standardized Root Mean Square Residual
T	
TACT	Target, Action, Context and Time
TPB	Theory of planned behaviours
U	
UB.	Upper boundary
UK	United kingdoms
UN	United Nations
V	
VPNC	Vehicle-Pedestrian near-crash
VYTP	Violation of yielding to pedestrians
W	
WHO	World Health Organization
X	
$\chi 2$	Chi-square statistics

Table of Contents

List of figures

List of tables

CHAPTER ONE: INTRODUCTION

1.1 Research background

1.1.1 Global situation of road safety

In 2018, the road crashes took lives of nearly 3700 people every day. Most of them were from the developing world; almost half were pedestrians, cyclists, and motorcyclists; the most vulnerable road users. While road traffic crashes are the 11th worldwide leading cause of deaths, it is the 8th leading cause of death in Middle and low-income countries and the leading killer for people in the 5-20 years age group. Moreover, every road fatality is accompanied by at least four road injuries (World Health Organisation, 2018).

The United Nations General Assembly, in early 2010, made a call to all 175 country members for the road safety decade of action, which started in 2011. The key message was to request each UN county member to improve the road safety by providing safer road infrastructure, ensuring more reliable vehicles, reducing road risky behaviour and improving the post-crash response (United Nations Road Safety, 2011).

As of 2019, nine years after the launch of the decade of road safety, the rates of road fatalities are still the highest in the Global South (with a global average higher than 18.2 deaths per 100,000 population) (Peden & Puvanachandra, 2019). In contrast, Sweden reduced the rate of road fatality rate to 2.8 fatalities per 100,000 people by 2018 (World Health Organisation, 2018).

1.1.2 Pedestrian road safety in Africa

In 2015, the World Health Organization stated that pedestrian road safety is a significant concern. At that time, pedestrian fatalities were 26% and 39% worldwide and in Africa, respectively. In the African region, the share of vulnerable road users separated from the rest of road traffic by road safety infrastructure has decreased from 27.3% in 2013 to 23.3% in 2015; due to the increase of African population which resulted in exposing more pedestrians to the road dangers (World Health Organization, 2015, 2016). Speaking of the magnitude of pedestrian fatalities in the African region, the proportion of pedestrian fatalities is hugely higher than national statistics in some cities. In Nairobi, the capital of Kenya, for example, from 2015 to 2017, the lowest annual share of pedestrians killed in road crashes was 72% of the total number of fatalities, while in Kenya only 37% was recorded nationally in 2016 (*National Transport and Safety Authority*, n.d.).

1.1.3 Pedestrian road safety in Rwanda

In 2009, pedestrians who died on the Rwandan road network accounted for 40% of all road deaths in Rwanda (World Health Organization, 2009). The latest information on pedestrian safety collected during a road safety audit in Rwanda showed that the pedestrians' road safety is generally more prevalent on the paved roads than on unpaved roads. The pedestrian fatalities accounted for 53.8% of the total road fatalities between 2009 to 2014 (SweRoad & GE&SS, 2014, p.18-25).

1.2 Problem statement

The global road safety disparities are associated with the economic situation of countries. Several researchers argued that road infrastructure construction, separating pedestrians and motor vehicles, is vital to reduce pedestrian crashes. The main problem is that it requires high economic potential; in many African countries the economy is weak, and there is a growing population of pedestrians (Martin et al., 2018; Sarkar, 1995; World Health Organisation, 2018).

Some road crashes mitigation techniques are relatively less expensive. Awareness-raising campaigns on road safety are among them, and WHO has indicated that the movement improves road safety in low-income countries, In 2019, Rwanda launched a year-long road safety awareness campaign for all road users; in previous years, the program lasted only two weeks (Munezero & Major, 2019; World Health Organisation, 2018).

The question being: how could this great effort be optimized to achieve its target effectively? Scholars alerted that there is a possibility that the road safety education may not be practical, or worsens the road safety situation among young road users (World Health Organization, 2004a).

WHO has recommended general nonspecific road safety campaigns should be avoided (World Health Organization, 2004a). Therefore, road safety awareness campaigns should target the most dangerous risky behaviours before the least important and prioritize the most affected road users. According to SweRoad & GE&SS (2014, p.18-25), Pedestrians in Rwanda represent about 53% of total road fatalities. Therefore, it is alarming to conduct a needs assessment of the risky behaviours of pedestrians and motorists.

1.3 Research objectives

This study pursues the following objectives, to deal with the challenge mentioned above;

1.3.1 Main objective

To conduct a needs assessment of the road safety campaign to effectively target behavioural factors influencing pedestrian road safety.

1.3.2 Specific objectives

i. To apply the TPB model to determine the underlying causes of crossing the road outside zebra crossing and the violation of yielding to pedestrian

ii. To identify a link between teen pedestrians and the driver’s risky behaviours and the risk of vehicle-pedestrian crashes.

iii. To determine the effects of demographic factors on teen pedestrians and drivers’ risky behaviours and pedestrian crashes.

1.4 Justification of the study

This study aimed to study teen pedestrians and drivers' current behaviours to clarify how road safety awareness campaigns can target pedestrian safety. This study sought to integrate into road safety awareness campaigns the means to address factors influencing pedestrian crashes. This study did not intend to change Rwanda's road safety campaign structure. It instead clarified how teen pedestrians and drivers' road behaviours translate into pedestrian safety problems. Furthermore, this study also investigated how different teen pedestrians and drivers’ behavioural factors put the pedestrian's lives in danger and how they the demographic factors correlate with changes in risk road behaviours (of teen pedestrians and motorists) that lead to the unsafety of pedestrians.

1.5 Study area description

This section provides a clear understanding of the pedestrian's crossings in Musanze district, and a general overview of the mobility situation, road infrastructure description, the demographic and economic situation information.

1.5.1 The demographic and economic situation

The area of Rwanda is 26,338 km^2. In February 2020, the average population density reached 525 inhabitants / km^2. According to World meter compilation of the United Nations data. The urban area of Musanze is in the Muhoza sector, which is on 21.1 km^2; other sectors of Musanze are peri-urban and rural. The highest population density (in Muhoza sector) was 2,453 / km^2 in 2012. in 2017, Musanze had 96 primary schools and 54 secondary schools.

Rwanda is a low-income country; its gross national income (GNI) per capita of Rwandan residents is less than $ 3,995. According to the World Bank forecasts, Rwanda should reach the status of a middle-income country by 2035.

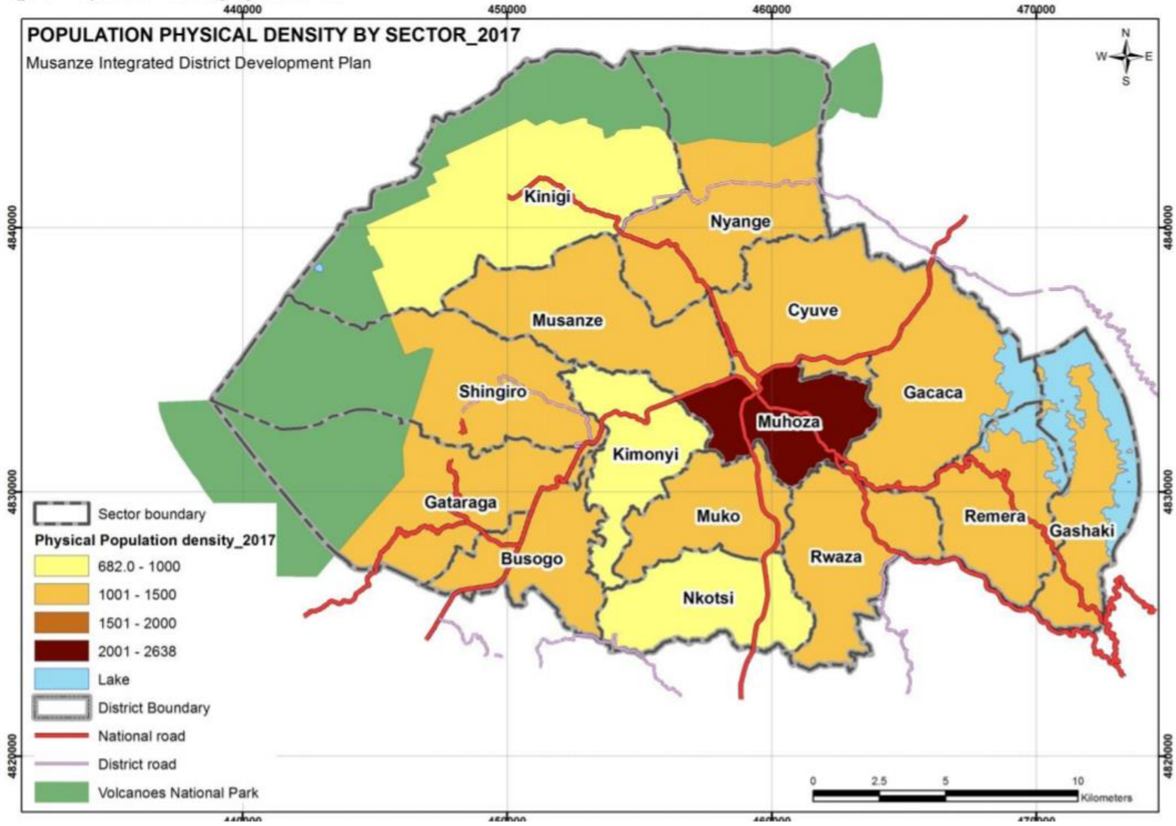


FIGURE 1 Musanze Map (Musanze District office, 2015).

1.5.2 Mobility and pedestrians Road infrastructure situation

In Musanze, and across Rwanda's country, walking is the most common means of transport for students to travel to and from schools. There are no traffic lights in the city of Musanze; only the zebra crossings mark the pedestrian crossings. A low share of passenger cars characterizes the Rwandan mobility situation. Motorized transport in Rwanda relies on public transport (buses and minibuses), motorcycles and active modes of transportation (cycling and walking) In 2010, the World Bank estimated 4.7 vehicles (cars, buses and trucks) per 1,000 inhabitants in Rwanda. Based on the statistics from the 2018 statistical yearbook of the National Statistics Institute of Rwanda, in 2017, the number of motor vehicles per 1,000 inhabitants increases to 8.1 (National Institute of Statistics of Rwanda, 2018).

Pedestrians road infrastructures in Musanze town centre have the typical lane width of 3.5 meters. 7m wide lanes covering a length of around 350m are the widest on the RN4 national road in Musanze downtown. Except for one crosswalk with around 13 meters of crossing distance (located just near the edge of the road island), the road crossing distance does not exceed 8 meters; side to side (when there is no traffic island) or side to the traffic island. Types of crosswalks in Musanze downtown are mid-block crosswalks and intersection crosswalks. Sidewalks are available in the downtown part of Musanze (at least on one side of the road); some of which are high above the traffic road level; others are at the same level as the road. Between the pedestrian and the rest of the traffic, there is no road island. Parts of the road are fitted with concrete curbs (raised above road level to less than 10 cm) separating pedestrians from the rest of the traffic. in the figure contains photos of the road Musanze town centre show what is described in this subsection

FIGURE 2 Intersection crosswalk

FIGURE 3 Concrete pavers elevated sidewalk

FIGURE 4 Marked crosswalk with the longest crossing distance

FIGURE 5 traffic island -Musanze downtown

FIGURE 6 Road with one only one sidewalk

FIGURE 7 curb separated sidewalk

CHAPTER TWO: LITERATURE REVIEW

This chapter gives the information from the past research and other sources on the risky behaviours of pedestrians and drivers. It gives explanation about how risk behavioural factors and demographical factors of drivers and pedestrians increase risk of crashes. The overview information about the road safety awareness campaigns is given by explaining its importance, challenges and the criteria. The theory of planned behaviours is elaborated by defining its constructs. Finally, the theoretical framework based on the content of this chapter is presented.

2.1 Pedestrian fatalities due to drivers and motorcycle drivers in Rwanda

This section identifies between motorist and motorcyclist; the leading agent of pedestrians fatalities. Although the information on pedestrian safety in Rwanda is not well documented; the RTDA study analysed a sample of 1,560 road deaths and found that pedestrian deaths accounted for 51%, 47% and 43% of the total casualties on Rwandan national roads, Rwandan unpaved highways and roads in Kigali, respectively. The same survey found that 32.6% of victims of motorcycle crashes are pedestrians, 26.1% motorcycle passengers and 41.3% motorcyclists. The number of pedestrians killed by motorcycles in Rwanda is lower than the number of motorcyclist fatalities (approximately three pedestrian deaths versus four motorcycle deaths)(SweRoad & GE&SS, 2014a). According to the World Health Organization (2009b), 40% of road death victims in Rwanda were pedestrians, while motorcyclists who died on the road accounted for only 16% of Rwanda's road deaths.

In recent years both motorcycles and vehicles have increased in number. From 2012 to 2017, the ratio of registered motorcycles to all registered vehicles increased by only 2.5% to 51%according to National Institute of Statistics of Rwanda (2018). drivers are most responsible for causing pedestrian crashes on the road, in Rwanda's context, as explained above, motorcyclists are second to motorists in inflicting pedestrian fatalities.

2.2 Risky behaviour of road users

The interaction between pedestrians and drivers depends on human factors. Human factors are defined as "the physical, perceptual and cognitive human capacities and characteristics that affect human interactions with tools, machines and the environment" (Federal Highway Administration, 2013).

The human factors cover a wide range of factors. The discussion here is only about the risky behaviours that affect the road users' physical, perceptual, and cognitive abilities since road safety awareness campaigns can target them. Researchers use ethological observation and self-reporting techniques to identify and understand risky behaviours and their adverse outcomes. The ethological observation approach is a procedure for collecting data through observation. Many studies used ethologic observation to research pedestrians’ behaviours (Cinnamon et al., 2011; Ledesma et al., 2018; Tom & Granié, 2011; Zeedyk & Kelly, 2003). the self-report method is the most widely used because of its advantage; unlike the ethological observation in a road environment on a specific place and unable to include all behaviours risk that road users take daily. The self-reporting methodology involves asking pedestrians the questions that reveal them behave. Many studies have used this technique, and the study documented in this report has used self-reporting methods to obtain useful information from pedestrians and drivers.

2.2.1 Alcohol impairment on drivers and pedestrians

Both pedestrians and drivers performances are affected by the level of alcohol concentration in their bloodstreams: In 2017, 5 to 35% of road deaths worldwide were attributable to alcohol consumption (World Health Organisation, 2018).

Compared to the effort that researchers put into exposing the dangers of alcohol in the driver's life. There is still little research to show what happens to a drunken pedestrian—a significant proportion of pedestrians intoxicated. For instance, in 2003, In South Africa and the UK 61% and 48% of pedestrians who died had been drinking (World Health Organization, 2004c).

To avoid confusion, here are some common explanations for whether a road user is drunk or not. A person is said to be under the influence of alcohol when they exceed the BAC limit, the BAC limit differs from one country to another, but the standard BAC limit for drivers is 0.05 g / dl. Unfortunately, in 2015, Less than half of World Health Organization member states have officially enacted drunk driving laws limiting the driver allowable blood alcohol concentration limit to 0.05 g / dl (World Health Organization, 2015).

One might wonder how the BAC level is known; the roadside traffic laws enforcers, use alcohol detectors to determine drunk drivers. A regular person can reasonably estimate their blood alcohol concentration (BAC) using standard grasses measurement; a standard drink corresponds to 12 grams of pure alcohol. Two standard glasses increase the blood's alcohol concentration to 0.05 g / dl (World Health Organisation, 2000).

Driving under the influence of alcohol is one of the main risky behaviours affecting traffic safety (World Health Organization, 2007).

The BAC greater than 0.05 g / dL, diminishes driver's performance to the point that road safety could be compromised if they drive. The probability of being involved in road crash increases significantly from 0.05 g / dl of blood alcohol level; a study presented that the relative probability of causing a single-vehicle crash with BAC of 0.05 g / dl to 0.079 g / dl is 7 to 21 times higher than when a driver is sober (Fell & Voas, 2014).

The alcohol affects the human brain in so many ways; cognitive latency, misinterpretation of environment, deviation of goal-oriented focus, blurred vision, and cognitive performance reduction are explained here. First, The acute level of blood alcohol concentration makes the drivers unable to appropriately respond to relevant stimuli, leading to latency in cognitive reaction time (Hernández & Vogel-Sprott, 2010). A study on drivers indicated that the alcohol increases the mean response time taken to react to hazard (Zuccalà et al., 2001). Zhao, Zhang, & Rong (2014), in their study, revealed that alcohol also affects the human judgement; drunk people misjudge the environment such as distance and speed. This effect results from the alcohol influence on the neurotransmitters' structural functioning because the alcohol changes the nature of information processing (Bartholow et al., 2003). Acute BAC level causes trouble to focus on the goal-oriented objective. As an activity of driving requires the coordination of the information that a driver receives and their cognitive processing depends on limited working memory and the reduction in focus on the goal-oriented objectives (Marinkovic et al., 2013). Blurred vision and difficulty to position a vehicle of the lane is an effect that is caused by the acute level of alcohol consumption is associated with the weakness of the eyes muscles which leads to the blurred vision (Silva et al., 2017). Alcohol consumption also affects the drive's tracking ability; drivers experience the strain to control the vehicle and stay aligned in the lane. They also misjudge the position of other vehicles on the road (Kenntner-Mabiala et al., 2015).

In addition to the effects of alcohol on human performance explained above, the research indicated that the acute level of alcohol in blood results in impaired cognition performance (Hernández et al., 2007). Cognition performance refers to a set of mental abilities that include learning, thinking, reasoning, memory, problem-solving, decision making, and awareness (Jacobson, 1997). It is proven that reaction time reduces due to the acute level of BAC. The alcohol slows down the reflexes that affect the facility to react promptly to changing traffic situations (Hernández et al., 2007).

2.2.2 *Effects of cell phone use on road safety*

2.2.2.1 Effects of cell phone use on pedestrian's performance

Any task handled by the brain uses a certain percentage of cognitive resources (Goldstein, 2011; G. A. Miller, 1956). Using a cell phone while walking or driving takes the cognitive capacity to process both tasks simultaneously when cell phone use becomes more rewarding than focusing on safety, and the cognitive distraction occurs (Zhang et al., 2019). Therefore, pedestrians jeopardize their safety and increase the risks of being hit by motor vehicles; when they use cell phones while walking. Scholars have revealed many adverse effects of using the cell phone while walking on the road. In this section, only inattention blindness, inattentiveness, and slow crossing speeds caused by increased cognitive demand are included. The inattention blindness stands for unexpectedly unaware of our environment details from one view to the next due to low or no attention (Simons & Chabris, 1999). The task of using cell phone uses up higher cognitive resources and leads to inattention blindness. The research of Nasar, Hecht and Wener (2008) contributed to the knowledge of inattention blindness among road users. A comparison among different categories of pedestrians; pedestrians walking in a pair, those walking while talking on the cell phone and pedestrians walking without any electronic devices and an assessment revealed how the road users were able to recall what they had seen when they were focusing on both their safety and cell phone tasks. The pedestrians walking while talking on the cell phone were negatively affected by inattention driving (Hyman et al., 2009). Identically, the assessment of the safety of the young pedestrians crossing the road while using the cell phone revealed that cell phone use distracts them to the point that they would cross when a short, safe time between their crossing and the next arriving vehicle is left, thus affecting the temporal and spatial gap acceptance (Stavrinos et al., 2009; H. Zhang et al., 2019). Furthermore, the pedestrians crossing the road while talking or texting on their cell phone may move slower than if they were not using the cell phone (Hatfield & Murphy, 2007). A study indicated a link between pedestrians' crossing speed and pedestrians' and safety margin (Onelcin & Alver, 2017).

2.2.2.2 Effects of cell phone use on the driver's performance

Adverse effects of cell phone use while driving; the cognitive demand is likely to exceed the cognitive capabilities when a cell phone is used while walking or driving (Schwebel et al., 2012). Mainly, driving is a complex activity that requires the coordination of different tasks simultaneously. Previous research identified the relationship between cognitive demand and driving performance (Ross et al., 2014). A study in the United States of America associated the high rate of road crashes of young drivers with the working memory variability, which presents trouble in detecting hazards while driving (Walshe et al., 2019). Indeed, the drivers' distraction due to cell phone usage gained a great deal of attention because many road crashes caused by cell phone use while driving increased and were found to be disproportionately higher among novice drivers and young drivers(World Health Organization, 2011). While many people think that only the handheld cell phones are dangerous and that the hand-free phones are safer the research has indicated that both types of the cell phones put the drivers at risk of getting involved in road crashes (World Health Organisation, 2014). The effects of cell phone use while driving on the driving performance is explained here in terms of change in reaction time to unforeseen events and change in vehicle control. Haque and Washington (2013) showed that the drivers' reaction time distracted by the cell phone increases higher than 50%. The distracted drivers tend to drive at lower speeds which is better than keeping higher speeds; However, unforeseen objects or road users could appear when a short time is remaining before coming into contact. It should also be noted that cell phones use while driving creates a secondary stimulus, the young and old drivers are more susceptible to be affected than the rest of the drivers because their cognitive control is relatively lower (Karthaus et al., 2018). Cell phone use while driving distracts and may cause loss of control of the vehicle. The negative effect of cell phone distraction on vehicle control is as equally found in young drivers as in older drivers (Dozza, Flannagan, & Sayer, 2015). A metadata study has also shown that cell phone use affects lateral vehicle control and headway (Caird et al., 2008).

2.2.3 Speeding

Exceeding the speed limit increases both the risk of road crashes and the severity of the crash injuries. World Health Organization (2004) confirmed that 1 km/h decrease in travelling speed would lead to a 2–3% reduction in road crashes. A lot is known about the effect of speed on road safety; Gårder (2004) indicated that driving speed is a good predictor of pedestrians safety. Nilsson (2004) presented a relationship between speed and crash risk and Tefft (2013) associated the speed with the severity of road crash outcome, here the Impact of speeding on road crash risks, and Impact of speed on the severity of the crash outcome are discussed

Nilsson (2004) developed traffic safety dimensions and the power model to describe the effect of speed on safety. Model development is based on the principles of kinetic energy and has been validated by empirical data. The pedestrians' case is different from other road users, though they use the road, they are usually not in the same trajectories with other road users. However, the power function of his model is independent of that difference. The presented power function, in FIGURE 8 is applicable to determine the risk of the speed on vehicle-pedestrian crashes; when the speed increases the probability reduces for pedestrians and drivers to avoid crashes successfully (Nilsson, 2004).

The graph in FIGURE 9 represents the pedestrians-vehicle crashes by forward-moving vehicles. Among pedestrians hit by a car travelling at 30 mph (about 48.2 kph), a fifth of them will not likely survive. If the victims are 70 year-older or older, a third of them are likely to die. If an average pedestrian is hit by vehicles travelling at a speed of 30 mph has a survival rate of 80% and an approximate 60% chance of not being seriously injured. At the same speed, a seated occupant (driver or passenger) has at only 4% risk of deaths if a vehicle they occupy hits head-on (Tefft, 2013).

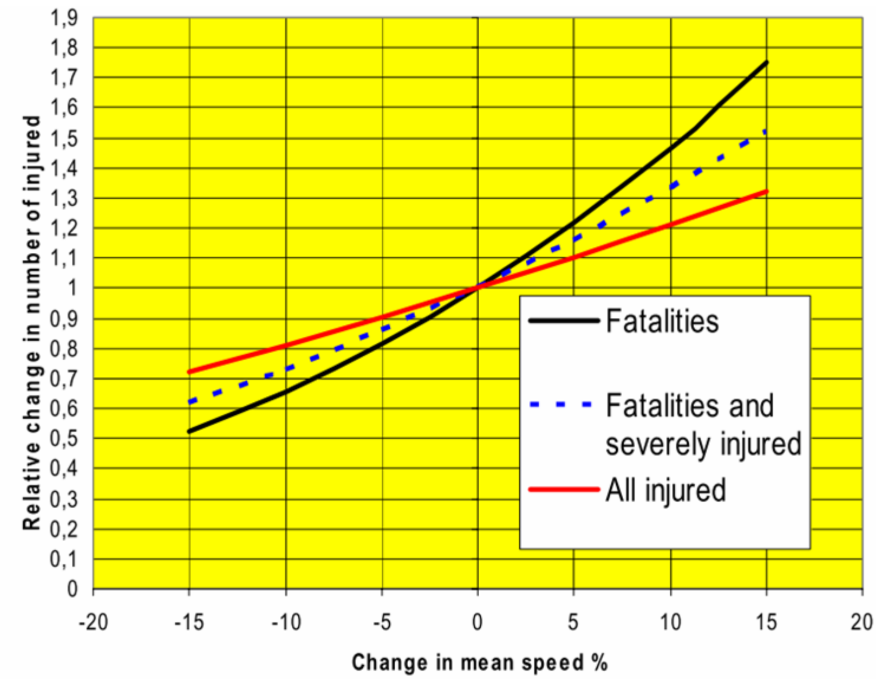


FIGURE 8 Effect of change in vehicle speed on change in the number of crash victims (Nilsson, 2004).

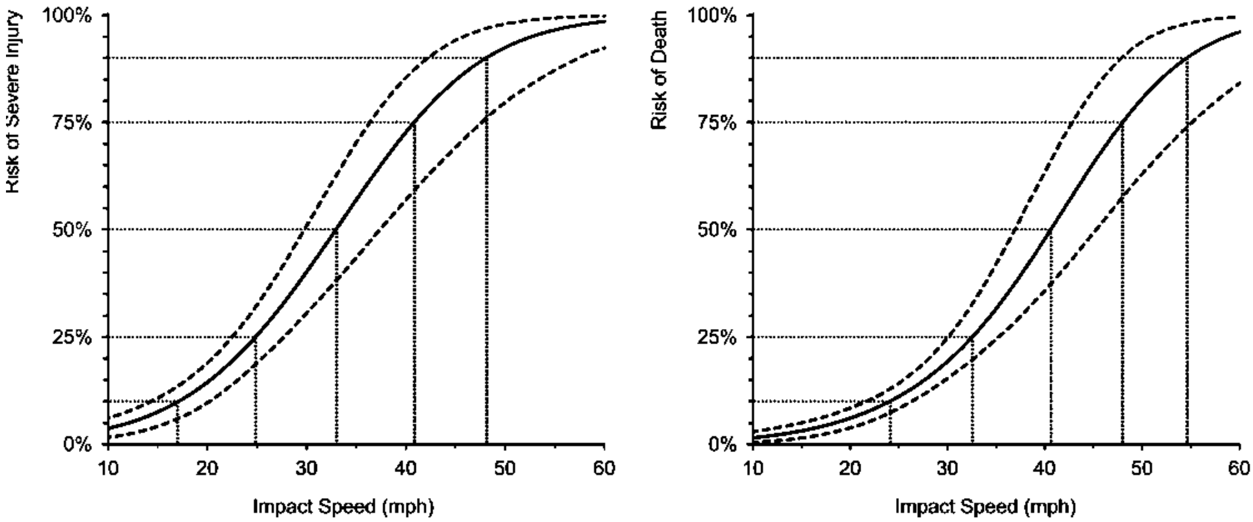


FIGURE 9 Impact of a striking vehicle's speed on a struck victim (Tefft, 2013).

2.2.4 Violation of the yielding to pedestrian's rule

Most research on yielding to pedestrians has focused on finding the factors affecting the drivers yielding to pedestrians. Such as the drivers' age on the comprehension of a pedestrian right-of-way warning sign (Abdulsattar & McCoy, 1999) and the effect of yielding signs on the behaviour of yielding right of way to pedestrians (Hochmuth & Van Houten, 2018; Huang et al., 2000; Samuel et al., 2013). Nevertheless, little research has been done on the importance of yielding to the pedestrian's safety. Furthermore, most of it focused on drivers' failure to yield to pedestrians on the left turn at the intersection with traffic lights. This case, the drivers' fail to give-way to pedestrians because they are preoccupied with watching the incoming traffic (Lord et al., n.d.). Unlike the drivers who consciously decide not to give in to pedestrians (case of unmarked crossings). Yielding the right of way to pedestrians is essential; for instance; the violation of it in Jordan, in 1997 caused about 52% of the total vehicle-pedestrians collisions (Sandt et al., 2016).

Drivers' yielding to pedestrians behaviour plays a role in reducing pedestrian crashes (Muley et al., 2019). The research has shown that the risky behaviour of not yielding to pedestrians, in most cases, goes hand in hand with reaching pedestrians crossings at high speeds; which confirms the danger of not yielding to pedestrians since the more the speed increases, the more the risk of crash and the severity of the crash also increase (Bertulis & Dulaski, 2014).

2.2.5 Pedestrians jaywalking

Pedestrians' jaywalking covers many pedestrian risky behaviours that lead to pedestrians' injuries and fatalities (Schmunk, 1998). Those behaviours include running the pedestrians light signal on the road, midblock crossing (crossing where there are no reserved pedestrian's marked crossings), carelessly crossing a road outside of a marked crosswalk when one is available and walking on vehicle traffic flow lanes (disregarding designated pedestrian paths) and other similar behaviours. Carelessly crossing the road is the most dangerous type of jaywalking; Most of the pedestrians' crashes occur when crossing the road (World Health Organisation, 2015). A study in Ghana indicated that 68% of the pedestrians had road crashes when crossing (Damsere-Derry at al., 2010).

A report on child injury prevention indicated that as the children work, play or live on the road get exposed to the road crashes because the road environment does not meet the children's requirement. As the children grow, they develop a need for bigger space beyond their homes, and they do not exclude roads from the places where they spend most of their times (WHO & UNICEF, 2008).

2.3 Influence of demographic factors on crashes risks

The analysis of the causes of road crashes shows that demographic factors are among the most critical factors used to predict road users' safety. Different demographic factors have a different power of explaining the variance in road safety crashes and behaviours; for example, research has shown driver education was the most crucial factor in the drivers, followed by driving license duration, driver age, driver occupation and gender (Shokouhyar et al., 2017). Among the pedestrians, the most critical identified demographic factor on their safety is their age (LaScala, Gerber, & Gruenewald, 2000). Research in Kenya has shown that pedestrians' gender is an insignificant factor in predicting changes in pedestrians' compliance with traffic rules. It also emphasizes that age is an essential factor for pedestrians in compliance with road safety laws (Otieno et al., 2016).

2.4 Road safety campaigns

The awareness campaigns target to increase road safety awareness of the road users, and they influence the road user's behaviour in a way that complies with the safety rules regulations (Hoekstra & Wegman, 2011). Wundersitz and colleagues (2010) reminded that the road safety campaign is not the only behavioural change intervention technique in Road safety. Fylan & Stradling (2014) in their study grouped 27 behavioural intervention techniques (26 from the study of Abraham and Michie (2008) and one from forensic psychology) into nine groups. The 1st two groups namely 'giving information' and 'teaching' are the interventions that could be used in a road safety campaign, the individual critical messages in those two groups are; to give information about consequences (threat appeal), to give information about other people's approval, to giver instruction regarding targeted road users' behaviours.

The road safety attitudes and some behavioural factors such as drink-driving behaviour are not significantly affected by the road safety raising awareness campaign; whereas other factors such as risk perception, yielding behaviour, seat belt use, and speeding are significantly affected by the safety campaigns (Vaa et al., 2009)

While the investments made in the road safety awareness campaigns represent plenty of resources, till 2009, there was no scientifically commonly accepted methodology that can be used to design the road safety awareness campaign, implement them, and assess their effectiveness. In 2016, the European Commission called for a proposal for the Campaigns and Awareness-raising Strategies in Traffic Safety to develop a methodology for designing and evaluating the road safety awareness campaigns. A specifically targeted research project, Campaigns and Awareness-raising Strategies in Traffic Safety (CAST), has been conducted by a group of 19 partners coordinated by the Belgian Road Safety Institute (IBSR-BIVV). The CAST project's final report includes the scientifically approved road safety campaign design and evaluation (European-Commission, 2009).

2.4.1 Design of road safety campaigns

The awareness campaign stages involve the investigation to shape a general picture of the target audience and detect potential behavioural change obstacles. Campaigns have varying natures; therefore, the assessment should be done to determine the essential elements of a particular awareness campaign, and those design elements of the road must be clear and measurable (Davies, 2012). The first stage of the road safety campaigns preparation is the design stage. The road safety campaigns should be combined with other types interventions such as enforcement, education and legislation. Its effectiveness according to depends on the theoretical model is used, whether or not the campaign is based on previous studies, its specificity, whether a specific theme is chosen rather than a collection of several themes, specification of the target audience, and whether or not the target audience is segmented (Delhomme et al., 2009).

2.4.2 Road safety campaigns messages

The road safety campaign messages could be classified into two main types: framed messages and threat appeal messages; The framed messages are required to give the audience a reason to analyse the issue themselves. Framing messages are not close to unanimous (Delhomme et al., 2009). However, a meta-analysis study confirmed that framed messages are effective when their goal is to communicate preventive messages (Goldenbeld et al., 2008). The framing messages could be positive or negative when they are harmful, and they are termed fear appeal. Fear appeal is different from threat appeal, the later communicate a threat, whereas the fear appears to generate fear as a reaction to the message. When road safety campaigns that use threat appeal, the threat should be well described, a clear plan of how to perform the desired behaviours should elaborate that plan should be practical, easy to follow, and should convince the audience to adopt it (Wundersitz et al., 2010).

The characteristics of the target audience play a significant role in the effectiveness of the campaign. Males and females reacted differently to threat appeal messages (Witte & Allen, 2000). A study indicated that fear appeal approach in campaigns against speeding happened to be counterproductive to males. Simultaneously, it generates positive changes or failed to generate any change in females (Goldenbeld et al., 2008).

2.4.3 Evaluation of road safety campaigns

The effectiveness evaluation of road safety campaigns is essential. Unfortunately, because the effectiveness evaluation phase did not follow many road safety campaigns so far; It is not easy to understand the effectiveness of road safety awareness campaigns. This gap undoubtedly allows ineffective road safety campaigning techniques to continue while effective new behavioural change methods are often overlooked (Delhomme et al., 2009).

It is not appropriate to use short term change in road crash count to evaluate road safety effectiveness. Since the road safety campaigns should take place alongside other road safety intervention activities, it is wrong to attribute the short-term change in traffic crashes to the road safety campaigns. Not all the changes have something to do with a specific single intervention (Wundersitz et al., 2010).

The road safety campaigns' evaluation should consist of observing changes in behaviours or using a self-report survey (questionnaire). In this way, it is possible to detect the campaigns' Impact (Robertson & Pashley, 2015). However, Robertson and Pashley (2015) warned that self-report surveys are biased and could only measure the message penetration and not the behavioural change. Thus, the superior technique to evaluate the change due to behavioural change intervention is observation.

2.4.4 Social psychology in designing road safety campaign

For road safety campaigns to be successful, there should be a thorough understanding of road users and their psychology (Hoekstra & Wegman, 2011). A report by the European Commission highlights the importance of psychology when designing the road safety awareness campaigns; human behaviours directly influence road safety, and social psychology helps research road safety (European-Commission, 2009).

The health behaviour models are the theoretical models that help to understand current and future health behaviours (Mullen et al., 1987). social cognition models explain the constructs of health behaviours theories and design the interventions that support people in preventing traumatic health epidemics (Schwarzer, 2001). Road injuries and fatalities are a challenging epidemic (McIlvenny, 2006), and a neglected epidemic in developing countries (Bener, 2005). Therefore, they should be handled the same way other health epidemics are handled by applying psychological models to optimize the road users' behavioural change interventions (Jindal & Mukherji, 2005).

2.5 Theory of planned behaviours (TPB)

Among all health Social Cognitive Theory Models, the theory of planned behaviours is the most widely used in road safety research (Forward, 2009). the theory of planned behaviour served in many road safety studies, such as predicting seat belt use (Ledesma et al., 2018), in determining the pedestrians' intention on how they cross the road (Zhou et al., 2009).

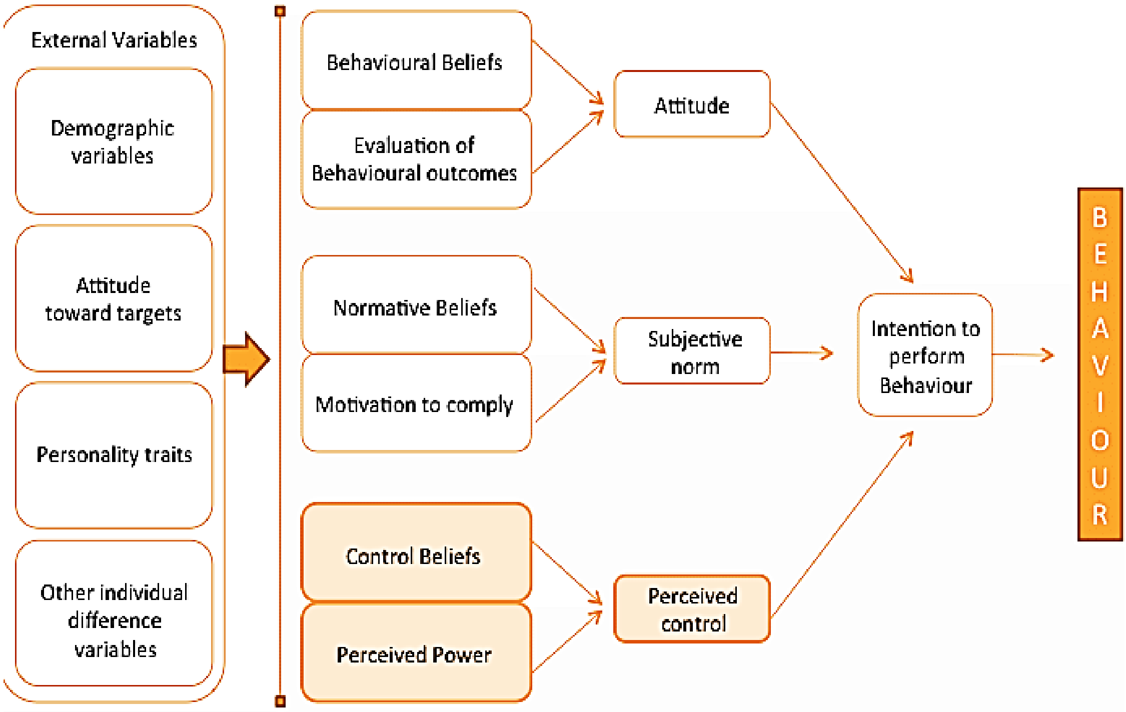


FIGURE 10 Theoryis Reasoned action and planned behaviour (Glanz et al., 2008).

The theory of planned behaviour by Ajzen (1991) has its predecessor the theory of reasoned action (Hill et al., 1977). It uses the intention as the most proximal predictor of the behaviour (Hagger & Hagger, 2019). As shown in FIGURE 10, the unshaded part of the diagram is the theory of reasoned action. Icek Ajzen upgraded the theory of reasoned action by adding perceived control as a determinant of the intention to perform a behaviour(Ajzen, 2004).

Attitude is "a set of emotions, beliefs, and behaviours toward a particular object, person, thing, or event. Attitudes are often the result of experience or upbringing, and they can have a powerful influence over behaviour" (Cherry, 2019). The research has shown that every attitude is shaped by behavioural belief and evaluation of behaviour outcome. Behavioural belief is just a subjective judgement that behaviour might result in a particular outcome, whereas evaluating behaviour outcomes determines the value attached to behaviour and attributes positive or negative judgments (Ajzen et al., 1977). For instance, for the attitude about speeding the behavioural belief might be "speeding saves time" the evaluation of speeding behaviour might be "saving time is good" (Stead et al., 2005).

Commonly, individuals acquire behaviours from their society and culture, and they tend to comply and match their social expectations. According to Evans and Norman (2003), the subjective norms are determined by "the perceived social pressure from salient referents to perform the behaviour weighted by the individual's motivation to comply with the referents". The influence of belief or perception becomes strong, depending on the normative beliefs and the motivation to comply. The Normative beliefs are beliefs about whether important referents would approve (Stead et al., 2005). Motivation to comply is the degree to which an individual is interested in following others' observed opinions (Hill et al., 1977).

Ajzen and Madden (1986) defined perceived control as “a user’s perceptions of the availability of required resources and opportunities to perform a particular behaviour”. Chipperfield, Perry, and Stewart (2012) have defined perceived control as “central to human cognition, motivation, behaviour, and well-being”. The beliefs indicate the perceived control about the frequency of accessing the factors that make behaviour more manageable or more difficult and the beliefs about the power to inhibit or ease a behaviour (Elliot, 2004).

2.6 Summary Road safety campaigns in Rwanda

This paragraph's information is form consulted Rwanda national police magazine by Kabera et al., (2019). On May 13, 2019, a 52 weeks long nationwide campaign to prevent road crashes called “Gerayo Amahoro” was launched to target all categories of road users (pedestrians, cyclists, drivers and motorcycle riders) so that they may understand their role in preventing and combating road crashes. The Rwanda National Police and various stakeholders, including public and private sectors, worked together to educate and train all road users and traffic laws to prevent crashes that continue to affect lives and damage many infrastructures. Before 2019, The duration of yearly road safety campaigns was only a week. The motive behind the launch of a year-long road safety campaign developed from the evident effectiveness of a seven days long road safety campaign. During the launch ceremony, it was presented that 80% of the road crashes were due to negligence and that the number of road crashes per day reduced by 46% during the road safety campaign period. The road safety awareness campaigns reached primary and secondary schools across Rwanda. The objective was to educate children so that they may raise with an awareness of road safety (knowledge of the rules of the road) a campaign in school was that by the Police in collaboration with the National Board of Education (REB), National Commission for Children (NCC) and ANPAER (Association Nationale des Proprietaires des Auto-Ecoles au Rwanda). Below are the key messages conveyed to the drivers and pedestrians during the GERAYO AMAHORO road safety campaign in Rwanda;

Specific message to drivers

- It is forbidden to drive a vehicle under the influence of alcohol
- It is forbidden to drive a vehicle talking on the cell phone
- It is forbidden to drive an uninsured vehicle
- It is forbidden to disconnect the speed governor devices
- It is forbidden to drive a vehicle that did not pass technical inspection
- It is forbidden to drive beyond the specified speed
- It is forbidden to park in an illegal area (especially for motorists).
- It is forbidden to drive without a seat belt or its occupants while it is running
- It is forbidden to ride a motorcycle without a helmet
- It is forbidden to run the red light

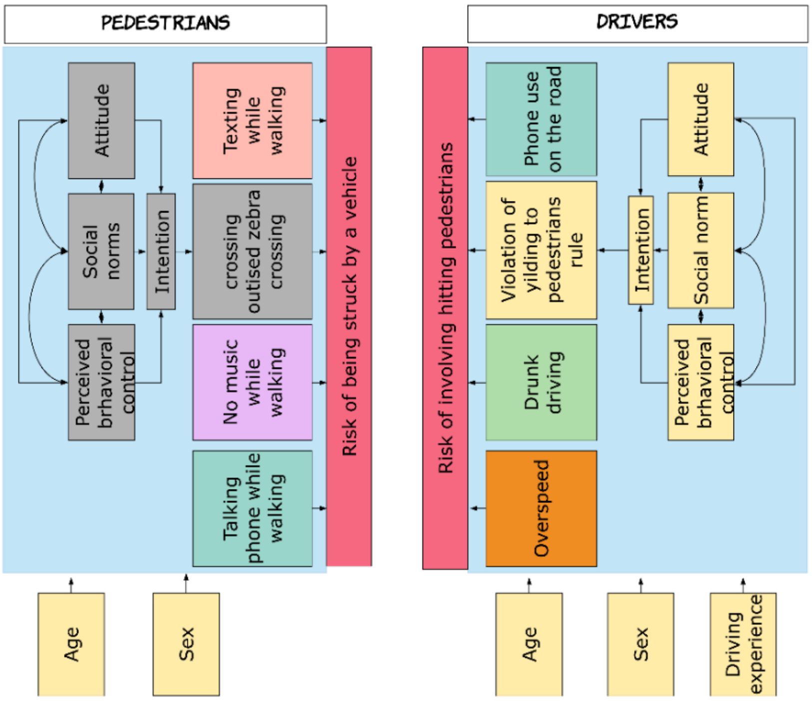
Message to pedestrians

- It is forbidden to cross the road talking on the cell phone
- It is forbidden to walk on the street wearing earplugs
- It is forbidden to cross outside zebra crossings
- It is forbidden to cross the run the red lights
- It is forbidden to talk on the street while you are crossing
- It is forbidden to play on the street (especially students)

2.7 Theoretical framework

This theoretical framework describes what this research is designed. Since all the factors linked with s cannot be exhausted in one study, only the pedestrians' behavioural factors and drivers associated with vehicle-pedestrian crashes are central to this study. The pedestrian's risky behaviours considered in this study are crossing the road outside crosswalks and using a mobile cell phone while walking. For the drivers, this study includes the following risky behaviours: the pedestrian right of way violations, speed limit violations, driving under the influence of alcohol and using the cell phone while driving. Analysing the Impact of this pedestrian and driver behaviours on pedestrian road safety was intended to reveal the behaviours should be prioritized. Of the many possible behavioural change interventions technics, this study intended to generate meaningful information to prepare effective Pedestrian-safety focused awareness campaigns in Rwanda. As clearly illustrates FIGURE 11, the idea is to generate the information which will help to improve the pedestrians-safety focused awareness campaign

Initial situation



Step 1. A needs assessment of the pedestrian safety-focused awareness campaigns

Step 2. Using the information of the needs assessment to improve pedestrian-focused campaigns

Desired situation

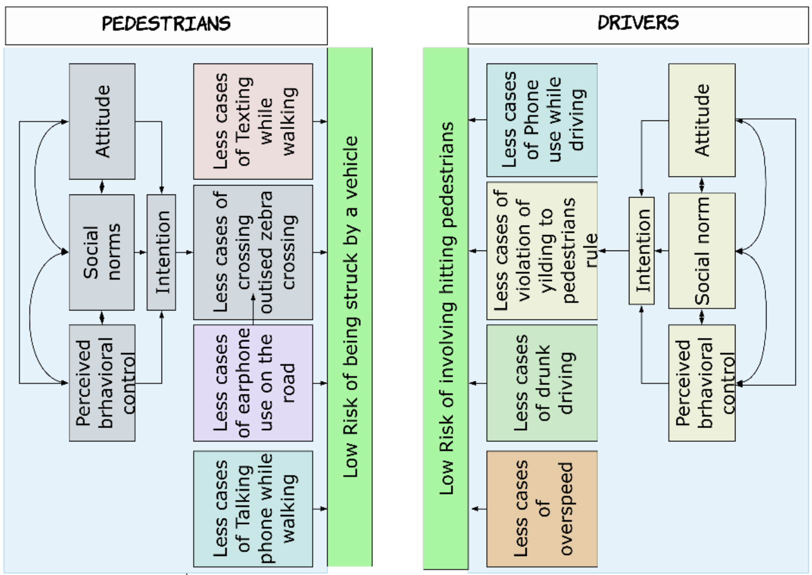


FIGURE 11 Theoretical framework.

CHAPTER THREE: METHODOLOGY

3.1 Respondents selection

Since pedestrians are the most vulnerable victims on the road, their responsibility to minimize the risks of pedestrian crashes is very much needed. Pedestrians aged between 11 years and 20 years were selected to participate in this study. The author expected them to have enough understanding to provide self-reported information about how they walk and behave on the road. Whereas drivers have been selected because according to documented information; vehicles are responsible for most of the pedestrians killed on the road (details can be found in section 2)

3.2 Methodological considerations

3.2.1 Study assumptions

Thanks to ensuring full anonymity to respondents and guiding them to understand the questions, the Self-reporting of risky behaviours on the road helped reveal how road users (drivers and pedestrians) behave. Speeding, disregarding the rule that drivers at pedestrian crossings must yield to pedestrians, exceed speed limits, use cell phones while driving, and drink-driving are known as drivers' risky behaviours. This study assumed them to endanger pedestrians. Crossing the road outside the pedestrian crossings and using mobile cell phones while walking is assumed to be related to the pedestrians' reduced safety on the road. The demographic factors for example gender (Cordellieri et al., 2016) and age(Lyon et al., 2020) generally influence road behaviours; therefore, in this research, they are assumed to be the underlying factors of unsafe driving and walking.

3.2.2 Delimitations of study

The temporal, geographical and methodological boundaries make the scope of this study delimitated. This research is a cross-sectional study; the data has been collected once from the targeted groups of road users (teen pedestrians and drivers). This research did not determine the effectiveness of the pedestrians' safety awareness-raising campaign in Rwanda. Only the analysis focused on determining the pedestrians' road unsafety roots.

The study area is one district of Rwanda (Musanze district), and for the group of pedestrians, only the secondary schools’ students, participated in this study. The responsible motorized transport modes for the pedestrians' fatalities and injuries on the road include motorcycles, three-wheelers, passengers’ cars, buses, and HGV. However, in this research, only the drivers of passenger vehicles, buses truck has been targeted.

3.3 Design of the questionnaires

Two questionnaires were designed, one for teen pedestrians and one for motorists. Both questionnaires are designed in such a way that they can reflect on the objectives of this study. Each questionnaire consists of three main parts; part 1: demographic factors, part 2: theory of planned behaviours, part 3: items for other necessary risky behaviours.

For the driver, the collected data included demographic factors including sex, age, driving experience (years) and his or her near vehicle-pedestrian crash experience (experienced in the last 12 months). For pedestrians; the data about sex, age, and his or her near-crash experience (experienced in the last 12 months) were collected.

Theory of planned behaviours part was designed to collect the data about the proximal and distal determinants of violation of yielding to pedestrians and crossing the road outside zebra crossings.

3.4 Data collection and data handling Methods

3.4.1 Sample size

This study's sample size has been selected based on the recommendation from the past studies; Francis and colleagues (2008) pointed that a minimum sample of 80 recipients for TPB studies using a multiple regression approach should be used. Rashidian et al. (2006) indicated that the published studies' sample sizes that utilized the planned behaviour model theory vary from less than 50 recipients to more than 750 recipients. Therefore, in this study, the goal was to have an immense sample size possible and at least more than 80 respondents also confirmed that a sample of 80 recipients is believed to be acceptable.

3.4.2 Data collection, data storing and value recoding

The unprecedented circumstances due to COVID-19 pandemic negatively affected the data collection process. The initially proposed process of data collection was modified (see). After collecting the data, the data was stored so that responses from each respondent were assigned a unique number; the ID number assignment was done automatically on the data collected using online Qualtrics Surveys Software. For the data collected from the pedestrians using paper-based surveys, each filled questionnaire was given a unique number. Then the coded values of all answers were then entered for all questionnaire items and all questionnaires.

The information collected from high school teen pedestrians and drivers was statistically analysed using the SPSS (IBM SPSS Statistic 25). The first step was to recode the values of the responses on socio-cognitive and behavioural variables. A higher score implies a more supportive view and behaviour towards road safety. The demographic items score was as were recoded so that lower score implies adverse prevalence toward road safety. With the following hypothesis; females (both pedestrians and drivers) behave more favourably than males on the road, older high school pedestrians are better off on the road safety than younger ones, Drivers who acquired higher driving experience drive safely on the road than those with low driving experience. Thus females, older people, highly experienced drivers have been recorded with higher coded value than males, younger people and less experienced drivers respectively.

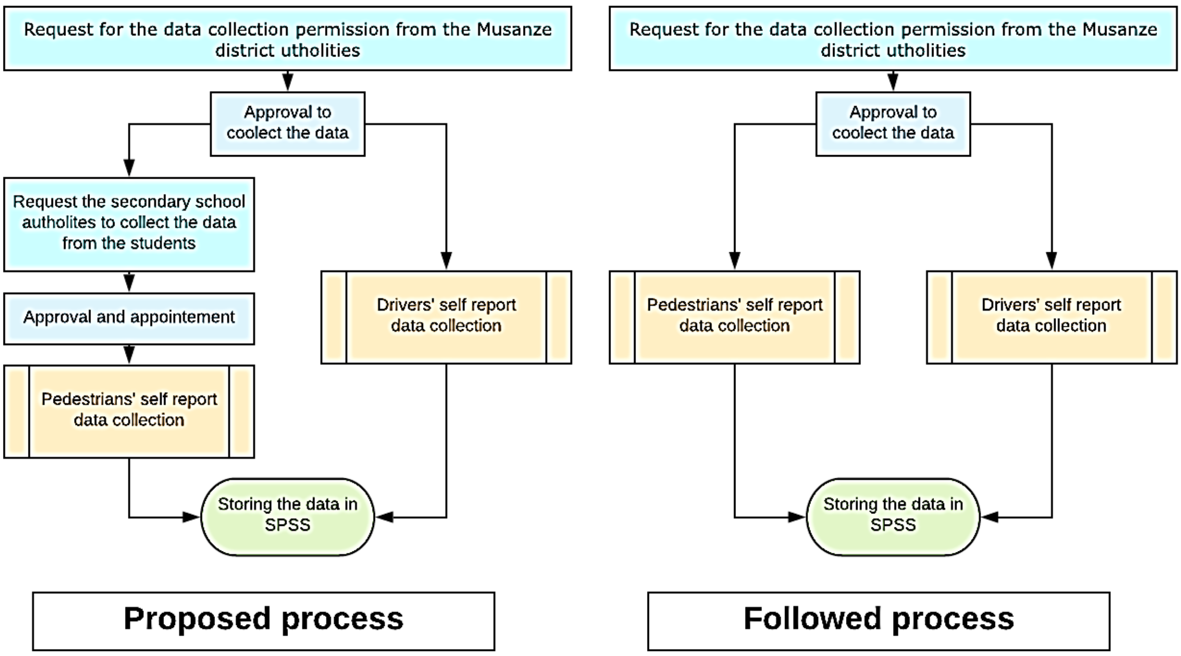


FIGURE 12 Summary of the data collection process.

3.5 Reliability and validity testing of questionnaire items

The guidelines documents of Francis et al. (2008) and Ajzen, (n.d.) helped design the TPB questionnaire items. Ajzen (n.d.) recommends using a 7-points Likert scale and several road traffic safety studies used a five-point scale such the studies by Mann (2010) and Ledesma and colleagues (2018). A 5-point scale has instead been used in the questionnaire used in this study. The target behaviours were defined, taking into account Target, Action, Context and Time (TACT). in order to master the defining a behaviour, the author learned from the format of TPB items used in road safety research questionnaire by Zhou, Horrey, & Yu, (2009).

3.5.1 Construct validity and Reliability through exploratory factor analysis

The factor analysis in SPSS with maximum likelihood methods served to test the questionnaire items' validity; by verifying if they represent the underlying factors (constructs). This process identified the items and the constructs that they predict according to their factor loading weight. Furthermore, only the items with a factor loading greater than 0.5 were retained.

3.5.2 Convergent and discriminant validity and Reliability

The convergent and discriminant validity were assessed using the validity threshold values and conditions from the study of Hair et al. (2010). For discriminant validity, the Average variance extracted (AVE) should be greater than the maximum shared variance (MSV) or average shared squared variance (ASV). The convergent validity is met if AVE is greater than 0.50 and less than CR; these cut-off values have been recommended by Hu & Bentler (1999). For the internal consistency (reliability), The Cronbach's Alpha reliability test was run as a preliminary test to ensure that all the items intended to predict the same constructs. A minimum of 0.6 Cronbach's Alpha coefficient has been accepted. Moreover, a composite reliability limit (CR) of 0.60 was considered the minimum value for acceptable internal consistency.

3.6 Statistical analysis methods

3.6.1 Structural equation modelling

The structural equation modelling (SEM) was done in IBM® SPSS® Amos. The structural equation modelling was used to conduct the descriptive analysis to assess how various risky behaviours translate to crash pedestrian's crash risks; and the confirmatory analysis for the theory of planned behaviours' items.

For the items to be part of a series of items that explain a particular construct, two main conditions were met: the condition to belong to the same factor and a performance condition at 0.6 Cronbach alpha.

The critical consideration for an adequate structural model has been explained widely by other research that provided Statistical guidelines. Notably, Hankins and colleagues (2000) recommended an essential consideration for generating a Structural equation model from the theory of planned behaviour questionnaire data when the multiple regression method is used. The key recommendation from the study of (Hankins et al., 2000) that the expectancy-values data should not be used in the model has been respected. Here the extraction of the factor and Consideration of Non-multivariate normality of the data are discussed

The examination of the residues as recommended by Hankins and colleagues., (2000) has been done in the SPSS using the Maximum Likelihood extraction method in the Factor analysis with PROMAX rotation. The percentage of the residuals greater than .005 was minimized to its lowest possible value while keeping the items' communality values and the factor loadings (regression coefficients). The goodness of fit probability as high as possible. Candidate items were included in the model. Then the scale reliability test was done, the condition was that Cronbach alpha of the candidate items reflecting one construct reaches 0.6. AMOS displays the normality assessments results regarding skewness, kurtosis value and Mahalanobis distance of the observations (questionnaire responses). The condition of the multivariate normality of the variables was not met. AMOS uses the approach of maximum likelihood estimation (ML). The ML analysis condition is that the variables should meet the condition of the multivariate normal distribution. If the normality condition is not met shown that the inflated chi-square could lead to a rejection of a plausible candidate model; which in turn could lead to attempts to re-specify the model; which could lead to a less suitable fashion model; it could also lead to a wrong inference since the underestimation of standard errors would be potential (Byrne, 2013). Among other methods (such as deletion of outlier cases, use other estimation analysis that does not assume the variable's multivariate normality) that could fix the non-multivariate normality issue of the data AMOS bootstrapping procedures have been chosen. The bootstrapping in AMOS is a resampling approach that crates a sample distribution to estimate standard errors and generate bias-corrected confidence intervals (with 95% confidence level) has been conducted with the help of AMOS, cut-off values used for the model fitting are recommended by Hu and Bentler (1999).

3.6.2 Spearman correlation

Before using the logit regression analysis, it was necessary to see the correlation between risky behaviour items, demographic factor items, and vehicle-pedestrians near miss. The Spearman correlation method was chosen instead of the Pearson correlation, and the latter one is used for parametric data, so the non-parametric Spearman correlation method was found more suitable to be used.

3.6.3 logit-ordinal regression analysis

The logit-ordinal regression analysis used the odds ratio (OR), which only the ordinal regression method PLUM (Polytomous Universal Logit Model) provides. Ordinal regression was relevant for two main reasons: first, the points on the questionnaire on the categorical order scale, second, to determine the impact of demographic factors on risk road behaviour and involvement in vehicle-pedestrian collisions, and the impact of risky behaviour on Determining vehicle-pedestrian collisions is the goal of this study.

In the ordinal regression using SPSS, the model fitting information presents a comparison between the final model (a model containing the independent variable) and the model without the parameter estimates. When $p>0.05$; there is evidence that the parameter estimate does not significantly improve the model; the independent variable in the model predicts a small amount of variance. The goodness of fit tells the extent to which the independent variables predict the dependent variable (in the model), and the Pseud, R explains the variation explained in the outcome.

In this research, the demographic factors (independent variables) were used; first, as the predictors of the risky behaviours, the second was the predictors of pedestrian crashes (measured from near-crash experience).

PLUM ordinal regression approach estimated the odds ratios of the vehicle-pedestrian near-crash involvement depending on how often drivers and pedestrians involved in risky behaviours. FIGURE 13 indicates drivers' categories depending on how often they have reported having been involved in different risky behaviours in the last 12 months. Moreover, FIGURE 14 is a graphical representation of the categories of risky pedestrian behaviours in which they are sequenced, and likewise, they were also used in the ordinal regression analysis. As can be seen, it starts at the lower level (low frequency of involvement of risky behaviour) and ends at the upper level (high frequency of involvement of risky behaviour).

It should be clear that the odds ratio is used to capture information about the increase or decrease that would occur if the predictor variable increases or decreases to a higher or lower. Furthermore, this is necessary because this research serves as a need’s assessment for behavioural interventions and performance levels of given behaviour have predetermined in this study.

Category 5		All trips		
Category 4		Most of the trips	All trips	
Category 3	Often	Half of the trips	Most of the trips	More than once per year
Category 2	Sometimes	A quarter of the trips	A quarter of the trips	At least once per year
Category 1	Never	Never	Never	Never
	Violation of yielding to pedestrians	Exceeding the speed limit	Cell phone use while driving	Drunk driving

FIGURE 13 categories of risky behaviours of the drivers.

Level 5	>80%	>80%		>80%	>80%
Level 4	60%-80%	60%-80%		60%-80%	60%-80%
Level 3	40%-60%	40%-60%	>40%	40%-60%	40%-60%
Level 2	20%-40%	20%-40%	20%-40%	20%-40%	20%-40%
Level 1	<20%	<20%	<20%	<20%	<20%
	Crossing outside zebra crossings	Talking Cell phone while walking	Earphone music listening while walking	Texting while on the road	Checking a content while on the road

FIGURE 14 categories of risky behaviour of the pedestrian.

CHAPTER FOUR: RESULTS

4.1 Pedestrian data analysis results

4.1.1 Highschool student participants

High school students living in Musanze district filled out questionnaires. The original plan was to reach pedestrian respondents at their schools. However, due to coronavirus total lockdown students were not at school during the data collection period; therefore, high school students were reached in their homes and were asked to fill out questionnaires.

Fifty questionnaires completed in the first days of data collection were discarded because participants were negligent in providing information. Each time before the participants start filling the questionnaires, it was decided to request them to read carefully and answer the questions truthfully. The respondents were given explanations about the questionnaire's structure and the meaning of the scale and asked to be truthful to complete the survey correctly. A total of 222 paper-based questionnaires were filled; 20 random questionnaires were removed to equalize the number of participants concerning demographic factors (age and gender). TABLE 1 contains the demographic information of the pedestrian respondents.

TABLE 1 Sex * Age Cross tabulation for secondary school respondents (pedestrians)

		Age (years)					Total
		11 - 12	13 - 14	15 -16	17 - 18	18-20	
Sex	Male	15	15	16	15	15	76
	Female	15	15	16	15	15	76
Total		30	30	32	30	30	152

4.1.2 Descriptive statistics of self-reported data from pedestrians

TABLE 2 contains descriptive statistics of the responses provided by high school students. The TPB items were treated as continuous variables. The mean, standard errors and skewness are in the table. The pedestrians' questionnaire is in Appendix 1(English translation version) and Appendix 2 (Kinyarwanda version). The questionnaire items aiming at gathering information about risky pedestrian behaviours that would affect traffic safety were treated as categorical variables. The questionnaire initially had a 5-point scale but based on some analysis from this study, some of the categories were merged (see categories in FIGURE 13). to provide insight into the risky behaviours of pedestrians, graphics are used in FIGURE 15. The responses of female participants and those of males are separated for better visualization. in addition to the risky traffic behaviours, a graph presenting their near-miss crash experiences in the past 12 months.

TABLE 2 Descriptive Statistics for data from the pedestrian

	All (152)			Females (n=76)			Males (n=76)		
	Mean	Std. Error	Skewness	Mean	Std. Error	Skewness	Mean	Std. Error	Skewness
att1	3.18	0.11	-0.36	3.03	0.16	-0.20	3.33	0.15	-0.53
att2	2.57	0.11	0.53	2.64	0.16	0.40	2.49	0.16	0.69
att3	3.07	0.11	-0.01	2.95	0.16	0.10	3.20	0.16	-0.12
att4	2.36	0.10	0.64	2.39	0.14	0.58	2.33	0.15	0.72
sn1	2.16	0.09	1.23	2.13	0.11	1.11	2.20	0.13	1.30
sn2	1.44	0.05	1.74	1.45	0.06	0.22	1.43	0.07	2.45
sn3	1.92	0.08	1.36	1.87	0.11	1.68	1.97	0.11	1.05
sn4	1.93	0.07	1.21	1.99	0.10	1.14	1.87	0.10	1.31
sn5	1.98	0.08	1.27	2.05	0.12	1.26	1.91	0.12	1.33
PBC1	3.81	0.11	-0.80	3.79	0.16	-0.74	3.83	0.15	-0.89
PBC2	3.86	0.10	-0.90	3.89	0.15	-0.85	3.82	0.15	-0.95

PBC3	3.23	0.11	-0.17	3.22	0.16	-0.20	3.24	0.16	-0.15
PBC4	3.49	0.12	-0.42	3.54	0.17	-0.55	3.43	0.18	-0.31
Int1	2.84	0.10	0.11	2.71	0.13	0.15	2.96	0.14	0.03
Int2	3.17	0.11	0.02	3.17	0.15	-0.01	3.17	0.15	0.05
Int3	2.70	0.10	0.38	2.64	0.16	0.42	2.76	0.14	0.38
Int4	2.74	0.10	0.27	2.78	0.14	0.23	2.71	0.14	0.31

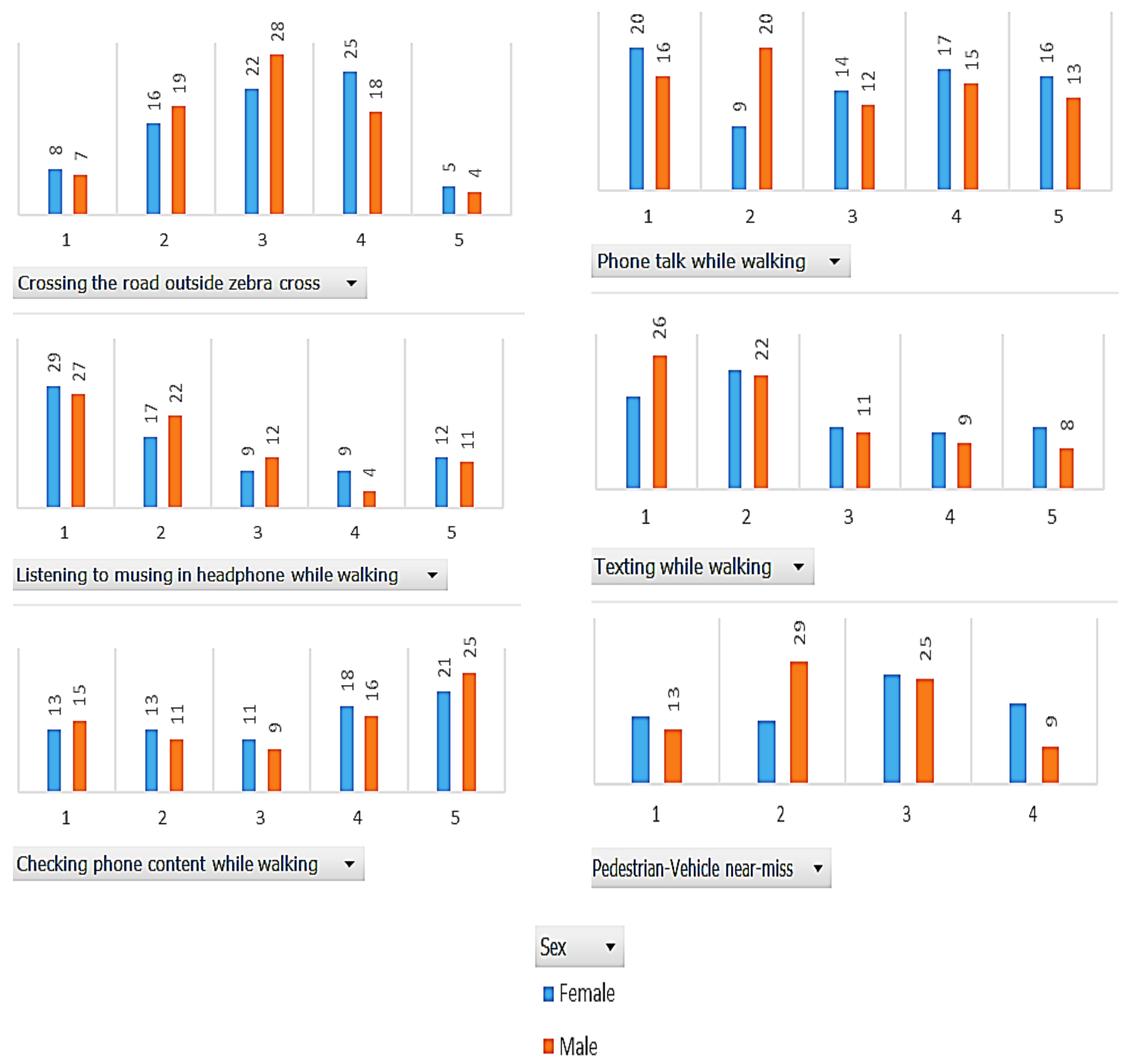


FIGURE 15 Pedestrians in risk behaviours categories and near-crash experience categories

4.1.3 TPB model for the behaviour of crossing outside zebra crossings

4.1.3.1 Validity and reliability of the TPB model for crossing outside zebra crossings behaviour

The theory of planned behaviours model generated an association between proximal and distal determinants of the behaviour of the violation of the zebra crossing outside a pedestrian crossing (when pedestrian crossings are in less than 50 meters away). Only 13 out of 18 items passed the validity test (see TABLE 3). The exploratory and confirmatory factor analysis was done; the Exploratory Factor Analysis (EFA) used a first-order model of the attitude, subjective norms, perceived behaviours control and intention constructs as first-order constructs (see FIGURE 16).

Five constructs were extracted from the combination of candidate elements that had passed the validity and reliability test (using the maximum likelihood method and PROMAX rotation with Kaiser Normalization in SPSS). Only four constructs were expected, the 5th factor (construct) resulted from the fact that the perceived behavioural control items for crossing outside zebra crossing generated two different constructs: to cross outside the zebra crossings due to implicit rewarding motivation to violate for instance if a pedestrian is in a hurry or tired (PCM_IMV) and to cross outside zebra crossings due to direct (explicit) rewarding motivation to violate (PBC_DMV), for instance when someone or an opportunity is on the other side of the street motivates a pedestrian to cross as quickly as possible).

TABLE 3 TPB items before and after the EFA

Constructs	Number of items before validation	Number of items after validation
Behaviour	1	1
Intention	4	3
PBC_IMV	4	2
PBC_DMV		2
SN	5	3
Attitude	4	2
Total	18	13

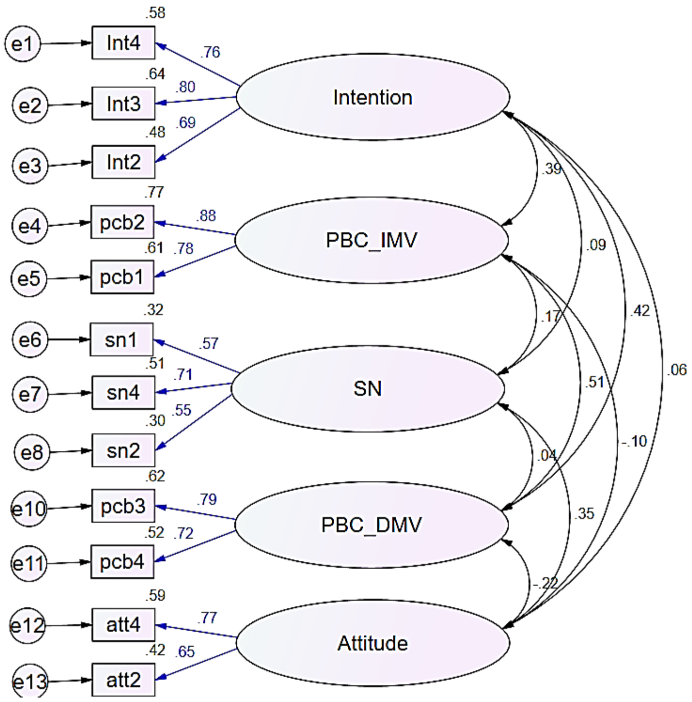


FIGURE 16 1st order model for TPB model for construct of crossing outside zebra crossings

The validity tests conducted on the theory of planned behaviour’s items used AVE, MSV and Max(R) to assess the constructs (both discriminant and convergent validity), and CR to assess the items' internal consistency reliability the same construct. TPB model constructs on crossing outside zebra crossings, except the subjective norms’ construct with an AVE value of 0.376 (indicating that SN elements had a low convergent validity), CR for Subjective norm and attitude constructs slightly below 0.7.

TABLE 4 Reliability and validity of the TPB items for the crossing outside the zebra crossings

	Constructs	CR	AVE	MSV	MaxR(H)
	Intention	0.798	0.569	0.18	0.805
	PBC_IMV	0.818	0.692	0.265	0.833
Questionnaire to pedestrians	PBC_DMV	0.728	0.573	0.265	0.733
	SN	0.641	0.376	0.122	0.659
	Attitude	0.673	0.509	0.122	0.687

4.1.3.2 Confirmatory factor analysis of the TPB model of crossing outside zebra crossings

The association between the behaviour of crossing outside the zebra crossings and its determinants was determined using the theory of planned behaviour. The structural equation model was generated, and the significance of determinants in predicting the outcome variables are indicated in the structural equation model using the colour symbol of arrows in the structural equation model (Green: P>0.05, Yellow: 0.05 <p<0.1). The values in red colour are the R^2values (proportion of the explained variance). Note that the indirect effect of PBC_DMV construct on the behaviour of crossing outside zebra crossings is insignificant. The tables containing the standardised effects (Total, direct and indirect) coefficients and their statistical powers are given in Appendix 5.

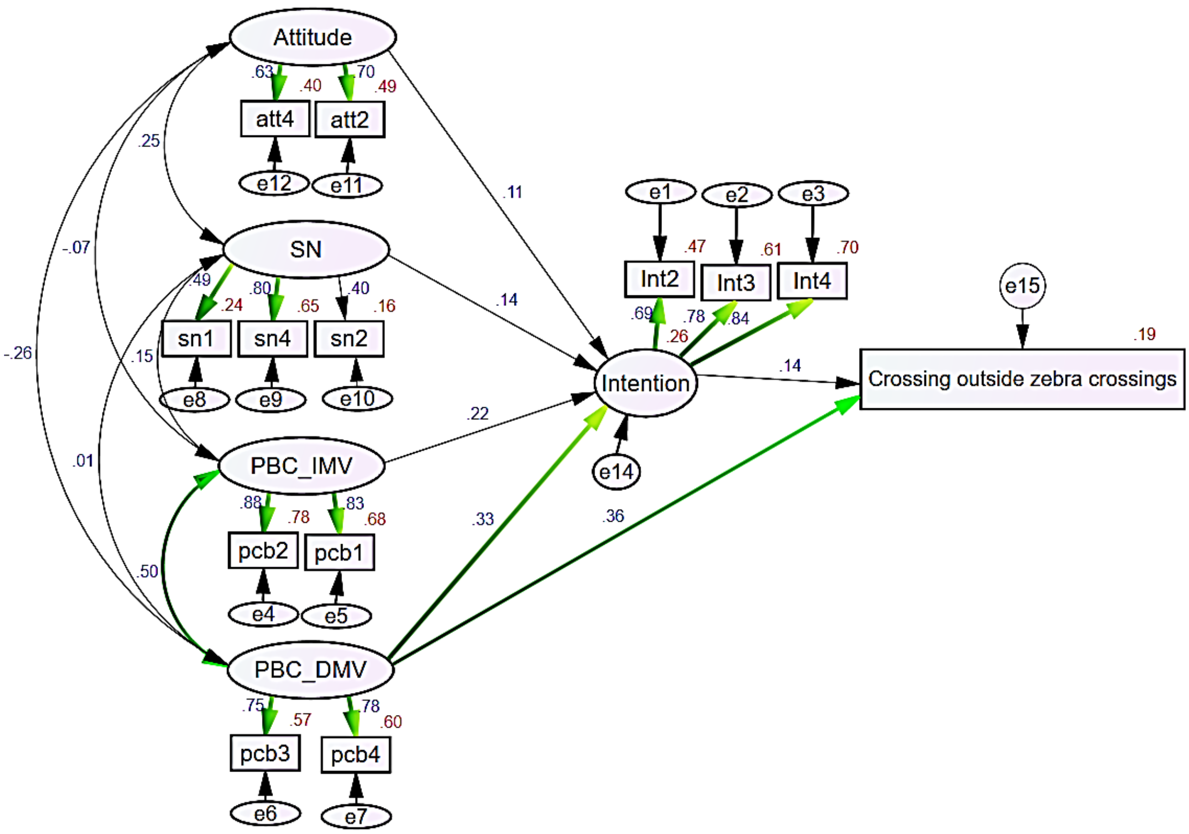


FIGURE 17 Path model for crossing outside zebra crossings behaviour.

TABLE5 contains the model fitness results; AMOS was used in determining the fitness of the model, AMOS plugin tools from *Gaskin and Lim (2016)* generated the interpretation that used the cut off criteria from the study of Hu and Bentler (1999)

TABLE5 Fitness measures of TPB model for the behaviour of crossing outside zebra crossing

Measure	Estimate	Threshold	Interpretation
CMIN	103.660	--	--
DF	55	--	--
CMIN/DF	1.885	Between 1 and 3	Excellent
CFI	0.906	>0.95 excellent, 0.9-0.95 acceptable	Acceptable
SRMR	0.068	<0.08	Excellent
RMSEA	0.078	<0.06 excellent, 0.06-0.1 acceptable	Acceptable
PClose	0.028	>0.05 excellent, 0.01-0.05 acceptable	Acceptable

4.1.3.3 Bootstrap for TPB model of crossing the road outside zebra crossing

Since the multivariate normality was not met the Bollen-Stine Bootstrap p-value was computed in AMOS. The model was found to fit better up to 110 out of 105 bootstrap samples. Testing the null hypothesis that the model is correct, Bollen-Stine bootstrap p = .015. Below is a bootstrap distribution

(Bootstrap samples N = 1000, Mean = 62.005, S. e. = 0.701);

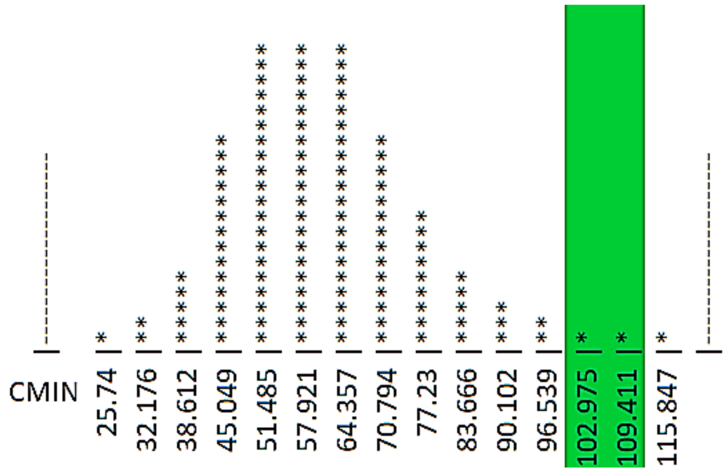


FIGURE 18 Bootstrap distribution.

4.1.4 Effect of Pedestrian risky behaviours on vehicle-pedestrian crashes.

4.1.4.1 Spearman correlation: pedestrian's risky behaviours and pedestrian near-crash experience

FIGURE 19 presents the statistically significant correlation among the risky pedestrian behaviour covered in this study: crossing the road outside the crosswalk and using the cell phone while walking; namely: talking on the cell phone, listening to earphone music and checking various contents in the cell phone. The questionnaire items measured the involvement of pedestrians in risky behaviours. The pedestrian behaviours related to cell phone use while walking significantly correlated with each other. Only listening to earphones music significantly associated with passing outside crosswalks and the only phone calling and texting while walking correlated with near-crash experience.

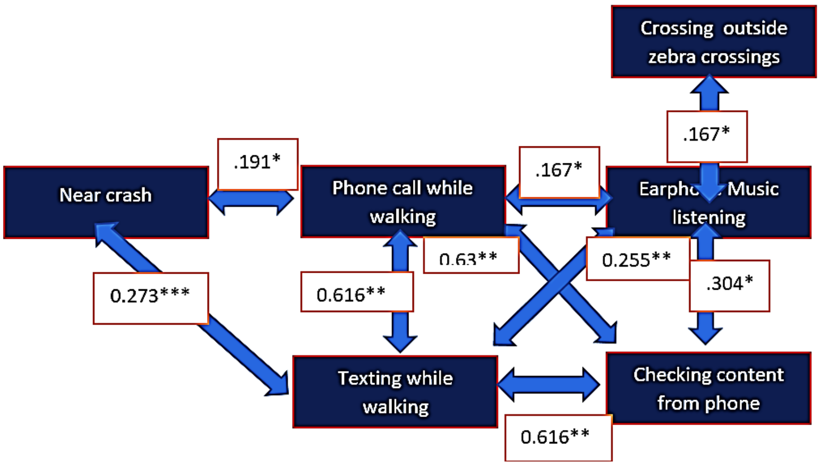


FIGURE 19 Correlation between driver's behaviours.

4.1.4.2 Prediction of risky pedestrian behaviour on vehicle-pedestrian crashes

The level of pedestrian involvement in risky behaviours could predict the risk of a pedestrian's crash. Together, the risky pedestrian behaviours covered in this study were found to explain 12.4% of the pedestrian near-miss variation. Crossing the road outside the zebra cross explains only 1% and cell phone use. In contrast, walking explains 15% (3.7%: talking on the cell phone while walking, 0.2%: listening to music on earphones while walking, 7.1% texting while walking and 0.5% checking cell phone content while walking on the road), The results have been found thank to the analysis of variance in SPSS and AMOS was also used to produce the diagram of structural equation model presented in FIGURE 20. As can be seen the R^2 (in red) as a measure of variance explained is equal to 0.16 (16%). The standardized regression weights are also presented on top of arrows, with blue colour and a green arrow indicating statistically standardized significant regression weight. The pedestrians' risky behaviours studied in this study are texting while walking, talking on the cell phone while walking, crossing the road outside zebra crossings, checking the cell phone content while walking and listening to earphone music while walking. In the same order as there are mentioned, they predict better the pedestrians near-crash experiences.

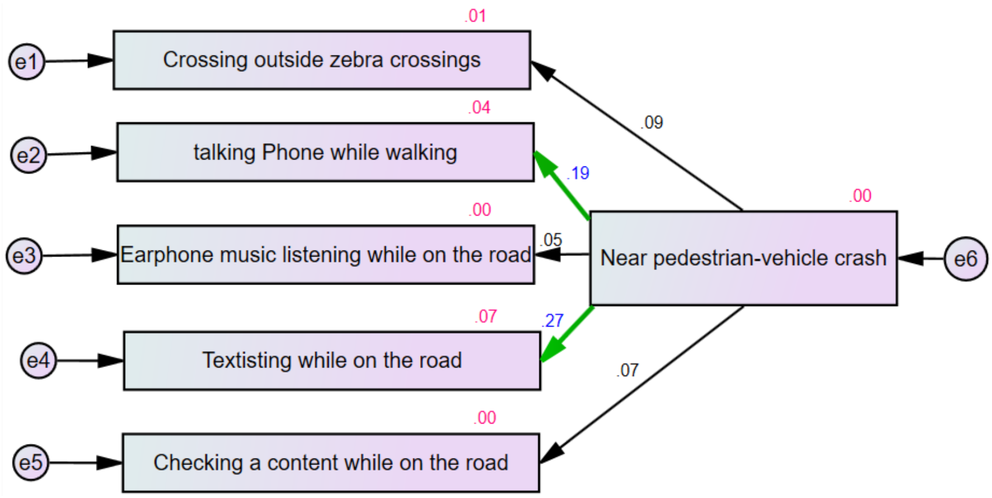


FIGURE 20 SEM for risky pedestrian behaviours as predictors of near pedestrian crashes.

4.1.5 Pedestrians' risky behaviours effect on the occurrence of vehicle-pedestrian crashes

4.1.5.1 Effect of crossing outside zebra crossings on the risk of pedestrian's crashes

Four levels were of often the pedestrians cross the road outside zebra crossing From TABLE 6; it can be seen that increased crossing of the road outside zebra crossings was associated with an increase in the odds of being hit by a vehicle, with an odds ratio of 1.2 (95% CI, 0.892 to 1.527) comparing a category with the next upper category. Wald χ2 (1) = 1.271, p> 0.05 this means that this effect is insignificant (for more details, consult Model 7 in Appendix 5).

TABLE 6 Effect of crossing outside zebra crossings on the risk of pedestrian's crashes

		Estimate	St. Error	Wald	df	Sig	L.B.	U. B	Exp_B	Lower	Upper
Threshold	[PVNC = 1]	-0.991	0.448	4.897	1	0.027	-1.87	-0.113	0.371	0.154	0.893
Threshold	[PVNC = 2]	0.386	0.439	0.773	1	0.379	-0.474	1.245	1.47	0.623	3.473
Threshold	[PVNC = 3]	1.961	0.468	17.537	1	0	1.043	2.878	7.103	2.838	17.78
Location	COZC	0.155	0.137	1.271	1	0.26	-0.114	0.424	1.167	0.892	1.527

4.1.5.2 Effect of the cell phone talking while walking on the risk of being hit by a vehicle

According to the results from TABLE 7, shifting to the next upper category of talking on the cell phone while walking is associated with increased vehicle-pedestrian crash risk with an odds ratio of 1.3 (95% CI, 1.053 to 1.575). statistically, this effect is significant, Wald χ2 (1) = 6.075, p <0.05 (for more details, consult Model 8 in Appendix 5).

TABLE 7 Effect of talking on the cell phone while walking the risk of being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[PVNC = 1]	-0.737	0.346	4.524	1	0.033	-1.416	-0.058	0.479	0.243	0.944
Threshold	[PVNC = 2]	0.668	0.341	3.83	1	0.05	-0.001	1.337	1.95	0.999	3.806
Threshold	[PVNC = 3]	2.274	0.387	34.479	1	0	1.515	3.033	9.716	4.549	20.755
Location	P_Tlk	0.253	0.103	6.075	1	0.014*	0.052	0.454	1.288	1.053	1.575

*Significant at p<0.05

4.1.5.3 Effect of listening to earphones music while walking the risk of being hit by a vehicle

TABLE 8 shows that increased earphones music listening on while walking increased the odds of being hit by a vehicle, with an odds ratio of 1.1 (95% CI, 0.869 to 1.297). Wald χ2 (1) = 0.346. However, this effect is insignificant p > 0.05 (for more details, consult Model 9 in Appendix 5)

TABLE 8 Effect of listening to music while walking the risk of being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[PVNC = 1]	-1.303	0.316	17.024	1	0	-1.923	-0.684	0.272	0.146	0.504
Threshold	[PVNC = 2]	0.063	0.293	0.046	1	0.83	-0.512	0.637	1.065	0.6	1.891
Threshold	[PVNC = 3]	1.632	0.326	25.066	1	0	0.993	2.271	5.113	2.699	9.686
Location	P_Msc	0.06	0.102	0.346	1	0.557	-0.14	0.26	1.062	0.869	1.297

4.1.5.4 Effect of texting while walking the risk of being hit by a vehicle

TABLE 9 indicates that increased texting while walking increased the risk of being hit by a vehicle, with an odds ratio of 1.5 (95% CI, 1.191 to 1.845). Statistically, this effect is highly significant, Wald χ2 (1) = 12.469, p < 0.001 (for more details, consult Model 10 in Appendix 5)

TABLE 9 Effect of texting while walking the risk of being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[PVNC = 1]	-0.527	0.324	2.651	1	0.104	-1.162	0.107	0.59	0.313	1.113
Threshold	[PVNC = 2]	0.912	0.322	8.013	1	0.005	0.281	1.544	2.49	1.324	4.683
Threshold	[PVNC = 3]	2.568	0.383	44.992	1	0	1.818	3.319	13.043	6.159	27.626
Location	P_Txt	0.394	0.111	12.469	1	0.001**	0.175	0.612	1.482	1.191	1.845

**Significant at p<0.01

4.1.5.5 Effect of checking cell phone content while walking the risk of being hit by a vehicle

TABLE 10 gives the information that shifting to the next level of checking the cell phone content while walking, increased the risk of being hit by a vehicle with an odds ratio of 1.1 (95% CI, 0.895 to 1.313). Wald $\chi 2$ (1) = 0.676, this effect is statistically insignificant (p> 0.05). for more details, consult Model 11 in Appendix 5.

TABLE 10 Effect of checking cell phone content while walking on the risk being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[PVNC = 1]	-1.18	0.377	9.797	1	0.002	-1.92	-0.441	0.307	0.147	0.643
Threshold	[PVNC = 2]	0.19	0.361	0.277	1	0.598	-0.518	0.899	1.21	0.596	2.456
Threshold	[PVNC = 3]	1.76	0.392	20.195	1	0	0.992	2.528	5.812	2.698	12.522
Location	P_Cont	0.08	0.098	0.676	1	0.411	-0.111	0.272	1.084	0.895	1.313

4.1.6 Pedestrians' demographic factors

This section includes results that show how demographic factors play a role in making it difficult for investors to engage in risky behaviours and how demographic factors determine the risk of being collided by a vehicle.

4.1.6.1 Effect of pedestrian demographic factors on being hit by a vehicle

TABLE 11shows that the increase in age of pedestrians is associated with an increased risk of being hit by a vehicle, with an odds ratio of 1.3 (95% CI, 1.083 to 1.645) and statistically, this effect is highly significant Wald $\chi 2$ (1) = 7.322, p < 0.01 (for more details, consult Model 6 in Appendix 5).

Male teen pedestrians in Musanze are at higher risk of being hit by a vehicle than female teen pedestrians, The odds between male and female secondary school students risk of being hit by a vehicle was found to be 1.5 (95% CI, 0.858 to 2.728), Wald $\chi 2$ (1) = 2.072, this effect of gender is though insignificant (p > 0.05) (for more details, consult Model 6 in Appendix 5).

TABLE 11 Effect of pedestrian demographic factors on being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	LB	U B	Exp_B	Lower	Upper
Threshold	[Risk = 1]	-0.428	0.388	1.217	1	0.27	-1.188	0.332	0.652	0.305	1.394
Threshold	[Risk = 2]	0.999	0.391	6.549	1	0.01	0.234	1.765	2.717	1.264	5.84
Threshold	[Risk = 3]	2.635	0.44	35.842	1	0	1.772	3.498	13.944	5.885	33.04
Location	Age	0.289	0.107	7.322	1	0.007**	0.08	0.498	1.335	1.083	1.645
Location	[Sex=0]	0.425	0.295	2.072	1	0.15	-0.154	1.004	1.53	0.858	2.728
Location	[Sex=1]	0			0				1		

**Significant at p<0.01

4.1.6.2 Effect of demographic factors on crossing outside zebra crossings

TABLE 12 shows that the increase in age is associated with a decrease of probability of crossing outside zebra crossings, with an odds ratio of 0.8 (95% CI, 0.655 to 0.99) and statistically, this effect is significant Wald $\chi 2$ (1) = 4.239, p = 0.04 (for more details, consult Model1 in Appendix 5). For male secondary school students, the odds of crossing outside zebra crossings were found to be 1.3 (95% CI, 0.736 to 2.319) times that of female secondary school students. Wald $\chi 2(1) = 0.831$, p>0.05 (for more details, consult Model1 in Appendix 5).

TABLE 12 Effect of demographic factors on crossing outside zebra crossings

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[COZC = 1]	-2.777	0.456	37.023	1	0	-3.671	-1.882	0.062	0.025	0.152
Threshold	[COZC = 2]	-1.238	0.395	9.823	1	0.002	-2.012	-0.464	0.29	0.134	0.629
Threshold	[COZC = 3]	0.168	0.381	0.193	1	0.66	-0.579	0.915	1.182	0.56	2.496
Threshold	[COZC = 4]	2.295	0.475	23.343	1	0	1.364	3.226	9.924	3.912	25.178
Location	Age	-0.217	0.105	4.239	1	0.04*	-0.423	-0.01	0.805	0.655	0.99
Location	[Sex=0]	0.267	0.293	0.831	1	0.362	-0.307	0.841	1.306	0.736	2.319
Location	[Sex=1]	0			0				1		

*Significant at p<0.05

4.1.6.3 Effect of demographic factors on talking on the cell phone while walking

TABLE 13 presents the findings that older teen pedestrians are more likely to talk on the cell phone while walking than young teen pedestrians with an odds ratio of 1.5 (95% CI, 1.209 to 1.838) between the pedestrian's lower category and those in the next higher category. This effect is statistically highly significant Wald $\chi 2$ (1) = 13.964, p < 0.001 (for more details, see Model 2 in Appendix 5). TABLE 13 also shows that for male high school students, the chance of using the cell phone while walking was 1.1 (95% CI, 0.647 to 2.009) times that of female high school students, Wald $\chi 2$ (1) = 0.205, p = 0.651 (for more details, see Model 2 in Appendix 5).

TABLE 13 Effect of demographic factors on talking on the cell phone while walking

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[P_Tlk = 1]	0.027	0.379	0.005	1	0.943	-0.717	0.771	1.027	0.488	2.162
Threshold	[P_Tlk = 2]	0.97	0.385	6.347	1	0.012	0.215	1.724	2.637	1.24	5.607
Threshold	[P_Tlk = 3]	1.713	0.402	18.166	1	0	0.925	2.501	5.547	2.523	12.196
Threshold	[P_Tlk = 4]	2.819	0.44	40.985	1	0	1.956	3.682	16.756	7.069	39.715
Location	Age	0.399	0.107	13.964	1	0**	0.19	0.609	1.491	1.209	1.838
Location	[Sex=0]	0.131	0.289	0.205	1	0.651	-0.436	0.698	1.14	0.647	2.009
Location	[Sex=1]	0			0				1		

** Significant at p<0.01

4.1.6.4 Effect of demographic factors on listening to earphone music while walking

TABLE 14 presents the information that increasing age (by two years) is associated with a greater likelihood of listening to music through earphones while walking, with an odds ratio of 1.2 (95% CI 0.995 to 1.543). Wald $\chi 2$ (1) = 3.682, p = 0.055, the effect of age on listening to music while walking is non-significant (for more details see Model 3 in Appendix 5). For male high school students, the likelihood of listening to music through earphones while walking is slightly smaller than that of female high school students. However, the effect of sex on listening to earphone music while walking is statistically insignificant.

TABLE 14 Effect of demographic factors on listening to music from held cell phone while walking

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[P_Msc1 = 1]	0.1	0.399	0.063	1	0.802	-0.682	0.883	1.105	0.505	2.418
Threshold	[P_Msc1 = 2]	0.678	0.403	2.828	1	0.093	-0.112	1.468	1.97	0.894	4.34
Location	Age	0.214	0.112	3.682	1	0.055*	-0.005	0.434	1.239	0.995	1.543
Location	[Sex=0]	-0.01	0.311	0.001	1	0.975	-0.62	0.6	0.99	0.538	1.823
Location	[Sex=1]	0			0				1		

*Significant at p<0.05

4.1.6.5 Effect of demographic factors on texting while walking

In TABLE 15, the presented information that increased age is associated with increased odds of texting while walking, with an odds ratio of 1.4 (95% CI, 1.148 to 1.747) and statistically, this effect is highly significant Wald$\chi 2$(1) = 10.585, P = 0.001 (See in the Appendix the Model 4 for more information). For high school boys, the probability of texting while walking was found to be 1.6 (95% CI, 0.89 to 2.812) times that of high school girls. Wald $\chi 2$ (1) = 2.439, p = 0.118 (see Model 4 in Appendix 5 for details).

TABLE 15 Effect of demographic factors on texting while walking

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[P_Txt = 1.0]	0.359	0.383	0.879	1	0.348	-0.391	1.109	1.432	0.676	3.032
Threshold	[P_Txt = 2.0]	1.684	0.406	17.176	1	0	0.888	2.481	5.388	2.43	11.95
Threshold	[P_Txt = 3.0]	2.385	0.428	31.007	1	0	1.545	3.224	10.856	4.689	25.13
Threshold	[P_Txt = 4.0]	3.264	0.466	48.982	1	0	2.35	4.178	26.155	10.485	65.243
Location	Age	0.348	0.107	10.585	1	0.001**	0.138	0.558	1.416	1.148	1.747
Location	[Sex=0]	0.459	0.294	2.439	1	0.118	-0.117	1.034	1.582	0.89	2.812
Location	[Sex=1]	0			0				1		

**Significant at p<0.01

4.1.6.6 Effect of demographic factors on checking the cell phone content while walking

TABLE 16 presents the findings that the increase in age is associated with an increase in the probability of checking the contents of the cell phone while walking, with an odds ratio of 1.3 (95% CI, 1.096 to 1.657) and statistically, this effect is significant Wald $\chi 2$ (1) = 8.021, p = 0.005 (for more details, see model 5 in the appendix). TABLE 16 also shows that for high school boys, the odds of checking cell phone content while walking were 0.9 (95% CI, 0.511 to 1.592) times that of high school girls, Wald $\chi 2$ (1) = 0.127, p>0.01 (for more details, see model 5 in Appendix 5)

TABLE 16 Effect of checking cell phone content while walking on the risk of being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[P_Cont = 1]	-0.696	0.387	3.228	1	0.072	-1.454	0.063	0.499	0.234	1.065
Threshold	[P_Cont = 2]	0.17	0.377	0.204	1	0.652	-0.569	0.91	1.186	0.566	2.484
Threshold	[P_Cont = 3]	0.742	0.382	3.775	1	0.052	-0.006	1.49	2.1	0.994	4.439
Threshold	[P_Cont = 4]	1.717	0.402	18.235	1	0	0.929	2.506	5.57	2.532	12.253
Location	Age	0.298	0.105	8.021	1	0.005**	0.092	0.505	1.348	1.096	1.657
Location	[Sex=0]	-0.103	0.29	0.127	1	0.722	-0.672	0.465	0.902	0.511	1.592
Location	[Sex=1]	0			0				1		

**Significant at p<0.01

4.2 Results from analysis of the data from drivers

4.2.1 Drivers Participants

At the beginning of the drivers' data collection, respondents were asked to complete the survey on paper-based questionnaires. Later it becomes clear that the information from drivers using this approach was not truthful (it was insinuated that this approach did not provide enough anonymity for the respondents to give the road safety information that they consider sensitive).

The online questionnaire was then used; The total number of drivers who took part in completing the online questionnaire is 136; however, only 102 responses were used in the analysis because 34 responses were discarded (10 incomplete responses, 18 responses from the participants who were not in Rwanda, according to the geographic coordinates recorded by the Qualtrics, and outlier responses eight responses). Only five female drivers took part in the online survey, due to this underrepresentation of female participants, the effect of sex (as a demographic factor) was not evaluated.

TABLE 17 Demography of the driver respondents

Types		Frequency	Percentage
Sex			
	Female	5	4.9
	Male	97	95.1
Age (years)			
	18 - 24	16	15.7
	25 - 34	50	49.0
	35 - 44	23	22.5
	45 - 54	13	12.7
Driving experience (years)			
	Less than 2	23	22.5
	2 - 4	29	28.4
	5 - 7	20	19.6
	8 - 10	14	13.7
	More 10	16	15.7

4.2.2 Descriptive statistics of self-reported data from pedestrians

TABLE 18 contains descriptive statistics of the data considered as continuous in the analysis. FIGURE 21 shows the number of teen pedestrians (vertical axis) in the categories (horizontal axis) indicating the frequency with which they are involved in the risky behaviours.

TABLE 18 Descriptive Statistics of the data from drivers

	Mean	Std. Error	Skewness
Att1	2.59	.131	.591
Att2	3.27	.121	-.711
Att3	2.87	.148	-.196
Att4	2.30	.115	.938
SN1	1.88	.099	1.338
SN2	1.94	.096	1.237
SN3	1.54	.101	2.281
SN4	1.59	.087	1.884
SN5	1.85	.107	1.391
PBC1	2.62	.110	.497
PBC2	2.77	.126	.376
PBC3	2.52	.118	.472
PBC4	2.67	.134	.386
INT1	1.93	.123	1.106
INT2	2.12	.133	.878
INT3	2.05	.132	.887
INT4	1.91	.124	1.221

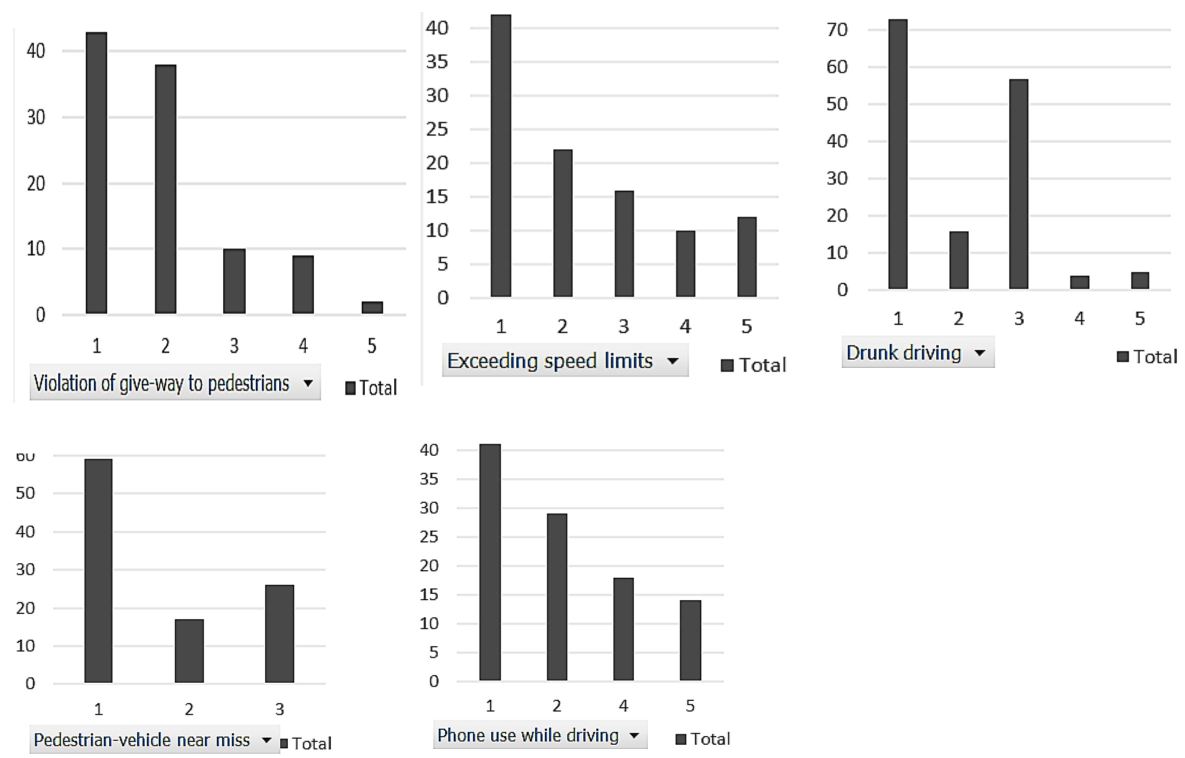


FIGURE 21 Number of drivers in different categories of risky road behaviours.

4.2.3 TPB model for the behaviour of violation of yielding to pedestrian

4.2.3.1 Validity and reliability of the TPB model for yielding to pedestrians' violation

In this study, the same approach described in section 4.1.3.1 has been used, only 11 out of 18 items in the original questionnaire were retained, the exploratory and confirmatory factor analysis was done the same way described in section 4.1.3.1. FIGURE 16 shows the 1st order model from the exploratory factor analysis. As can be seen, four constructs were extracted using the maximum likelihood method, Promax rotation with Kaiser Normalization in SPSS; TABLE 19 presents the account of items in the original questionnaire and the items that were retained after the exploratory factors' analysis

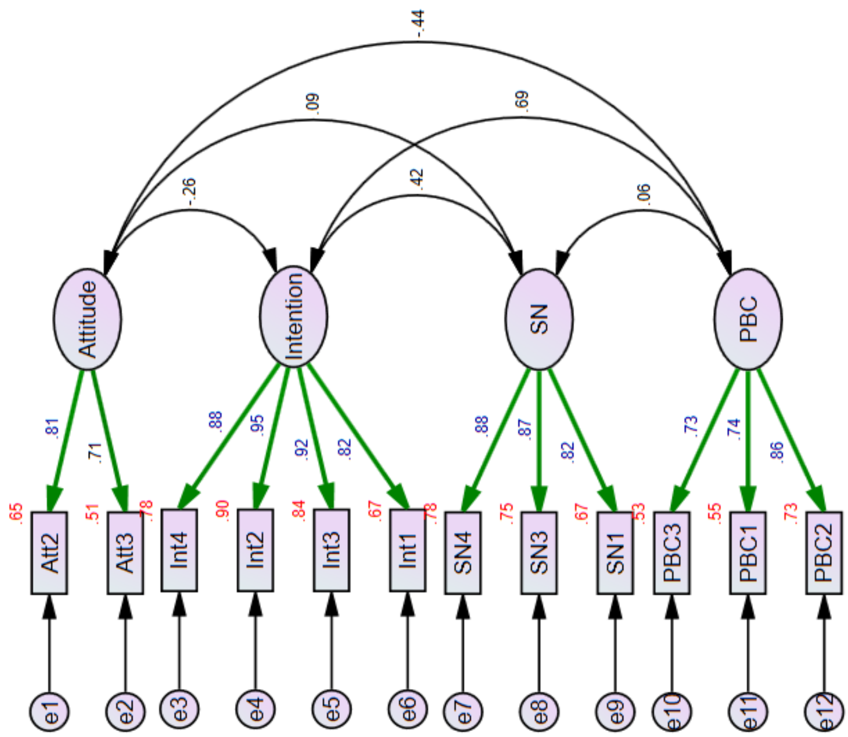


FIGURE 22 1st order model for the TPB model for construct of crossing outside zebra crossings.

TABLE 19 TPB model items for the violation of yielding to pedestrian's behaviour

Constructs	Number of items before validation	Number of items after validation
Intention	4	4
SN	5	3
Attitude	4	2
PBC	4	3
Total	17	12

The validity tests conducted on the theory of planned behaviour's items used AVE, MSV and Max(R) to assess the constructs (both discriminant and convergent validity), and CR assessed the internal consistency reliability of the items of the same construct. The TPB constructs on violation of yielding to pedestrian did not present any validity or reliability concerns, and TABLE 20 presents the results.

TABLE 20 Reliability and validity of the TPB items for the behaviour of crossing outside the zebra crossings

	CR	AVE	MSV	MaxR(H)
Attitude	0.731	0.577	0.19	0.742
Intention	0.94	0.797	0.473	0.951
SN	0.892	0.734	0.178	0.896
PBC	0.82	0.605	0.473	0.836

4.2.3.2 Confirmatory factor analysis

The association between yielding to pedestrians and its determinants using the Theory of Planned Behaviour generated the following results: The structural equation model was generated and presented in FIGURE23. The statistical significance of determinants in predicting the outcome variables is indicated in the path model using the colour symbol, the colour of the arrow, in the path diagram (Green: P>0.01, Yellow: 0.01 <p<0.05). The values in red colour are the R^2 values (proportion of the explained variance). The table containing the standardised regression weights for Total, direct and indirect effects and their statistical powers are given in Appendix 6.

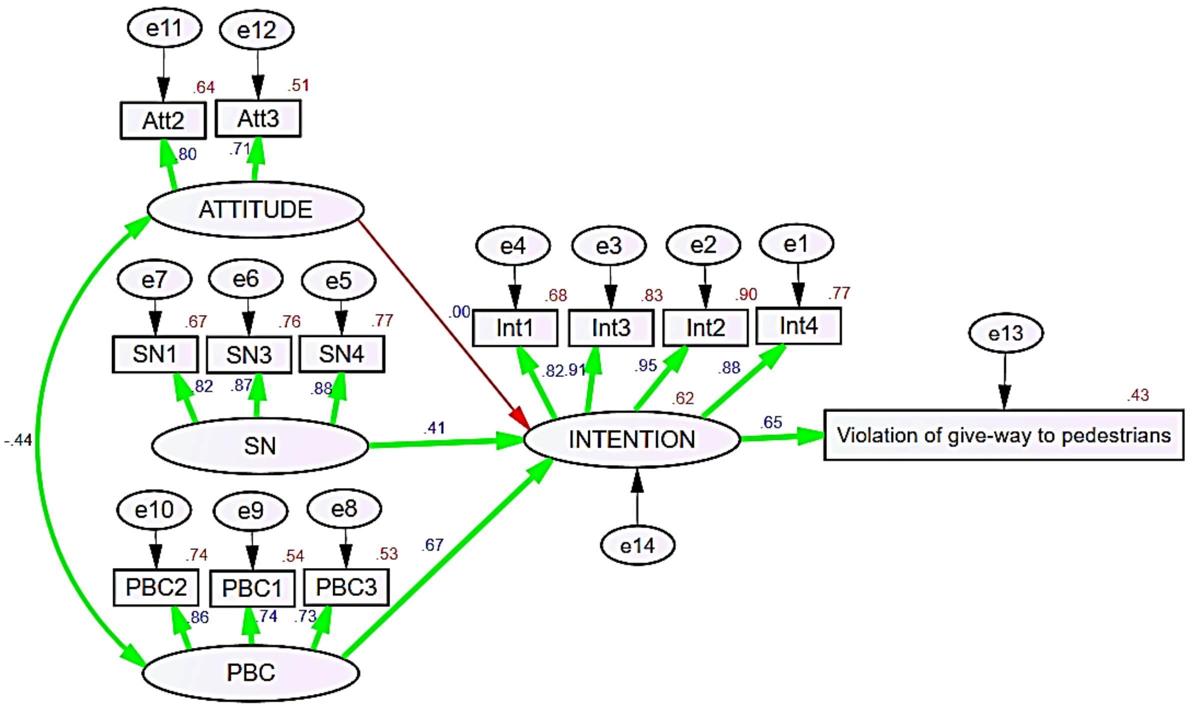


FIGURE23 Path model for violation of yielding to pedestrians

TABLE 21 contains different measures of the model fitness from AMOS, AMOS plugin tool from Gaskin and Lim (2016) was used to generate the interpretations according to the cut-off criteria from the study of Hu and Bentler (1999)

TABLE 21 TPB model fitness measure for the behaviour of violation of yielding to pedestrians

Measure	Estimate	Threshold	Interpretation
CMIN	99.774	--	--
DF	62	--	--
CMIN/DF	1.609	Between 1 and 3	Excellent
CFI	0.956	>0.95 excellent, 0.9-0.95 acceptable	Excellent
SRMR	0.080	<0.08	Excellent
RMSEA	0.078	<0.06 excellent, 0.06-0.1 acceptable	Acceptable
PClose	0.061	>0.05 excellent, 0.01-0.05 acceptable	Excellent

4.2.3.3 Bootstrap for TPB model of yielding to pedestrians

Since the multivariate normality condition was not met, the Bollen-Stine Bootstrap p-value was computed in AMOS. The model fits better in 899 bootstrap samples out of 1000 bootstrap samples. Testing the null hypothesis that the model is correct Bollen-Stine bootstrap, p = 0.102. Below is a bootstrap distribution (Statistics for bootstrap samples N = 1000, Mean= 76.402, S. e. = .624).

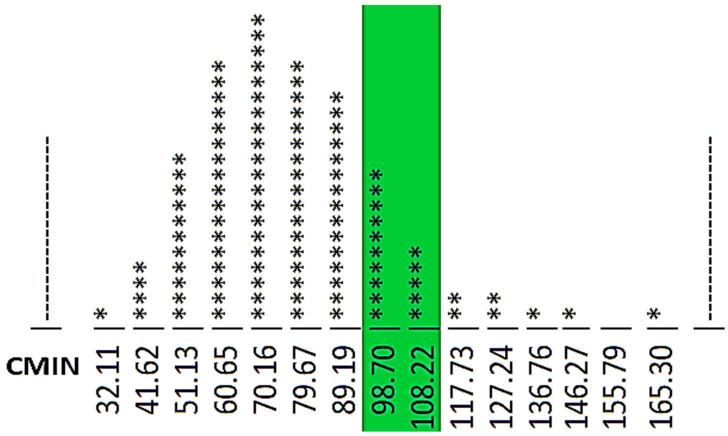


FIGURE24 Bootstrap distribution for the TPB model of yielding to pedestrians.

4.2.4 Effect of driver's risky behaviours on vehicle-pedestrian crashes

4.2.4.1 Association of driver's risky behaviours with pedestrian crashes

Four risky behaviours, namely the violation of yielding to pedestrians, exceeding the speed limits, and cell phone use while driving and drunk driving. Non-parametric correlation, Spearman's rho correlation, analysis of the data from the drivers' responses indicated that the four investigated risky behaviours are significantly correlated with each other.

TABLE 22 presents the correlation between a driver's risky behaviours. It is important to note that this relationship is only correlational; not causal. The violation of giving way to pedestrians at marked crosswalks is the only driver risky behaviour, investigated in this study, that was found to have an insignificant influence on vehicle-pedestrian near-crash risk.

TABLE 22 Spearman correlation among driver's risky behaviours

	Violation of yielding to pedestrians	Exciding the speed limit	Cell phone use while driving	Drunk driving	Near vehicle-pedestrian crash experiment
Violation of yielding to pedestrians	1.000	.598**	.489**	.275**	.078
Exciding the speed limit		1.000	.719**	.466**	.257**
Cell phone use while driving			1.000	.440**	.323**
Drunk driving				1.000	.208*
Near vehicle-pedestrian crash experiment					1.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.2.4.2 Prediction of driver's risky behaviour on vehicle-pedestrian crashes

The linear regression was calculated in AMOS with bootstrap to correct bias from non-normality to predict the drivers' vehicle-pedestrian crash. Some risky behaviours predict better the vehicle-pedestrian near-crash than others. Among the driver's risky behaviour covered in this study, cell phone use while driving is the best significant predictor with R^2=0.12 (P=0.023), followed by exciding speed limits with R^2=0.07 (P=0.030) and drunk driving with R^2=0.05 (P=0.030). The violation of yielding to pedestrians at pedestrian crossings comes last and does not significantly predict the vehicle-pedestrian near-crash with R^2=0.03 (P=0.602).

Overall, the risky behaviours studied only explain 24.1 % of the reasons for which pedestrian near-crashes reported by the drivers occur. FIGURE 25 is a structural equation model indicating the standardized regression weight; As can be seen, there is no statistical significance between the risky behaviour of the drivers who participate in this study with the pedestrian near-crashes that they reported.

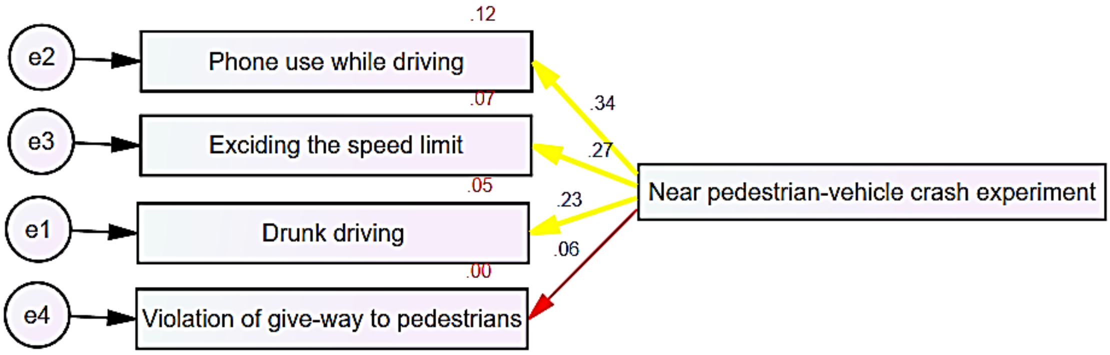


FIGURE 25 Drivers' risky behaviours as predictors of near pedestrian crashes.

4.2.5 Drivers risky behaviours effect on the occurrence of vehicle-pedestrian crashes

4.2.5.1 Effect of violation of yielding to pedestrians on risk hitting a pedestrian

The results in TABLE 23 indicate the increase of violating yielding to pedestrians associated with an increase of odds of risk of hitting a pedestrian, with an odds ratio of 1.2 (95% CI, 0.755 to 2.035). statistically this effect is insignificant, Wald $\chi2$ (1) = 0.719, p = 0.396 (for more details, consult Model 17 in Appendix 6)

TABLE 23 Effect of violation of yielding to pedestrians on the risk of hitting a pedestrian

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[VPNC = 1]	0.692	0.499	1.92	1	0.166	-0.287	1.671	1.998	0.751	5.316
Threshold	[VPNC = 2]	1.453	0.516	7.921	1	0.005	0.441	2.464	4.275	1.554	11.757
Location	YTP1	0.215	0.253	0.719	1	0.396	-0.281	0.71	1.239	0.755	2.035

4.2.5.2 Effect of speeding behaviour on the risk of hitting a pedestrian

TABLE 24 shows that shifting from the lower category to the next upper category of exceeding speed limits is associated with an increase of odds of risk of hitting a pedestrian, with an odds ratio of 1.5 (95% CI, 1.054 to 2.018). statistically, this effect is significant; Wald $\chi2$ (1) = 5.189, p = 0.023 (for more details, consult Model 18 in Appendix 6)

TABLE 24 Influence of speeding behaviour on the risk of hitting a pedestrian

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[VPNC = 1]	1.151	0.427	7.266	1	0.007	0.314	1.988	3.162	1.369	7.304
Threshold	[VPNC = 2]	1.943	0.456	18.139	1	0	1.049	2.837	6.98	2.855	17.07
Location	ESL	0.377	0.166	5.189	1	0.023*	0.053	0.702	1.458	1.054	2.018

*Significant at p<0.05

4.2.5.3 Effect of cell phone use while driving on the risk of hit a pedestrian

TABLE 25 indicates that the increase in cell phone use while driving is associated with an increased risk of hitting a pedestrian. As can be seen drivers in a given higher category compared to the drivers in the next low category, the odds ratio is 1.8 (95% CI, 1.266 to 2.666) and statistically, this effect is very significant, Wald $\chi2$ (1) = 10.248, p <0.01 (for more details, consult Model 19 in Appendix 6).

TABLE 25 Effect of cell phone use while driving on the risk of hitting a pedestrian

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[VPNC = 1]	1.569	0.456	11.844	1	0.001	0.675	2.462	4.801	1.965	11.731
Threshold	[VPNC = 2]	2.397	0.493	23.626	1	0	1.431	3.364	10.992	4.181	28.898
Location	PU	0.608	0.19	10.248	1	0.001**	0.236	0.981	1.837	1.266	2.666

**Significant at p<0.01

4.2.5.4 effect of drunk driving on the risk of hitting a pedestrian

As shown in TABLE 27, The increase of drunk driving frequency was associated with an increase of odds of hitting a pedestrian with an odds ratio of 1.7 (95% CI, 1.082 to 2.712). Statistically, this effect is significant Wald $\chi2$ (1) = 5.277, p= 0.022 (for more details, consult Model 20 in Appendix 6).

TABLE 26 Effect of drunk driving behaviour on pedestrians' risk of being hit by a vehicle

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[VPNC = 1]	1.128	0.412	7.489	1	0.006	0.32	1.935	3.089	1.377	6.927
Location	[VPNC = 2]	1.921	0.443	18.806	1	0	1.053	2.789	6.827	2.865	16.266
Location	DD	0.538	0.234	5.277	1	0.022*	0.079	0.998	1.713	1.082	2.712

*Significant at p<0.05

4.2.6 Effect of drivers' demographic factors

The data from the driver's responses were non-homogeneous for the demographic factors; in the analysis of the demographic effect factor on the drivers' risky behaviours, the attempt to use the ordinal regression with the PLUM procedure presented a high percentage of cells with zero frequencies. The scale of the questionnaire's risky behaviours items was modified to have all the cell with at least one frequency.

4.2.6.1 Demographic factors effect on the risk of hitting a pedestrian

TABLE 27 contains the effect of the driver demographic factors (driving experience and age) on the risk of involvement in vehicle-pedestrian crashes. The increase in driving experience is associated with an increase of the odds of risk of hitting a pedestrian with an odds ratio of 1.1 (95% CI, 0.762 to 1.663). Statistically, this effect is insignificant, Wald $\chi 2$ (1) = 0.355, p = 0.551 (for more details, consult Model 16 in Appendix 7). The Increase in the age of the drivers (expressed in group age) is associated with a decrease of the odds of risk of hitting a pedestrian with an odds ratio of 0.9 (95% CI, 0.511 to 1.7) this effect is statistically insignificant, Wald $\chi 2(1)$ = 0.053, p = 0.819 (for more details, consult Model 16 in Appendix 6.

TABLE 27 Effect of demographic factors on the risk of a vehicle-pedestrian crash

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[VPNC = 1]	0.458	0.547	0.702	1	0.402	-0.614	1.531	1.582	0.541	4.622
Threshold	[VPNC = 2]	1.221	0.56	4.764	1	0.029	0.125	2.318	3.392	1.133	10.157
Location	Drivex	0.119	0.199	0.355	1	0.551	-0.272	0.509	1.126	0.762	1.663
Location	Age	-0.07	0.306	0.053	1	0.819	-0.671	0.53	0.932	0.511	1.7

4.2.6.2 Effect of demographic factors on violation of yielding to pedestrians

TABLE 28 shows that the increase of driving experience is associated with a decrease in violating yielding to pedestrians' rule with an odds ratio of 1 (95% CI, 0.66 to 1.384). Statistically, this effect is insignificant, Wald $\chi 2$ (1) = 0.058, p = 0.81 (for more details, consult Model 12 in the in Appendix 6).

TABLE 28 Effect of demographic factors on risk on the violation of yielding to pedestrians

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[YTP1 = 1]	-0.691	0.53	1.704	1	0.192	-1.729	0.347	0.501	0.177	1.414
Threshold	[YTP1 = 2]	0.993	0.536	3.428	1	0.064	-0.058	2.044	2.699	0.944	7.722
Location	Drivex	-0.045	0.189	0.058	1	0.81	-0.416	0.325	0.956	0.66	1.384

4.2.6.3 Effect of demographic factors on speeding behaviour

TABLE 29 presents the findings that the increase of the driving experience decreases the odds of exceeding the speed limit with the odds ratio of 0.9 (95% CI, 0.71 to 1.197). Statistically, this effect is insignificant, Wald $\chi 2$ (1) = 0.372, p = 0.542 (for more details, consult Model 13 in Appendix 6). TABLE 29 shows that The Increase in the drivers' age (expressed in group age) is associated with a decrease of the odds of exceeding the speed limit with an odds ratio of 0.9 (95% CI, 0.589 to 1.311). Statistically, this effect is insignificant, Wald $\chi 2(1)$ = 0.4, p = 0.527 (for more details, consult Model 13 in Appendix 6)

TABLE 29 Effect of demographic factors on speeding behaviour

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[ESL = 1]	-0.559	0.414	1.829	1	0.176	-1.37	0.251	0.572	0.254	1.286
Threshold	[ESL = 2]	0.33	0.411	0.646	1	0.422	-0.475	1.136	1.391	0.622	3.115
Threshold	[ESL = 3]	1.062	0.426	6.202	1	0.013	0.226	1.898	2.892	1.254	6.671
Location	Drivex	-0.081	0.133	0.372	1	0.542	-0.342	0.18	0.922	0.71	1.197
Threshold	[ESL = 1]	-0.658	0.516	1.625	1	0.202	-1.671	0.354	0.518	0.188	1.425
Threshold	[ESL = 2]	0.22	0.513	0.184	1	0.668	-0.785	1.225	1.246	0.456	3.403
Threshold	[ESL = 3]	0.99	0.524	3.568	1	0.059	-0.037	2.018	2.693	0.963	7.525
Location	Age	-0.129	0.204	0.4	1	0.527	-0.529	0.271	0.879	0.589	1.311

4.2.6.4 Demographic factors effects on cell phone use while driving

The results in TABLE 30 display that the increase in the driving experience, reduces the odds of cell phone use while driving with the odds ratio of 0.8 (95% CI, 0.624 to 1.06) statistically, this effect is insignificant, Wald $\chi 2$ (1) = 2.329, p = 0.127 (for more details, consult Model 14 in the appendix). Also, TABLE 30 shows that increase in age of the drivers (expressed in group age) is associated with a decrease of the odds of cell phone use while driving with an odds ratio of 0.7 (95% CI, 0.467 to 1.059) statistically, this effect is insignificant, Wald $\chi 2(1)$ = 2.846, p = 0.092 (for more details, consult Model 14 in the appendix)

TABLE 30 Effect of demographic factors on cell phone use while driving

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[PU = 1]	-0.946	0.422	5.032	1	0.025	-1.773	-0.12	0.388	0.17	0.887
Threshold	[PU = 2]	0.232	0.411	0.319	1	0.572	-0.574	1.039	1.262	0.563	2.825
Threshold	[PU = 3]	1.307	0.446	8.585	1	0.003	0.433	2.182	3.697	1.542	8.865
Location	Drivex	-0.206	0.135	2.329	1	0.127	-0.471	0.059	0.814	0.624	1.06
Threshold	[PU = 1]	-1.227	0.53	5.369	1	0.021	-2.266	-0.189	0.293	0.104	0.828
Threshold	[PU = 2]	-0.021	0.515	0.002	1	0.967	-1.03	0.988	0.979	0.357	2.687
Threshold	[PU = 3]	1.052	0.54	3.801	1	0.051	-0.006	2.109	2.863	0.994	8.242
Location	Age	-0.352	0.209	2.846	1	0.092	-0.761	0.057	0.703	0.467	1.059

4.2.6.5 Demographic factors effects on drunk driving behaviour

TABLE 31 presents the information that increased driving experience is associated with decreased drunk driving odds with an odds ratio of 0.8 (95% CI, 0.604 to 1.162). Statistically, this effect is insignificant, Wald $\chi 2$ (1) = 1.122, p = 0.289 (for more details, consult Model 15 in in Appendix 6). TABLE 31 also indicates that the increase in age of the drivers (expressed in group age) is associated with a decrease of the odds of drunk driving with an odds ratio of 0.9 (95% CI, 0.569 to 1.496) statistically, this effect is insignificant Wald $\chi2(1) = 0.106$, $p = 0.744$ (for more details, consult Model 15 in Appendix 6

TABLE 31 Effect of demographic factors on drunk driving behaviour

		Estimate	St. Error	Wald	df	Sig	L.B.	U.B.	Exp_B	Lower	Upper
Threshold	[DD = 1]	0.501	0.481	1.083	1	0.298	-0.442	1.444	1.65	0.642	4.236
Threshold	[DD = 2]	0.884	0.489	3.266	1	0.071	-0.075	1.842	2.42	0.928	6.31
Location	Drivex	-0.177	0.167	1.122	1	0.289	-0.505	0.151	0.838	0.604	1.162
Threshold	[DD = 1]	0.738	0.607	1.476	1	0.224	-0.452	1.928	2.091	0.636	6.874
Threshold	[DD = 2]	1.165	0.616	3.58	1	0.058	-0.042	2.371	3.205	0.959	10.713
Location	Age	-0.08	0.247	0.106	1	0.744	-0.564	0.403	0.923	0.569	1.496

4.3 Summary of results

The finding responding to the 1st objective of this study are the standardized path model coefficient of TPB model of crossing the road outside zebra crossing and the TPB model of violating yielding to pedestrians on zebra crossings, the models formed indicate the details about the effect in the change of behaviour proximal determinant (intention) changes the behaviour, and how the change in a lateral determinant of behaviours (attitude, social norms and perceived behaviour control) influence the change in intention. Attitude, social norms, perceived behavioural control and intention were expressed as latent variables, the behaviour and items of latent determinants of behaviours are observed variables. TABLE 32 and TABLE 33 present the summary all the results for the 2nd and 3rd objectives for pedestrian factors and drivers factors respectively, the factors are classified as behavioural factors or as demographic factors, independent variables and dependent variables are named and the odds ratios and statistical significance are presented. Not that the in depend variable appear in the table according to their impotence order.

In short, also the diagram representing the information in table are presented graphically in FIGURE 26 and FIGURE 27 respectively in Appendix 8. Those diagrams list the order of importance of each variable (risky behaviour variable and demographic factor variable) that it has in the preparation of behaviour change interventions, that is, it lists the risky target behaviours and the target group the criteria according to their importance. The dashed blue arrows represent insignificant relationships, thin green arrows represent significant (at 95% significant level) relationships, and thick green arrows represent significant (at 99% significant level) influence.

TABLE 32 Summary of the findings for 2nd and 3rd obectives on pedestrians factors

Independent variable	Dependant variable	Odds ratio	Significance
Behavioral factors as independent variables			
Texting while walking	Risk of pedestrian- vehicle crash	1,482	0
Talking on phone while walking	Risk of pedestrian-vehicle crash	1,288	0,014
Crossing the road outside zebra crossings	Risk of pedestrian-vehicle crash	1,167	0,26
Checking the content on phone while walking	Risk of pedestrian-vehicle crash	1,084	0,411
Listening musing from ear-phones while walking	Risk of pedestrian-vehicle crash	1,062	0,557
Demographic factors as independent variables			
Age	Risk of being hit by a vehicle	1,335	0
Age	Texting while walking	1,416	0,001
Age	Checking the content in phone while walking	1,348	0,005
Age	Crossing outside zebra cross	1,2	0,04
Age	Listening to music through ear-phone while walking	1,239	0,055
Sex	Texting while walking	1,582	0,118
Sex	Risk of being hit by a vehicle	1,53	0,15
Sex	Crossing outside zebra cross	1,306	0,362
Sex	Talking on phone while walking	1,14	0,651
Sex	Checking the content in phone while walking	0,902	0,722
Sex	Listening to music through ear-phone while walking	0,99	0,975

TABLE 33 Summary of the findings for 2nd and 3rd obectives on pedestrians factors

Dependent variable	Risky behaviour	Odds	Significance
Behavioural factors as independent variables			
Risk of pedestrian vehicle crash	Phone use while driving	1,837	0,001
Risk of pedestrian vehicle crash	Drunk driving	1,7	0,022
Risk of pedestrian vehicle crash	Exceeding the speed limits	1,5	0,023
Risk of pedestrian-vehicle crash	Violating the rule of yielding to pedestrians	1,2	0,396
Demographic factors as independent variables			
Age	Phone use while driving	0,7	0,092
Driving experience	Phone use while driving	0,814	0,127
Driving experience	Drunk driving	0,838	0,289
Driving experience	Exceeding the speed limit	0,879	0,527
Age	Exceeding the speed limit	0,922	0,542
Driving experience	Risk of hitting a pedestrian	1,1	0,551
Driving experience	Drunk driving	1,1	0,744
Age	Violating the yielding to pe-destrian rule	0,956	0,81
Age	Risk of hitting a pedestrian	0,932	0,819

CHAPTER FIVE: DISCUSSION

In this discussion, comparison and contrast highlight a link between the results of this study and objectives. The discussion covers the influence of teen pedestrians and motorists' risky behavioural factors on the occurrence of vehicle-pedestrian crashes and the contribution of this study to a better understanding of the behavioural factors that endanger pedestrian safety Musanze district of Rwanda.

5.1 Pedestrians factors

5.1.1 Texting and talking on the cell phone while walking

Among the four pedestrians' risky behaviours in this study are: 1.) crossing the road outside the pedestrian crossing, 2.) texting while on the cell phone; 3.) talking on the cell phone while walking and 4.) listening to music on the cell phone while walking—only texting and telephoning while walking was found to reduce pedestrian safety significantly.

Previous research focused more on using cell phones while driving, but the effects of using cell phones while walking have not been extensively studied (Russo et al., 2018). The danger of using the cell phone while walking varies depending on the cell phone's task. Thanks to this study, texting while walking is the most dangerous among high school students in the Musanze district. This study does not explain why texting is more dangerous than talking on the cell phone while walking, and listening to earphone music the least dangerous while walking. Simmons and colleagues (2020) got the same finding that texting while walking was the most dangerous type of cell phone use while walking. They found a reduced rate of looking left and right among those who cross the road while texting. Texting was potentially more detrimental than talking on the cell phone and listening to music while crossing.

5.1.2 Crossing the road through the zebra crossing

Previous research advanced that most car-pedestrian crashes occur when pedestrians cross (Pelé et al., 2017). This study analysed crossing the road outside of zebra crossings (specifically, crossing outside zebra crossing located at most 50 m away from the zebra crossing). However, this study did not confirm the expectation that crossing outside zebra crossings significantly affects the risks of being hit by a vehicle. Initially, this study overestimated the importance of crossing at zebra crossings among high school pedestrians. Insignificant findings do not necessarily reject a potential correlation between pedestrians illegal crossing and risk of vehicle-pedestrian collision in Musanze. Instead, this fact leaves a considerable uncertainty, and rises a question; why zebra crossings in Musanze are not good enough to significantly reduce teen pedestrians' crashes? SafetyNet (2009) reported that many pedestrians' crashes in Europe took place at facilities designated for pedestrians. Also, the definition attributed to this study's crossing behaviour probably covers an insignificant proportion of road crossing scenarios.

While crossing the road against red light increased collision risk more than 20 times in Australia (Cameron et al., 1976). This study indicated that teen pedestrians cross outside zebra crossing less than 20% of their total road crossings have less than twice the risk of a crash that those who violate zebra crossing more than 80% (and this factor is insignificant only valid in only 74% of the Musanze teen pedestrian). Therefore, the collision risks due to illegal road crossing depend on the type of violated traffic rules and the crossed road's characteristics. Running a red light is more dangerous than violating crossing through zebra crossing at non-signalized intersections.

Evans & Norman (2003) 's study applied the theory of planned behaviour and found that intention to cross a residential street through a pedestrian crossing was only significantly associated with the observed behavioural control, this study has got the same results. This study found that crossing from outside the crosswalk is not significantly predicted by intention (this gap between intention and behaviour was not intended). The perceived behavioural control, in the presence of extrinsic rewards to cross outside the pedestrian crossing, significantly predicts the behaviour of crossing outside zebra crossing. However, according to the existing social psychology research, when the behaviour changes interventions run into an intention-behaviour gap, the intention fails to translate into the desired behaviour. one would describe that for the high school pedestrians of Musanze district, crossing the road outside zebra crossing is a non-intentional process. Behavioural intervention techniques to change automatic processes behaviours should be used as it has been suggested by many scholars in health social psychology (Marteau et al., 2012; Papies, 2012).

5.1.3 Demographic factors among teen pedestrians

The high school students' age and sex in Musanze, were analysed to determine their effect on the pedestrian risk of being hit by a vehicle and risky behaviours involvement (cell phone use while walking and crossing the road outside zebra crossings). While the sex of the high school student in Musanze significantly influences neither their risk of being hit by a vehicle nor their enrolment in risky behaviours, age had a significant effect on getting involved in risky behaviour and the risk of being hit by a vehicle. Young pedestrians were found to be at higher risks of being hit by vehicles. Older high school pedestrians violate the rule of zebra crossing less frequently than a young high school student. This finding is in line with the results of the study of Ferenchak (2016). The later indicated that older pedestrians cross more often outside zebra crossing than young pedestrians.

Nevertheless, younger high school students use the cell phone while walking less frequently than older higher school students. Baswail and colleagues (2019) mentioned that the low frequency of cell phone-related violations among younger pedestrians could be influence by low cell phone ownership. Older teen pedestrians were found to be at a higher risk of a road crash than younger ones. A similar trend was found by Ivan and his colleagues (2019). Their study also indicated that other age groups had different. Therefore, it is essential to only see this trend as relevant to explain teen pedestrians' situation.

5.2 Drivers factors

The analysis revealed the relationship between risky behaviours and vehicle-pedestrian near-collisions. Using the cell phone while driving was the most dangerous driver behaviour to cause pedestrian crashes, followed by speed limit violations and drunk driving. Driver’s failure to giving right of way to pedestrians was found to have an insignificant effect on pedestrian crashes.

5.2.1 Yielding to pedestrians

Bertulis and Dulaski (2014) indicated that drivers who do not yield to pedestrians tend to approach the crossing at high speed. This study confirmed that this phenomenon occurs among the motorists in MUSANZE, the frequency of violating the pedestrian right of way rule was significantly correlated with the frequency of violating the speed limits.

The analysis of the behaviour of violation of the yielding to pedestrian found that the attitude is not a significant determinant of the intention. Only the subjective norms and the perceived behavioural control significantly predicted the driver's intention towards the behaviour of giving way to the pedestrian at the zebra crossing. The perceived behaviour control plays a more critical role than the driver's subjective norms for yielding to pedestrians.

The behavioural intervention to increase driver-to-pedestrian yielding should not focus on making the driver’s attitude more positive towards yielding to pedestrians. The target should be to enhance first the perceived behavioural control by influencing the driver's perception of control towards always yielding to pedestrians even if they are tired or in a hurry. Secondly, subjective norms should also be targeted by making the drivers believe that their family and traffic police officers disapprove of their failure to yield to pedestrians and convince them that when they yield to pedestrians, they earn respect and appreciation from the pedestrians to whom they yield.

5.2.2 Cell phone use while driving, exceeding the speed limit, drunk driving

This study found that cell phone use while driving inflicts the most the crashes to pedestrians, The finding is in line with the previous research, such as the study by Sundfør, Sagberg and Høye (2019), which indicates that driver negligence or inattentiveness is the leading cause of pedestrian crashes. The association between the effect of the driver's negligence and inattention is explained in the literature review chapter of this report.

Furthermore, this study revealed that the drivers' exceeding of the speed limit put the pedestrians in danger significantly, thus confirming the finding from the study of Nilsson (2004); the higher the speed, the higher the number of crash victims. There could be an association between this finding and the previous study findings confirming a link between speed and vehicle manoeuvrability (Aarts & Van Schagen, 2006; Kang et al., 2019).

Eventually, drunk driving increases the risk of a vehicle-pedestrian crash, and this finding highlights the effect of alcohol on driving performance such as latency in cognitive reaction time (Hernández & Vogel-Sprott, 2010; Zuccalà et al., 2001), slow reflexes (Hernández et al., 2007), jugement (Zhao et al., 2014b), reduced ability to process information (the blurred vision (Silva et al., 2017). loss of ability to focus on goal-oriented objectives (Marinkovic et al., 2013)

5.2.3 Demographic factors among drivers

This study found that the drivers' age and their driving experience do not significantly influence their risky behaviours. Among other drivers' risky behaviours, the cell phone use while driving was mostly affected by age. Previous research has shown that younger drivers are more likely to use cell phones than older drivers (Nurullah et al., 2013).

5.3 Relative risk measure

The odds ratio have considerable importance in safety research. Böhning and Na Ayutha (1997) assessed the odds ratio to determine the risks that the risk factors cause by comparing the risks between the baseline level and the next level of the independent variable. Gjerde and colleague (2014) reacted to the alarming odds ratio for road crash involvement which higher in Finland and Norway compared to other countries. As this study is a needs assessment, the author found it helpful to explain the importance of odds ratio presented in the results chapter. The odds ratio that has been found in this research will be useful to estimate the pedestrians' risks of being hit by a vehicle. The odds ratio was used to estimate the proportion of change in pedestrians' crashes risk attributed to a specific behaviour. For instance, a 20% increase in texting while walking is associated with the odds ratio of 1.482. As indicated by intervention Robertson and Pashley (2015), the observed change in behaviours is the best measure of behavioural change intervention's effectiveness. Because the criteria of a useful behaviour intervention involve the specificity and that it is essential to do the intervention's effectiveness evaluation. The evaluation would then only give the effectiveness fraction representing a change in the targeted behaviour. The question arises: what is the vehicle-pedestrian crash relative risk between the before period and period after intervention? For clarification a scenario is given; If in the before period, 60 offenders in one week were spotted using the phone while walking, and after the intervention 40 in one week in the same specific location offender were observed. It will give information that the intervention's effectiveness was $(50 - 40) * 100/60 = 16.67\%$. In this case, to determine the odds of a pedestrians car crash between the before period and the current period with being given by $〚1.482〛$ ^(16/20) = 1,36, it means a reduction by 36,99% of the risks of pedestrians' crashes due to texting while walking. Therefore, this study's odds values are the relative risk indicators and are useful input for intervention planning and evaluation.

5.4 Limitations of the study

The following limitation has affected the process and the quality of this research:

1. This study was affected by the fact that previous research on Rwandan road safety did not provide enough information on drivers and risky pedestrian behaviours. The author's initial intuition was that the road-crossing facilities play a tremendous role in reducing pedestrian crashes and deducing that violating the traffic rules at crosswalks (crossing outside zebra crossings and violating the yielding right of way to pedestrians) should have a robust connection with pedestrians' crashes. However, this study's results eventually indicated that other risky behaviours of drivers (cell phone use while driving and speeding) were more dangerous to pedestrians than violation of giving way to pedestrians. Other Pedestrians' risk behaviours (texting while walking and talking on the cell phone while walking) are somewhat more dangerous to pedestrians than crossing the road outside zebra crossing. The TPB model was applied to study the underlying causation of crossing the road outside zebra crossings and driver's violation of yielding to pedestrians. This study intended to reveal the most useful information to improve the effectiveness of the Rwandan pedestrian-focused road safety campaigns. Thus, the lack of prior knowledge affected this study's efficiency, leading to applying the TPB model to statistically insignificant risk behaviours.

2. Open-source information about road safety statistics in Rwanda did not provide enough details to guide the author to understand the pedestrian's road safety situation in Rwanda.

3. The methodology of this study has been designed before acquiring minimum information about the behaviour affecting the pedestrian's safety in Rwanda. It has been later realised that a pilot study before producing the questionnaires is an essential step which has unfortunately not been considered. It affected this study of questionnaires' representativeness. The pilot study could have generated items representing more sensitive and essential variables in the models for drivers and pedestrians' risky behaviours and vehicle-pedestrian crash risks.

4. During the data collection period, unexpected circumstances due to COVID-19 emerged, and lockdown made it challenging to acquire the drivers and pedestrians' data. This limitation affected this research negatively because it has been impossible to have a larger sample size as this could make the results of this research more representative of the reality.

CHAPTER 6. CONCLUSION

Rwanda has, in 2019, put more efforts in using road safety campaigns as a behavioural intervention to reduce road users' risky behaviours. This study aimed to understand the pedestrians' and drivers' behaviours that affected the pedestrian's safety in Rwanda to be effectively targeted in road safety campaigns. It provides a necessary level of understanding of the pedestrians' and drivers' behaviours that inflict pedestrians' crashes. The pedestrians and drivers' demographic factors were also evaluated to help understand the importance of determining the target group's criteria. As the behavioural factors that negatively affect pedestrians, safety could not be exhausted in one study. A simplification used few variables to explain and represent a complexity (statistic models). The simplification, guided by the existing knowledge, form previous studies. The analysis of the data involved a regression analysis and structural equation model using SPSS and AMOS tools.

This research's findings can serve a great deal of importance, serving as the input to the design of pedestrian's safety-focused awareness campaign. This research used clear variables; pedestrians self-report risky behaviours, sex and gender of the pedestrians, and driving experience of drivers and TPB variables (social norms, attitude, perceived behavioural control, intention), and straight forward methodology (data collection using questionnaires, and statistical analysis). This study is thus repeatable. It contributes positively to understanding the basic needs required to design more effective behaviour intervention to mitigate vehicle-pedestrian crashes. It raises a call to further research to complete a full needs assessment for the pedestrian safety-focused awareness campaigns and design behavioural interventions based on this study's findings.

This study's objectives were reached; the main objective was to conduct a needs assessment for behavioural change intervention was reached by attaining the specific objectives. Firstly, applying the Theory of Planned Behaviour model intended to understand that it is necessary to predict crossing the road outside zebra crossing and driver violation of yielding to pedestrians. Based on the results from the TPB model if crossing the road outside zebra crossing, it could be concluded that only the perceived behaviour control about crossing the road at a zebra crossing when factors are motivating them to cross outside zebra crossing is essential to influence the pedestrian cross the road at zebra cross. In contrast, attitude, social norms and intention of the teen pedestrian about crossing the road at zebra crossings do not contribute significantly to how frequently they would cross outside zebra crossing. Secondly, from the implication of each of the studied risky behaviour on pedestrian safety. It could be concluded that vehicle-pedestrian collisions depend firstly on the drivers and the pedestrians since cell phone use was found to be the leading factor increasing the risk of a vehicle-pedestrian crash. Texting and cell phone talking while walking being the riskiest behaviours among Musanze teen pedestrians. Other non-distraction factors; speeding and drunk driving significantly increase the risk of vehicle-pedestrian crashes. The unexpected finding violation at zebra crossing did not significantly influence on pedestrian safety raised a question that was forwarded to the future research. This study succeeds in determining how demographic differences of drivers and pedestrian's teen determine their tendency to be involved in risky behaviours and their involvement in Vehicle-pedestrians crash. The results helped to conclude that teen pedestrians' age is the only significant factor for behavioural change interventions.

The self-report near-crash served a role of representing the risk of getting involved in a road crash, and the findings are in line with previous studies. It is an indication that it should be considered as an appropriate surrogate for crashes risks. Self-report near-crash data is a useful tool; they are quick to acquire and could serve a great deal of role to understand the effect of road users' risky behaviours.

CHAPTER 7. PRACTICAL RECOMMENDATIONS AND FUTURE RESEARCH

These recommendations serve as guidelines to improve the road safety in RWANDA, and they are based on the results of this study and the author's experience throughout this research documented in this report and the arguments from previous studies:

7.1 Rwanda National Police, traffic department

The following suggestions are addressed to the traffic department of the Rwandan National Police in charge of enforcing the road safety rules and implementing the road safety campaigns in Rwanda.

1. For the sake of efforts optimization, in road safety awareness-raising campaigns, it is essential to avoid general and nonspecific road safety campaigns (World Health Organization, 2004a).

2. In response to the 1st message above, since it takes addressing target-specific behaviours one at a time. More sensitive risk behaviours should be prioritized before tackling less essential behaviours. Crossing the road outside zebra crossings and yielding right of way to pedestrians at zebra crossing do not significantly increase vehicle-pedestrian crash risks. Therefore, targeting this specific behaviour, as it is defined in this study, should not be a priority target until further evidence contradicts this finding.

3. In the awareness campaigns to mitigate the risky behaviour of crossing the road outside zebra crossing, it is suggested to apply the implementation intentions planning techniques or other equivalent techniques that take into consideration the issues of the intention-behaviour gap, because this study found that the issue of intention-gap exists among high school students in Musanze. This study showed that the intention to cross at the crosswalk would not necessarily result in crossing the road at the crosswalks. Therefore, instead of giving a message to adolescent pedestrians developing their intention to cross at pedestrian crossings. Instead, it is necessary to show them the obstacles that limit pedestrians to crossing the road via pedestrian crossings and teach them how to overcome the temptation to cross outside the pedestrian crossings.

4. The evaluation of road safety behaviours interventions' effectiveness is an essential step that should always follow each behavioural intervention. The evaluation of the behavioural intervention effectiveness using crash data (before period data and after period data concerning the implementation period) is not appropriate because it is subjected to bias. It is recommended to do this evaluation using the data from observational surveys and not self-report data because the later only helps determine the massage penetration and not necessary the behavioural change, it should target to determine the actual change comparing the before and after periods and determine the change in the number of traffic rules offenders such as a change in cases of drunk driving). The data should be collected from the targeted group before and after the intervention (Robertson & Pashley, 2015).

6. It would be helpful to make more detailed traffic crash data open to the public. The accessible open-source road safety information would help attract international researchers to work on Rwanda's road safety issues and guide the researcher's choice to more significant, sensitive and alarming road safety issues in Rwanda. This opportunity would contribute significantly to the development of road safety in Rwanda.

7.2 Rwandan Ministry of education

Though this study aimed to find the information necessary for useful pedestrians' safety-focused awareness campaign in Rwanda, some of the pedestrians' behaviours would be better addressed through the road safety traffic education. The ministry of education and its governmental institution Rwanda education board (REB), based on the results of this study and supporting arguments from the existing literature, are given the suggestions below;

1.Changing some pedestrians' behaviours take a more comprehensive education than a road safety awareness campaign, which is deemed short-lived. It is therefore essential that road safety education must be included in the school's curriculum. This study points out that cell phone use while walking is the most dangerous pedestrian risky behaviours that negatively affects pedestrian's safety. Therefore, the road safety education curriculum should treat cell phone use while walking, particularly texting, to target risky behaviour. It is expected that the practice of relying on texting will continue to persist, as argued by Bailey and colleagues (2016). Texting is becoming a more common way of communication than it was before.

Furthermore, young people involved in dangerous activities is not always caused by the ignorance of potential dangers (Reyna &Farley, 2006). Therefore, it would help a lot to mitigate the use of cell phones while walking through education. It is suggested that to build the self-efficacy and action control of children toward inhibiting cell phone use while walking. A suggestion is made to apply implementation intentions planning technics; because they are more potent than mindfulness acceptance-based techniques to reduce non-essential cell phone use (Miller & Brannon, 2017).

2. the Ministry of Education's contribution in Rwanda to attract local research to study road safety-related issues would speed up optimizing road safety education and awareness campaigns, which would save lives in Rwanda.

7.3 Further research

The following messages could offer a useful guide to those interested in offering their contribution to behavioural interventions to reduce Rwanda's risky behaviours.

1. No study on behaviour change intervention in the field of road safety in Rwanda has yet been published. This research investigated the interaction between road users (pedestrians and drivers) and determined the effects of the behaviour of each specific type of road user (adolescent pedestrians and drivers) on pedestrian road safety; The authors of this report call for further research in 2 stages; the first step being to conduct several studies using the philosophy of this study to cover different districts of Rwanda and among different groups of road users. The second phase of the study should then treat the results of the first step as secondary data and analyse each behavioural factor individually to determine how they can be addressed in a behaviour change intervention. That research would determine the target groups and the functional structure of the messages conveyed to drivers and pedestrians in Rwanda's specific districts to reduce pedestrian crashes.

2. This research raised a question; why do the crossing of teenage outside zebra crossings and the violation of motorists to yield the right to pedestrians at zebra crossings have no significant effect on pedestrian safety Musanze? The author calls on researchers to re-examine this finding in question and determine whether additional road crossing safety features or facilities are needed in Musanze on top of the existing pedestrian crossings to provide additional safety in Musanze.

REFERENCES

Aarts, L., & Van Schagen, I. (2006). Driving speed and the risk of road crashes: A review. *Crash Analysis and Prevention*, *38*(2), 215–224. https://doi.org/10.1016/j.aap.2005.07.004

Abdulsattar, H. N., & McCoy, P. T. (1999). Effects of drivers' age on the comprehension of a pedestrian right-of-way warning sign. *Transportation Research Record*, *1674*, 27–31. https://doi.org/10.3141/1674-04

Abraham, C., & Michie, S. (2008). A Taxonomy of Behavior Change Techniques Used in Interventions. *Health Psychology*, *27*(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Ajzen, I. (n.d.). *TPB Questionnaire Construction*.

Ajzen, I. (2004). Theory of reasoned action. In *Encyclopedia of psychology, Vol. 8.* (pp. 61–63). American Psychological Association. https://doi.org/10.1037/10523-026

Ajzen, I. (2012). The theory of planned behavior. In *Handbook of Theories of Social Psychology: Volume 1* (Vol. 50, pp. 438–459). https://doi.org/10.4135/9781446249215.n22

Ajzen, I., Hill, R. J., & Fishbein, M. (1977). Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. *Contemporary Sociology*, *6*(2), 244. https://doi.org/10.2307/2065853

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *Journal of Experimental Social Psychology*, *22*(5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4

Bailey, S. K. T., Schroeder, B. L., Whitmer, D. E., & Sims, V. K. (2016). Perceptions of mobile instant messaging apps are comparable to texting for young adults in the United States. *Proceedings of the Human Factors and Ergonomics Society*, *September 2017*, 1234–1238. https://doi.org/10.1177/1541931213601288

Bartholow, B. D., Pearson, M. A., Gratton, G., & Fabiani, M. (2003). Effects of Alcohol on Person Perception: A Social Cognitive Neuroscience Approach. In *Journal of Personality and Social Psychology* (Vol. 85, Issue 4). https://doi.org/10.1037/0022-3514.85.4.627

Baswail, A., Allinson, L., Goddard, P., & Pfeffer, K. (2019). Adolescents' mobile phone use while crossing the road. *Safety*, *5*(2). https://doi.org/10.3390/safety5020027

Bener, A. (2005). The neglected epidemic: road traffic crashs in a developing country, State of Qatar. *International Journal of Injury Control and Safety Promotion*, *12*(1), 45–47. https://doi.org/10.1080/1745730051233142225

Bertulis, T., & Dulaski, D. M. (2014). Driver approach speed and its impact on driver yielding to pedestrian behavior at unsignalized crosswalks. *Transportation Research Record*, *2464*, 46–51. https://doi.org/10.3141/2464-06

Böhning, D., & Na Ayutha, R. S. (1997). A case-control study of non-fatal traffic crashs on hospital patients in Bangkok metropolis. *Sozial- Und Praventivmedizin*, *42*(6), 351–357.

https://doi.org/10.1007/BF01318610

Byrne, B. M. (2013). Structural equation modeling with AMOS: Basic concepts, applications, and programming, second edition. In *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming, Second Edition*. Taylor and Francis. https://doi.org/10.4324/9780203805534

Caird, J. K., Willness, C. R., Steel, P., & Scialfa, C. (2008). *A meta-analysis of the effects of cell phones on driver performance A meta-analysis of the effects of cell phones on driver performance*. *June 2018*. https://doi.org/10.1016/j.aap.2008.01.009

Cameron, M. H., Stanton, H. G., & Milne, P. W. (1976). *Pedestrian crashs and exposure in Australia*. *1*.

Cherry, K. (2019). Attitudes and Behavior in Psychology. *Verywell*, 20–43. https://www.verywellmind.com/attitudes-how-they-form-change-shape-behavior-2795897

Chipperfield, J. G., Perry, R. P., & Stewart, T. L. (2012). Perceived Control. In *Encyclopedia of Human Behavior: Second Edition* (2nd ed., Issue January). Elsevier Inc. https://doi.org/10.1016/B978-0-12-375000-6.00109-9

Cinnamon, J., Schuurman, N., & Hameed, S. M. (2011). Pedestrian Injury and Human Behaviour: Observing Road-Rule Violations at High-Incident Intersections. *PLoS ONE*, *6*(6), e21063. https://doi.org/10.1371/journal.pone.0021063

Cordellieri, P., Baralla, F., Ferlazzo, F., Sgalla, R., Piccardi, L., & Giannini, A. M. (2016). Gender Effects in Young Road Users on Road Safety Attitudes, Behaviors and Risk Perception. *Frontiers in Psychology*, *7*, 1412. https://doi.org/10.3389/fpsyg.2016.01412

Damsere-Derry, J., Ebel, B. E., Mock, C. N., Afukaar, F., & Donkor, P. (2010). Pedestrians' injury patterns in Ghana. *Crash Analysis and Prevention*, *42*(4), 1080–1088. https://doi.org/10.1016/j.aap.2009.12.016

Davies, N. (2012). What are the ingredients of successful travel behavioural change campaigns? *Transport Policy*, *24*, 19–29. https://doi.org/10.1016/j.tranpol.2012.06.017

Delhomme, P., De Dobbeleer, W., Forward, S., Simoes, A., Adamos, G., Areal, A., Chappe, J., Eyssartier, C., Loukopoules, P., Nathanail, T., Nordbakke, S., Peters, H., Philiips, R., Pinto, M., Frederique Ranucci, M., Marco Sardi, G., Trigoso, J., Vaa, T., Veisten, K., & Walter, E. (2009). Manual for designing, implementing and evaluating road safety communication campaigns. *2009*, *January*, 1–328. https://www.researchgate.net/profile/Forward_Sonja/publication/281801452_Manual_for_Designing_Implementing_and_Evaluating_Road_Safety_Communication_Campaigns/links/561cfe0a08aef097132b136a/Manual-for-Designing-Implementing-and-Evaluating-Road-Safety-Commu

Dozza, M., Flannagan, C. A. C., & Sayer, J. R. (2015). Real-world effects of using a phone while driving on lateral and longitudinal control of vehicles. *Journal of Safety Research*, *55*, 81–87. https://doi.org/10.1016/j.jsr.2015.09.005

Elliot, M. A. (2004). the Attitudes and Behaviour of Adolescent Road Users: an Application of the Theory of Planned Behaviour. *Trl Report Trl 601*, 82 p. http://trid.trb.org/view/704146

European-Commission. (2009). *CAST-Publishable Final Activity Report*. 1–35.

Evans, D., & Norman, P. (2003). Predicting adolescent pedestrians' road-crossing intentions: An application and extension of the Theory of Planned Behaviour. *Health Education Research*, *18*(3), 267–277. https://doi.org/10.1093/her/cyf023

Federal Highway Administration. (2013). *Signalized Intersections Informational Guide, Second Edition.* https://safety.fhwa.dot.gov/intersection/conventional/signalized/fhwasa13027/fhwasa13027.pdf

Fell, J. C., & Voas, R. B. (2014). The effectiveness of a 0.05 blood alcohol concentration (BAC) limit for driving in the United States. *Addiction*, *109*(6), 869–874. https://doi.org/10.1111/add.12365

Ferenchak, N. N. (2016). Pedestrian age and gender in relation to crossing behavior at midblock crossings in India. *Journal of Traffic and Transportation Engineering (English Edition)*, *3*(4), 345–351. https://doi.org/10.1016/j.jtte.2015.12.001

Forward, S. E. (2009). The theory of planned behaviour: The role of descriptive norms and past behaviour in the prediction of drivers' intentions to violate. *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(3), 198–207. https://doi.org/10.1016/j.trf.2008.12.002

Francis, J., Eccles, M. P., Johnston, M., Walker, A. E., Grimshaw, J. M., Foy, R., Kaner, E. F. S., Smith, L., & Bonetti, D. (2008). Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers. In *City Research Online* (Vol. 37, Issue 9).

Fylan, F., & Stradling, S. (2014). Behavioural Change Techniques used in road safety interventions for young people. *Revue Europeenne de Psychologie Appliquee*, *64*(3), 123–129. https://doi.org/10.1016/j.erap.2014.02.003

Gårder, P. E. (2004). The impact of speed and other variables on pedestrian safety in Maine. *Crash Analysis and Prevention*, *36*(4), 533–542. https://doi.org/10.1016/S0001-4575(03)00059-9

Gaskin, J., & Lim, J. (2016). *Master validity and Model Fit Measures for AMOS plugins*. http://statwiki.kolobkreations.com/index.php?title=Plugins

Gjerde, H., Bogstrand, S. T., & Lillsunde, P. (2014). Commentary: Why Is the Odds Ratio for Involvement in Serious Road Traffic Crash Among Drunk Drivers in Norway and Finland Higher Than in Other Countries? *Traffic Injury Prevention*, *15*(1), 1–5. https://doi.org/10.1080/15389588.2013.780651

Glanz, K., Rimer, barbara k., & Viswanath, K. (2008). *Health behavior and health eductation*.

Goldenbeld, C., Twisk, D., & Houwing, S. (2008). Effects of persuasive communication and group discussions on acceptability of anti-speeding policies for male and female drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 11*(3), 207–220. https://doi.org/10.1016/j.trf.2007.11.001

Goldstein, E. B. (2011). Cognitive Psychology. Connecting mnds, research, abd everyday experience. In *Wadsworth Cengage Learning*.

Hagger, M. S., & Hagger, M. S. (2019). The Reasoned Action Approach and the Theories of Reasoned Action and Planned Behavior. *Psychology*, *March*. https://doi.org/10.1093/obo/9780199828340-0240

Hankins, M., French, D., & Horne, R. (2000). Statistical guidelines for studies of the theory of reasoned action and the theory of planned behaviour. In *Psychology and Health* (Vol. 15, Issue 2, pp. 151–161). Routledge. https://doi.org/10.1080/08870440008400297

Haque, M. M., & Washington, S. (2013). Effects of mobile phone distraction on drivers' reaction times. *Journal of the Australasian College of Road Safety*, *24*(3), 20–29.

Hatfield, J., & Murphy, S. (2007). The effects of mobile phone use on pedestrian crossing behaviour at signalised and unsignalised intersections. *Crash Analysis and Prevention*, *39*(1), 197–205. https://doi.org/10.1016/j.aap.2006.07.001

Hernández, O. H., & Vogel-Sprott, M. (2010). Alcohol slows the brain potential associated with cognitive reaction time to an omitted stimulus. *Journal of Studies on Alcohol and Drugs*, *71*(2), 268–277. https://doi.org/10.15288/jsad.2010.71.268

Hernández, O. H., Vogel-Sprott, M., & Ke-Aznar, V. I. (2007). Alcohol impairs the cognitive component of reaction time to an omitted stimulus: A replication and an extension. *Journal of Studies on Alcohol and Drugs*, *68*(2), 276–281. https://doi.org/10.15288/jsad.2007.68.276

Hill, R. J., Fishbein, M., & Ajzen, I. (1977). Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. *Contemporary Sociology*, *6*(2), 244. https://doi.org/10.2307/2065853

Hochmuth, J., & Van Houten, R. (2018). Influence of advanced placement of the in-street sign gateway on distance of yielding from the crosswalk. *Transportation Research Record*, *2672*(35), 13–20. https://doi.org/10.1177/0361198118776480

Hoekstra, T., & Wegman, F. (2011). Improving the effectiveness of road safety campaigns: Current and new practices. *IATSS Research*, *34*(2), 80–86. https://doi.org/10.1016/j.iatssr.2011.01.003

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Huang, H., Zegeer, C., & Nassi, R. (2000). Effects of innovative pedestrian signs at unsignalized locations: Three treatments. *Transportation Research Record*, *1705*, 43–52. https://doi.org/10.3141/1705-08

Hyman, I. E., Boss, S. M., Wise, B. M., McKenzie, K. E., & Caggiano, J. M. (2009). Did you see the unicycling clown? Inattentional blindness while walking and talking on a cell phone. *Applied Cognitive Psychology*, *24*(5), 597–607. https://doi.org/10.1002/acp.1638

Ivan, K., Benedek, J., & Ciobanu, S. (2019). School-Aged Pedestrian–Vehicle Crash Vulnerability. *Sustainability*, *11*(4), 1214. https://doi.org/10.3390/su11041214

Jacobson, S. F. (1997). Evaluating instruments for use in clinical nursing research. In Marilyn Frank-Stromborg & Sharon J. Olsen (Ed.), *Instruments for Clinical Health-Care Research* (pp. 3–19). Jones and Bartlett Publishers. https://www.amazon.com/s?k=instruments+for+clinical+health-care+research&crid=2Q5HB7JQLFJLD&sprefix=instruments+for+clinical+healthcare%2Caps%2C1317&ref=nb_sb_ss_i_1_31

Jindal, A., & Mukherji, S. (2005). World report on road traffic injury prevention. *Medical Journal Armed Forces India*, *61*(1), 91. https://doi.org/10.1016/s0377-1237(05)80135-2

Kabera, J., Munyambo, B., Twahirwa, C., Nkuranga, L., Ndayisaba, E., Muhizi, N., & Babirye, J. (2019). Imyaka 19 y'ubufatanye mu bikorwa byo kubungabunga umutekano no guteza imbere imibereho myiza y'abaturage [19 years of cooperation in security and social development]. *RNP Magazine*, 14=17.

Kang, X., Namgung, M., Fujiwara, A., Kim, W., & Wang, W. (2019). Analysis of Vehicle Maneuverability and Driving Characteristics on a Curved Road Condition. *KSCE Journal of Civil Engineering*, *23*(1), 420–432. https://doi.org/10.1007/s12205-018-1803-y

Karthaus, M., Wascher, E., & Getzmann, S. (2018). Effects of Visual and Acoustic Distraction on Driving Behavior and EEG in Young and Older Car Drivers: A Driving Simulation Study. *Frontiers in Aging Neuroscience*, *10*(December), 1–15. https://doi.org/10.3389/fnagi.2018.00420

Kenntner-Mabiala, R., Kaussner, Y., Jagiellowicz-Kaufmann, M., Hoffmann, S., & Krüger, H. P. (2015). Driving performance under alcohol in simulated representative driving tasks: An alcohol calibration study for impairments related to medicinal drugs. *Journal of Clinical Psychopharmacology*, *35*(2), 134–142. https://doi.org/10.1097/JCP.0000000000000285

Ledesma, R. D., Tosi, J. D., Díaz-Lázaro, C. M., & Poó, F. M. (2018). Predicting road safety behavior with implicit attitudes and the Theory of Planned Behavior. *Journal of Safety Research*, *66*, 187–194. https://doi.org/10.1016/j.jsr.2018.07.006

Lord, D., Smiley, A., Haroun, A., Smiley, A., & Haroun, A. (n.d.). *PEDESTRIAN CRASHS WITH LEFT-TURNING TRAFFIC AT SIGNALIZED INTERSECTIONS: CHARACTERISTICS, HUMAN FACTORS AND UNCONSIDERED ISSUES Author for correspondence*.

Lyon, C., Mayhew, D., Granié, M. A., Robertson, R., Vanlaar, W., Woods-Fry, H., Thevenet, C., Furian, G., & Soteropoulos, A. (2020). Age and road safety performance: Focusing on elderly and young drivers. *IATSS Research*, *44*(3), 212–219. https://doi.org/10.1016/j.iatssr.2020.08.005

Mann, H. (2010). *Predicting Young Driver Behaviour from Pre-driver Attitudes , Intentions and Road*

Behaviour (Issue August) [Heriot-Watt University]. http://www.ros.hw.ac.uk/handle/10399/2396

Marinkovic, K., Rickenbacher, E., Azma, S., Artsy, E., & Lee, A. K. C. (2013). Effects of acute alcohol intoxication on saccadic conflict and error processing. *Psychopharmacology*, *230*(3), 487–497. https://doi.org/10.1007/s00213-013-3173-y

Marteau, T. M., Hollands, G. J., & Fletcher, P. C. (2012). Changing human behavior to prevent disease: The importance of targeting automatic processes. *Science*, *337*(6101), 1492–1495. https://doi.org/10.1126/science.1226918

Martin, A., Lagarde, E., & Salmi, L. R. (2018). Burden of road traffic injuries related to delays in implementing safety belt laws in low- and lower-middle-income countries. *Traffic Injury Prevention*, *19*, S1–S6. https://doi.org/10.1080/15389588.2017.1344354

McIlvenny, S. (2006, June). Road traffic crashs - A challenging epidemic. *Sultan Qaboos University Medical Journal*, *6*(1), 3–5. http://www.ncbi.nlm.nih.gov/pubmed/21748119

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81–97. https://doi.org/10.1037/h0043158

Miller, M. M., & Brannon, L. A. (2017). Testing Mindfulness-Based Acceptance Against Implementation Intentions to Discourage Counterintentional Cell Phone Use. *Mindfulness*, *8*(5), 1212–1224. https://doi.org/10.1007/s12671-017-0694-1

Muley, D., Kharbeche, M., Downey, L., & Saleh, W. (2019). *Road Users ' Behavior at Marked Crosswalks on Channelized Right-Turn Lanes at Intersections in the State of Qatar*. 1–19.

Mullen, P. D., Hersey, J. C., & Iverson, D. C. (1987). Health behavior models compared. *Social Science and Medicine*, *24*(11), 973–981. https://doi.org/10.1016/0277-9536(87)90291-7

Munezero, M. G., & Major, A. (2019, May 14). Road safety: Police launch new campaign. *The New Times*. https://www.newtimes.co.rw/news/road-safety-police-launch-new-campaign

Musanze District office. (2015). *Situation Analysis for Musanze District*.

Nasar, J., Hecht, P., & Wener, R. (2008). Mobile telephones, distracted attention, and pedestrian safety. *Crash Analysis and Prevention*, *40*(1), 69–75. https://doi.org/10.1016/j.aap.2007.04.005

National Institute of Statistics of Rwanda. (2018). *Statistical yearbook 2018*. https://doi.org/10.18356/5e7afe7d-en

National Transport and Safety Authority. (n.d.). Retrieved February 12, 2020, from http://www.ntsa.go.ke/index.php?option=com_content&view=article&id=237

Nilsson, G. (2004). Traffic Safety Dimensions and the Power Model to Describe the Effect of Speed on Safety. In *Lund Institute of Technology and Society, Traffic Engineering*.

Nurullah, A. S., Thomas, J., & Vakilian, F. (2013). The prevalence of cell phone use while driving in a Canadian province. *Transportation Research Part F: Traffic Psychology and Behaviour*, *19*(2013), 52–62. https://doi.org/10.1016/j.trf.2013.03.006

Onelcin, P., & Alver, Y. (2017). The crossing speed and safety margin of pedestrians at signalized intersections. *Transportation Research Procedia*, *22*, 5–7. https://doi.org/10.1016/j.trpro.2017.03.002

Otieno, M. M., Mwangi, I., & Opiyo, T. (2016). *Influence of Pedestrian Demographic Factors on Implementation of Road Safety Rules in the City of Kisumu , Kenya*. *June 2018*.

Papies, E. K. (2012). Goal Priming in Dieters: Recent Insights and Applications. *Current Obesity Reports*, *1*(2), 99–105. https://doi.org/10.1007/s13679-012-0009-8

Peden, M. M., & Puvanachandra, P. (2019). Looking back on 10 years of global road safety. *International Health*, *11*(5), 327–330. https://doi.org/10.1093/inthealth/ihz042

Pelé, M., Bellut, C., Debergue, E., Gauvin, C., Jeanneret, A., Leclere, T., Nicolas, L., Pontier, F., Zausa, D., & Sueur, C. (2017). Cultural influence of social information use in pedestrian road-crossing behaviours. *Royal Society Open Science*, *4*(2). https://doi.org/10.1098/rsos.160739

Rashidian, A., Miles, J., Russell, D., & Russell, I. (2006). Sample size for regression analyses of theory of planned behaviour studies: Case of prescribing in general practice. *British Journal of Health Psychology*, *11*(4), 581–593. https://doi.org/10.1348/135910705X66043

Reyna, V. F., & Farley, F. (2006). Risk and rationality in adolescent decision making: Implications for theory, practice, and public policy. *Psychological Science in the Public Interest, Supplement*, *7*(1), 1–44. https://doi.org/10.1111/j.1529-1006.2006.00026.x

Robertson, R. D., & Pashley, C. R. (2015). *the Traffic Injury Research Foundation*. www.tirf.ca

Ross, V., Jongen, E. M. M., Wang, W., Brijs, T., Brijs, K., Ruiter, R. A. C., & Wets, G. (2014). Investigating the influence of working memory capacity when driving behavior is combined with cognitive load: An LCT study of young novice drivers. *Crash Analysis and Prevention*, *62*, 377–387. https://doi.org/10.1016/j.aap.2013.06.032

Russo, B. J., James, E., Aguilar, C. Y., & Smaglik, E. J. (2018). Walking on the Wild Side : Distracted Pedestrians and Traffic Safety. *Transfers*, 13–18.

SafetyNet. (2009). Pedestrians & Cyclists. *Transport*.

Samuel, S., Romoser, M., Gerardino, L., Hamid, M., Gómez, R., Knodler, M., Collura, J., & Fisher, D. (2013). Effect of advance yield markings and symbolic signs on vehicle-pedestrian Conflicts. *Transportation Research Record*, *2393*, 139–146. https://doi.org/10.3141/2393-16

Sandt, L. S., Marshall, S. W., Rodriguez, D. A., Evenson, K. R., Ennett, S. T., & Robinson, W. R. (2016). Effect of a community-based pedestrian injury prevention program on driver yielding behavior at marked crosswalks. *Crash Analysis and Prevention*, *93*, 169–178. https://doi.org/10.1016/j.aap.2016.05.004

Sarkar, S. (1995). Evaluation of different types of pedestrian-vehicle separations. *Transportation Research Record*, *1502*, 83–95.

Schmunk, G. A. (1998). Pedestrian Injuries and Fatalities. In *Pedestrian Crash Reconstruction and*

Litigation, 2nd Edition (Issue 51).

Schwarzer, R. (2001). Social-Cognitive Factors in Changing Health-Related Behaviors. *Current Directions in Psychological Science*, *10*(2), 47–51. https://doi.org/10.1111/1467-8721.00112

Schwebel, D. C., Stavrinos, D., Byington, K. W., Davis, T., O'Neal, E. E., & De Jong, D. (2012). Distraction and pedestrian safety: How talking on the phone, texting, and listening to music impact crossing the street. *Crash Analysis and Prevention*, *45*, 266–271. https://doi.org/10.1016/j.aap.2011.07.011

Shokouhyar, S., Taati, E., & Zolfaghary, S. (2017). The effect of drivers' demographic characteristics on road crashs in different seasons using data mining. *Promet - Traffic - Traffico*, *29*(6), 555–567. https://doi.org/10.7307/ptt.v29i6.2342

Silva, J. B. S., Cristino, E. D., De Almeida, N. L., De Medeiros, P. C. B., & Dos Santos, N. A. (2017). Effects of acute alcohol ingestion on eye movements and cognition: A double-blind, placebo-controlled study. *PLoS ONE*, *12*(10), 1–16. https://doi.org/10.1371/journal.pone.0186061

Simmons, S. M., Caird, J. K., Ta, A., Sterzer, F., & Hagel, B. E. (2020). Plight of the distracted pedestrian: a research synthesis and meta-analysis of mobile phone use on crossing behaviour. In *Injury Prevention* (Vol. 26, Issue 2, pp. 170–176). BMJ Publishing Group. https://doi.org/10.1136/injuryprev-2019-043426

Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception*, *28*(9), 1059–1074. https://doi.org/10.1068/p281059

Stavrinos, D., Byington, K. W., & Schwebel, D. C. (2009). Effect of cell phone distraction on pediatric pedestrian injury risk. *Pediatrics*, *123*(2). https://doi.org/10.1542/peds.2008-1382

Stead, M., Tagg, S., MacKintosh, A. M., & Eadie, D. (2005). Development and evaluation of a mass media Theory of Planned Behaviour intervention to reduce speeding. *Health Education Research*, *20*(1), 36–50. https://doi.org/10.1093/her/cyg093

Sundfør, H. B., Sagberg, F., & Høye, A. (2019). Inattention and distraction in fatal road crashes – Results from in-depth crash investigations in Norway. *Crash Analysis and Prevention*, *125*(January), 152–157. https://doi.org/10.1016/j.aap.2019.02.004

SweRoad, & GE&SS. (2014a). *Consultants ' Services for Road Safety Audit of the National Road Network & Development of Road Safety Action Plan*.

SweRoad, & GE&SS. (2014b). *Road Safety Audit Report*.

Tefft, B. C. (2013). Impact speed and a pedestrian's risk of severe injury or death. *Crash Analysis and Prevention*, *50*, 871–878. https://doi.org/10.1016/j.aap.2012.07.022

Tom, A., & Granié, M. A. (2011). Gender differences in pedestrian rule compliance and visual search at signalized and unsignalized crossroads. *Crash Analysis and Prevention*, *43*(5), 1794–1801. https://doi.org/10.1016/j.aap.2011.04.012

United Nations Road Safety. (2011). Global plan for the Decade of Action for Road Safety 2011–2020.

Geneva: WHO, 25. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Global+Plan+for+the+Decade+of+Action+for+Road+Safety+2011-2020#0

Vaa, A. T., Phillips, R., Adamos, G., Ausserer, K., Delhomme, P., Divjak, M., De, W., Forward, S., Krol, B., Meng, A., Moan, S., Nathanail, T., Pohlmeier, E., Sardi, G. M., Schepers, P., Sedá, E., Ulleberg, P., & Walter, E. (2009). Effects of Road Safety Campaigns - Final version. In *CAST, Campaign and awareness raising strategies in traffic safety*.

Walshe, E. A., Winston, F. K., Betancourt, L. M., Khurana, A., Arena, K., & Romer, D. (2019). Working Memory Development and Motor Vehicle Crashes in Young Drivers. *JAMA Network Open*, *2*(9), e1911421. https://doi.org/10.1001/jamanetworkopen.2019.11421

WHO, & UNICEF. (2008). Children and road traffic injury. *Injury Prevention*, 2.

Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behavior*, *27*(5), 591–615. https://doi.org/10.1177/109019810002700506

World Health Organisation. (2014). *Mobile phone use: a growing problem of driver distraction*. https://www.who.int/violence_injury_prevention/publications/road_traffic/distracted_driving/en/

World Health Organisation. (2015). Global Status Report on Road Safety 2015. In *World Health Organization*.

World Health Organisation. (2018). *Global status report on road safety 2018*. http://e-journal.uajy.ac.id/14649/1/JURNAL.pdf

World Health Organization. (2004a). Implementing specific interventions to prevent road traffic injuries. *Road Traffic Injury Prevention: Training Manual*, 76. http://www.who.int/violence_injury_prevention/road_traffic/activities/roadsafety_training_manual_unit_4.pdf

World Health Organization. (2004b). *Road safety- Speed*.

World Health Organization. (2007). Drinking and Driving: a road safety manual for decision-makers and practitioners. In *Global Road Safety Partnership*.

World Health Organization. (2009a). Global Status Report on Road Safety: Time for action. In *World Health Organization*. http://apps.who.int/iris/bitstream/handle/10665/44122/9789241563840_eng.pdf;jsessionid=80D4774FE6C0CA3666010581CD4B9C1F?sequence=1

World Health Organization. (2009b). *GLOBAL STATUS REPORT ON ROAD SAFETY: TIME FOR ACTION*.

World Health Organization. (2011). *Mobile phone use: a growing problemofdriver distraction*.

World Health Organization. (2015). Pedestrian Safety: A road safety manual for decision-makers and practitioners. In *Encyclopedia of Trauma Care*. https://doi.org/10.1007/978-3-642-29613-0_101118

World Health Organization. (2016). *ROAD SAFETY IN THE AFRICAN REGION 2015*.

Wundersitz, L., Hutchinson, T., & Woolley, J. (2010). *Road Safety Campaign Handbook (CASR074)*.

Zeedyk, M. S., & Kelly, L. (2003). Behavioural observations of adult-child pairs at pedestrian crossings. *Crash Analysis and Prevention*, *35*(5), 771–776. https://doi.org/10.1016/S0001-4575(02)00086-6

Zhang, H., Zhang, C., Chen, F., & Wei, Y. (2019). Effects of mobile phone use on pedestrian crossing behavior and safety at unsignalized intersections. *Canadian Journal of Civil Engineering*, *46*(5), 381–388. https://doi.org/10.1139/cjce-2017-0649

Zhang, L., Cui, B., Yang, M., Guo, F., & Wang, J. (2019). Effect of using mobile phones on driver's control behavior based on naturalistic driving data. *International Journal of Environmental Research and Public Health*, *16*(8), 1–13. https://doi.org/10.3390/ijerph16081464

Zhao, X., Zhang, X., & Rong, J. (2014a). Study of the effects of alcohol on drivers and driving performance on straight road. *Mathematical Problems in Engineering*, *2014*. https://doi.org/10.1155/2014/607652

Zhao, X., Zhang, X., & Rong, J. (2014b). Study of the effects of alcohol on drivers and driving performance on straight road. *Mathematical Problems in Engineering*, *2014*. https://doi.org/10.1155/2014/607652

Zhou, R., Horrey, W. J., & Yu, R. (2009). The effect of conformity tendency on pedestrians' road-crossing intentions in China: An application of the theory of planned behavior. *Crash Analysis and Prevention*, *41*(3), 491–497. https://doi.org/10.1016/j.aap.2009.01.007

Zuccalà, G., Onder, G., Pedone, C., Cesari, M., Landi, F., Bernabei, R., & Cocchi, A. (2001). *Dose-Related Impact of Alcohol Consumption on Cognitive Function in Advanced Age: Results of a Multicenter Survey*.

APPENDICES

Appendix 1. Questionnaire to pedestrians (translated from Kinyarwanda)

Hello,
Thank you for participating in this survey.
My name is MURENZI Jean-Clement; I am a master student at Hasselt University. This study relates to the evaluation of behavioural factors involved in pedestrians focused on safety awareness campaigns. The results of this study will be included in my master thesis. This questionnaire is designed to collect information on the safety of pedestrians in traffic. Pedestrians should complete this questionnaire between 11 and 20 years of age. No personal information is required.
Thank you

Part 1: Demographic factors

1. Sex

Male	Female
1	2

2. Age

11- 12	13-14	15-16	17-18	19-20
1	2	3	4	5

3. Near crash experience

How many times has a car almost hit you in the past 12 months?

Never	once	Few times	Many times,
1	2	3	4

Part 2 Theory of planned behaviour (zebra crossing)

Compliance with the zebra crossing rule can protect pedestrians from crashes. Crossing outside zebra crossings is considered risky behaviour; whenever in less than 50 meters there is a zebra crossing. The risky target behaviour is crossing outside zebra crossings when a zebra crosses in less than 50 meters.

A. Attitude

I think that when the zebra crossing is within 50 meters, crossing outside of the zebra crossing;

		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Att1	saves time	1	2	3	4	5
Att2	is safe	1	2	3	4	5
Att3	is necessary	1	2	3	4	5
Att4	does not interfere with the right of other road users	1	2	3	4	5

B. Subjective Norm

Q2. The following people would be shocked to learn that you cross outside the zebra crossing when the zebra crossings are less than 50 meters away

		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
SN1	*family members*	1	2	3	4	5
SN2	*friends*	1	2	3	4	5
SN3	*Traffic police officers*	1	2	3	4	5
SN4	Teacher	1	2	3	4	5

4. You want to comply with your loved ones' beliefs about making an effort to cross the road at zebra cross.

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
SN5	1	2	3	4	5

C. Perceived behavioural control

Q2. when you are about 50 meters from the crosswalk, In the following scenarios; how easy or difficult is it to walk to the crosswalk and cross at the crosswalk (instead of crossing in front of you)?

		Diffi-cult	Slightly difficult	Mod-erate	Slightly easy	Very easy
PBC1	When you are tired	1	2	3	4	5
PBC2	When you are late and, in a hurry,	1	2	3	4	5
PBC3	When you need to meet someone, who is on the other side of the road	1	2	3	4	5
PBC4	When a bus you want to board is on the other side of the road	1	2	3	4	5

D. Intention

In the following scenarios, when you will be about 50 meters from the marked crosswalk, how often do you intend to walk to the marked crosswalk and cross there (instead of crossing in front of you to shorten the travel distance)?

		Never	rarely	Half of the times	Often	Al-ways
INT1	When you will be tired	1	2	3	4	5
INT2	When you will be late and, in a hurry,	1	2	3	4	5
INT3	When you want to meet a person is on the other side of the road	1	2	3	4	5
INT4	When you a bus you want to board is on the other side of the road	1	2	3	4	5

E. Past behaviour

When you were about 50 meters from the pedestrian crossing;

	<20%	20%-40%	40%-60%	60%-80%	>80%
How often did you walk and cross pedestrian cross-ings (instead of crossing in front of you)?	1	2	3	4	5

Part 3: Cell phone use while walking

Texting or chatting, putting on earphone to listen to music, conversation on the cell phone and viewing content on the cell phone while walking is regarded as a risky pedestrian behaviour.

When you walk on the road, how many of them you complete without using a cell phone (not even once);

	<20%	20%-40%	40%-60%	60%-80%	>80%
5. To text or chat	1	2	3	4	5
6. To listen to music through earphone	1	2	3	4	5
7. To make or receive a call	1	2	3	4	5
8. To check or view a content	1	2	3	4	5

Appendix 2. Questionnaire to pedestrians (Kinyarwanda)

Muraho,
Murakoze kwitabira gutanga ibitekerezo muri ubu bushakashatsi.
Nitwa MURENZI Jean Clement, niga kuri Kaminuza ya Hasselt, ubu bushakashatsi bujyanye no gusuzuma ibintu bigira uruhare mubikorwa by'ubukangurambaga bwibanda ku mutekano w'abanyamaguru, ibizava muri ubu bushakashatsi bizashyirwa mu gitabo cyandikwa hasozwa icyiciro cya 3 cya kaminuza. Ibibazo bikubiye muri uru rwandiko bigamije gukusanya amakuru yerekeranye n' umutekano w'umunyamaguru mumuhanda, by'umwihariko ibi bibazo bigenewe gusubizwa n'abantu bari mukigero cy'imyaka ari hagati ya 11 na 20 . Nta makuru yihariye agaragaza umwirondoro wanyu asabwa.Gusubiza ibibazo byose bifata iminota itarenze 15.

PART 1: Demographic factors

1. Igitsina

Umuhungu	Umukobwa
1	2

2. Ikigero cy'imyaka y'ubukure

11- 12	13-14	15-16	17-18	19-20
1	2	3	4	5

3. Akaga k'impanuka

Mu mezi 12 ashize ni kangahe byabayeho, imodoka akaba yenda kukugonga, kubwamahirwe ntibibe?

Ntibirabaho	Rimwe	Rimwe narimwe	Kenshi
1	2	3	4

Part 2: TPB

A. Attitude

Kubwanjye kwambukira ahatarateganirijwe abanyamaguru (zebra crossing) mba numva

	Simbyemera na gato	*Simbyemera*	*Simbyemera simbihakana*	*Ndabyemera*	*Ndabyemera cyane*
4. Byihutisha urugendo	*1*	*2*	*3*	*4*	*5*
5. Bitateza impanuka	*1*	*2*	*3*	*4*	*5*
6. Ari ngombwa	*1*	*2*	*3*	*4*	*5*
7. Bitabangamye	*1*	*2*	*3*	*4*	*5*

B. Subjective Norm

Aba bantu bakurikira byababababaza bamenye ko ukunze kwambukira ahatarateganyirijwe abanyamaguru…

	Simbyemera na gato	*Simbyemera*	*Simbyemera sinabihakana*	*Ndabyemera*	*Ndabyemera cyane*
8. Inshuti zawe	*1*	*2*	*3*	*4*	*5*
9. Umuryango wawe	*1*	*2*	*3*	*4*	*5*
10. Umupolisi wo ku muhanda	*1*	*2*	*3*	*4*	*5*
11. Umwarimu wawe	*1*	*2*	*3*	*4*	*5*
12. Wifuza kugendera ku byifuza by'abantu bawe bahafi	*1*	*2*	*3*	*4*	*5*

C. Perceived behavioural control

Mubihe bikurikira byoroshye kuruhe rugero kuzenguruka ukajya kwambukira ahagenewe kwambukirwa haherereye muri metero 50 avuye aho uri (aho kwambukira ibusamo).

	Bira-goye	*Bijya ku-gorana*	*Ntibyoroshye ntibina-gogoye*	*Bijya ko-roha*	*Biro-roshye*
13. Unaniwe	*1*	*2*	*3*	*4*	*5*
14. Wakerewe/uri kwihuta	*1*	*2*	*3*	*4*	*5*
15. Hari umuntu ushaka guhura nawe ahagaze kurundi ruhande rw'umuhanda	*1*	*2*	*3*	*4*	*5*
16. Bus ushaka gutega iri kurundi ruhande rw'umuhanda	*1*	*2*	*3*	*4*	*5*

D. Intention

Mubihe bizaza ni kangahe uzazenguruka ukajya kwambukira ahagenewe kwambukirwa haherereye muri metero 50 avuye aho uri (aho kwambukira ibusamo).

	Munsi ya 20%	*20%-40*	*40%-60%*	*60%-80*	*Hejuru ya 80%*
17. Mugihe unaniwe	*1*	*2*	*3*	*4*	*5*
18. Mugihe wakerewe/ uri kwihuta	*1*	*2*	*3*	*4*	*5*
19. Mugihe hari umuntu ushaka guhura nawe ahagaze kurundi ruhande rw'umuhanda.	*1*	*2*	*3*	*4*	*5*
20. Mugihe bus ushaka gutega iri kurundi ruhande rw'umuhanda.	*1*	*2*	*3*	*4*	*5*

E. Past behaviour

21. Mu nshuro wambuka umuhanda, ni kangahe uzenguruka ukajya kwambukira ahagenewe kwambukirwa haherereye muri metero 50 avuye aho uri (aho kwambukira ibusamo).

Munsi ya 20%	*20%-40*	*40%-60%*	*60%-80*	*Hejuru ya 80%*
1	2	3	4	5

PART 3: Gukoresha telecell phone mugihe ugenda n'amaguru

Gukoresha terefone mugihe ugenda mumuhanda bivuga kuganira kuri terefone, kumva amajwi kuri terefone, kohereza ubutumwa bugufi no gusoma ikintu muri terefone yawe mugihe ugenda mumuhanda. Gukoresha telecell phone mugihe ugenda. Iyo bibaye ugenda abarwa nk'uwakoresheje telecell phone mugihe ari kugendera mumuhanda .

Mungendo z'amaguru ukorera mumuhanda , ni zingahe muri zo utangira ukagera kumusosozo wazo…

	Munsi ya 20%	*20%-40*	*40%-60%*	*60%-80*	*Hejuru ya 80%*
22. Utavugiye kuri telecell phone	1	2	3	4	5
23. Udakoresheje cell phone wunmvira indirimbo muri ecouteur	1	2	3	4	5
24. Udakoresheje cell phone wandika ubutumwa (chatting)	1	2	3	4	5
25. Udakoresheje cell phone hari icyo urebamo.	1	2	3	4	5

Appendix 3. Questionnaire for drivers (English version)

Dear Respondent,
Thank you for your willingness to take this survey. I am assessing the factors contributing to the effectiveness of pedestrians' safety-focused awareness campaigns. This questionnaire is a data collection tool for my master's thesis. It serves to collect the pedestrians' road safety information from drivers. This questionnaire is made of 25 questions, it takes less than *15 minutes* to complete the survey, you do not need to type while answering, and all you have to do is to select the choice that best describes your choice, for example: if you are 22 years old, the answer to the 2nd question is (18-24). Your participation in this research study is intentional. You can withdraw at any time. The information provided is anonymous and will be treated in strict confidence. The information obtained in the study may be published academically.
Please do your best to provide the truthful answer.
Thank you!

PART 1: Demographic factors

Q1 **Sex**

	Male	Female
1. You are	1	2

Q2 **Age**

	18 - 24	25 - 34	35 - 44	45 - 54	55 or older
2. Your age group is					

Q3 Driving experience (Years)

	Less than 2	2 - 4	5 - 7	8 - 10	More 10
3. You have been driving for					

Q4 Near vehicle-pedestrian crash experiment (To nearly hit a pedestrian, and successfully manoeuvre to avoid the crash)

	Never	once	Few times	Many times,
4. in the last 12 months, how often did you experience a near pedestrians-vehicle crash when you are driving?				

PART 2: Theory of Planned Behaviour (TPB)

Yielding to the pedestrian's rule request that whenever a driver arrives at the zebra cross, they must stop and let the pedestrians cross the road, and only get past the zebra crossings after all the pedestrians have crossed the road.

		Strongly disagree	Somewhat disagree	Neither agree nor	Somewhat agree	Strongly agree
Att1	5. Yielding to pedestrians makes the trip less enjoyable	1	2	3	4	5
Att2	6. I dislike stopping from time to time when I am driving	1	2	3	4	5
Att3	7. Yielding to pedestrians is not important	1	2	3	4	5

Att4	8. Yielding to pedestrians is time-consuming	1	2	3	4	5
SN1	9. My family would be shocked if they notice that I do not yield to pedestrians at the zebra crossing.	1	2	3	4	5
SN2	10. My friends would be shocked if they notice that I do not yield to pedestrians at a zebra crossing.	1	2	3	4	5
SN3	11. A traffic police officer would be shocked if they notice that I do not yield to pedestrians at a zebra crossing.	1	2	3	4	5
SN4	12. Pedestrians would be shocked if they notice that I do not yield to pedestrians at a zebra crossing.	1	2	3	4	5
SN5	13. I think that I should comply with the wishes of people who are important to me.	1	2	3	4	5

		Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy
PBC 1	14. When you are tired, yielding to pedestrians is	1	2	3	4	5
PBC 2	15, When you are late and, in a hurry, yielding to pedestrians is	1	2	3	4	5
PBC 3	16. When a car in front of you does not yield to pedestrians, yielding to pedestrians is	1	2	3	4	5
PBC 4	17. On a road with consecutive zebra crossings, Yielding to pedestrians at each of the zebra crossings	1	2	3	4	5

Q8 Intention

		Never	Sometimes	About half the time	Most of the time	Always
INT1	18. In the future, when you will be tired, how many times will you yield to pedestrians?	1	2	3	4	5
INT2	19. When you will be late, and, in a hurry, how many times will you yield to pedestrians?	1	2	3	4	5
INT3	20. When a vehicle in front of you will not be yielding to pedestrians, how many times will you yield to pedestrians?	1	2	3	4	5
INT4	21. On a road with consecutive zebra crossings, how many times will you yield to pedestrians?	1	2	3	4	5

	Never	Sometimes	About half the time	Most of the time	Always
22. in the last 12 months, how often in the past did you yield to pedestrians?	1	2	3	4	5

Part 2. Other human factors

Q10 Over speed (exciding the speed limit)

23. How many trips do you drive to a destination (the whole trip) without exceeding the speed limit?

None	A quarter of the trips	Half of the trips	almost all the trips	all the trips

Q11 Cell phone use while driving (texting, call, viewing a content while driving)

24. How many trips do you drive to a destination without using (not even once) your cell phone?

None	A quarter of the trips	Half of the trips	Almost all the trip	All the trips

Q12 Drunk driving (Driving under the influence of alcohol, with BAC above 0.08g/L)

	Never	Once	rarely	often	all the time
25. How many times have you driven under the influence of alcohol in the last 12 months?	1	2	3	4	5

Appendix 4. Questionnaire for drivers (Kinyarwanda version)

Muraho,

Murakoze kwitabira gutanga umusanzu wanyu kuri ubu bushakashatsi. Ndimo gusuzuma ibintu bigira uruhare mubikorwa byubukangurambaga bwibanda kumutekano wabanyamaguru. Uru rupapuro ni-gikoresho cyo gukusanya amakuru. Gusa abashoferi Hittabira umuntu wese utwara ikinyabiziga ntabwo (ari umushoferi wumwuga gusa).

Bisaba iminota itarenze 15 yo gusubiza , ntaho usabwa kwandika mugihe usubiza, icyo ugomba gukora nukuguhitamo uburyo busobanura neza igisubizo cyawe cyukuri. Urugero: niba ufite imyaka 22, igi-subizo cyikibazo cya 2 ni (18-24). Ntabwo uhatirwa kwitabira kuzuza iyi fomu, Kuyuzuza ni ubushake.

Murakoze!

	Umugabo/ umusore	Umugore/ umukobwa
1. Uri.	1	2

	18 - 24	25 - 34	35 - 44	45 - 54	>54
2. Hitamo ikigero cy'imyaka yamavuko yanyu	1	2	3	4	5

	<2	2 - 4	5 - 7	8 - 10	>10
3. Hashize imyaka ingahe utwara ikinyabiziga?	1	2	3	4	5

4. Mumeze 12 ashize, Nikangahe wegereje kugonga umunyamaguru, kubwamahirwe ukabasha kubuza iyo mpanuka kuba.

Ntanarimwe	Rimwe	Rimwe nar-imwe	Kenshi
1	2	3	4

PART B :Theory of Planned Behaviour (TPB)

Kureka umunyamagura akabanza kwambuka mugihe ugeze aho abanyamaguru bambu-kira : igihe cyose umuntu utwaye ikinyabiziga ageze aho abanyamaguru bambukira agomba guhagarara abanyamaguru bose bahari bakabanza kwambuka, akabona gukomeza urugendo

	Simbyemera na gato	Simbyemera	Simbyemera sinabiha-	Ndabyemera	Ndabyemera cyane
5. Guhagarara igihe cyose hari abanyamaguru bashaka kwambuka bi-tuma urugendo rurambirana	1	2	3	4	5
6. Nanga kugenda mpagarara	1	2	3	4	5

7. Guhagarara igihe cyose hari abanyamaguru bashaka kwambuka si ngomwa	1	2	3	4	5
8. Ibinyabiziga nibyo byihuta, baba byiza ari byo bibanza guhita	1	2	3	4	5
Byababababaza bamenye ko ntajya ndeka abanyamaguru ngo babanze batambuke					
9. Abo mumuryango wanjye	1	2	3	4	5
10. Inshuti zanjye	1	2	3	4	5
11. Umupolice wo kumuhanda	1	2	3	4	5
12. Abanyamaguru ntahagaze ngo babanze bambuke	1	2	3	4	5
13. Ibyifuzo by'abantu banjye kubijyanye no kureka abanyamaguru ngo babanze kwambuka mbigenderaho	1	2	3	4	5

	Biragoye cyane	Biragoye	Ntibyoroshye ntibinagoye	Biroroshye	Biroroshye cy-
14. Guhagara kugira ngo umunyamaguru abanze yambuke, mugihe unaniwe	1	2	3	4	5
15, Guhagara kugira ngo umunyamaguru abanze yambuke, mugihe wakerewe uri kwihuta	1	2	3	4	5
16. Guhagara kugira ngo umunyamaguru abanze yambuke, mugihe imodoka ikuri imbere itari kubyubahiriza	1	2	3	4	5
17. Guhagara kugira ngo umunyamaguru abanze yambuke, mugihe uwo muhanda ufite aho abanyamaguru bambukira henshi hegeranye	1	2	3	4	5

	Ntanarimwe	Rimwe narimwe	½ cyaho bisabwa	Hafi buri gihe	Burigihe
18. Nuba unaniwe, ni kangahe uteganya kuzajya ahugarara kugira ngo umunyamaguru yambuke?	1	2	3	4	5
19. Nuba wakerewe, uri kwihuta, ni kangahe uteganya kuzajya ahugarara kugira ngo umunyamaguru yambuke?	1	2	3	4	5
20. Imodoka ikuri imbere niba itari kubahiriza guhagarara ngo umunyamaguru abanze yambuke, ni kangahe uteganya kuzajya ubyubahiza?	1	2	3	4	5
21. Mugihe uri mu muhanda ufite aho abanyamaguru bambukira henshi hegeranye ni kangahe uteganya kuzajya ahugarara kugira ngo umunyamaguru yambuke?	1	2	3	4	5

22. Mubihe byashize ni kangahe wahagaze kugira ngo abanyamaguru bategereje kwmbuka babanze bambuke?

Ntanarimwe	Rimwe narimwe	½ cyaho bisabwa	Hafi buri gihe	Burigihe
1	2	3	4	5

Part C. Other human factors

Q10 Umuvuduko urenze uwemewe kugenderwaho

23. Mungendo ukora utwaye, ni zingahe murizo urangiza utarengeje umuvuduko ntarengwa?

Ntazo	¼ cy'ingendo nkora	½ cy'ingendo nkora	Hafi ingendo zose nkora	Ingendo zose nkora
1	2	3	4	5

Q11 Gukoresha cell phone mugihe utwaye (kwandika ubutumwa, kuvugira kuri cell phone, kugira icyo ureba kuri cell phone)

24. Mungendo ukora utwaye, ni zingahe murizo urangiza udakoresheje telecell phone narimwe?

Ntazo	¼ cy'ingendo nkora	½ cy'ingendo nkora	Hafi ingendo zose nkora	Ingendo zose nkora
1	2	3	4	5

Q12 Gutwara wanyoye inzoga

25. Mumezi 12 ashize ni kangahe watwaye wanyoye ibisindisha

Ntanarimwe	Rimwe	Gake	Kenshi	Kenshi cyane
1	2	3	4	5

Appendix 5. Effects of change in variables (TPB model for crossing outside zebra crossings)

TABLE 34 Standardized total effect in the TPB model of crossing outside zebra crossings

	Standardized Total Effects (Group number 1 - Default model)						Standardized Total Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)					
	COZC	Intention	PBC_DMV	PBC_IMV	SN	Attitude	COZC	Intention	PBC_DMV	PBC_IMV	SN	Attitude
Intention	0.28						0.02	...	...	...	...	...
PBC_DMV	0.37	0.36					0.00	0.01	...	...	...	...
PBC_IMV	0.12	0.41					0.01	0.00	...	...	...	...
SN	0.03	0.10					0.29	0.32	...	...	...	...
Attitude	0.01	0.04					0.60	0.74	...	...	...	...
Att4	0.01	0.03				0.65	0.58	0.68	...	...	...	0.00
att2	0.01	0.03				0.66	0.59	0.75	...	...	...	0.01
SN2	0.02	0.06			0.55		0.21	0.24	...	...	0.00	...
sn4	0.02	0.07			0.71		0.33	0.34	...	...	0.01	...
sn1	0.02	0.06			0.57		0.23	0.26	...	...	0.01	...
PBC4	0.28	0.27	0.76				0.01	0.01	0.01	...	...	...
PBC3	0.27	0.27	0.74				0.00	0.02	0.01	...	...	...
PBC1	0.09	0.32		0.78			0.01	0.00	...	0.01	...	...
PBC2	0.10	0.36		0.88			0.01	0.00	...	0.01	...	...
Int4	0.22	0.78		0.00			0.02	0.01	...	...	...	...
Int3	0.22	0.78		0.00			0.02	0.00	...	...	...	...
Int2	0.20	0.69		0.00			0.02	0.00	...	...	...	...

TABLE 35 Standardized indirect effect in the TPB model of crossing outside zebra crossings

	Standardized Indirect Effects (Group number 1 - Default model)						Standardized Indirect Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)					
	COZC	INTENTION	PBC_DMV	PBC_IMV	SN	ATTITUDE	COZC	INTENTION	PBC_DMV	PBC_IMV	SN	ATTITUDE
INTENTION	0.00	0.00	0.00	0.00	0.00	0.00	...	...	...	...	...	...
PBC_DMV	0.10	0.00	0.00	0.00	0.00	0.00	0.02	...	...	...	...	...
PBC_IMV	0.12	0.00	0.00	0.00	0.00	0.00	0.01	...	...	...	...	...
SN	0.03	0.00	0.00	0.00	0.00	0.00	0.29	...	...	...	...	...
ATTITUDE	0.01	0.00	0.00	0.00	0.00	0.00	0.6	...	...	...	...	...
ATT4	0.01	0.03	0.00	0.00	0.00	0.00	0.58	0.68	...	...	...	...
ATT2	0.01	0.03	0.00	0.00	0.00	0.00	0.59	0.75	...	...	...	...
SN2	0.02	0.06	0.00	0.00	0.00	0.00	0.21	0.24	...	...	...	...
SN4	0.02	0.07	0.00	0.00	0.00	0.00	0.33	0.34	...	...	...	...
SN1	0.02	0.06	0.00	0.00	0.00	0.00	0.23	0.26	...	...	...	...
PBC4	0.28	0.27	0.00	0.00	0.00	0.00	0.01	0.01	...	...	...	...
PBC3	0.27	0.27	0.00	0.00	0.00	0.00	0.00	0.02	...	...	...	...
PBC1	0.09	0.32	0.00	0.00	0.00	0.00	0.01	0.00	...	...	...	...
PBC2	0.10	0.36	0.00	0.00	0.00	0.00	0.01	0.00	...	...	...	...
INT4	0.22	0.00	0.00	0.00	0.00	0.00	0.02	...	...	...	...	...
INT3	0.22	0.00	0.00	0.00	0.00	0.00	0.02	...	...	...	...	...
INT2	0.20	0.00	0.00	0.00	0.00	0.00	0.02	...	...	...	...	...

Appendix 6. Effects of change in variables (TPB model for violation of yielding to pedestrians)

TABLE 36 Standardized total effect in the TPB model of violation of yielding to pedestrians

	Standardized Total Effects (Group number 1 - Default model)				Standardized Total Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)			
	SN	PBC	ATTITUDE	INTENTION	SN	PBC	ATTITUDE	INTENTION
INTENTION	0.578	0.849	0	0	0.001	0.003	0.942	...
PBC3	0	1	0	0	...	...	...	...
PBC1	0	0.942	0	0	...	0.003	...	...
PBC2	0	1.264	0	0	...	0.003	...	...
SN3	1.151	0	0	0	0.001	...	...	...
SN1	1.057	0	0	0	0.003	...	...	...
Int4	0.578	0.849	0	1	0.001	0.003	0.942	...
Int2	0.669	0.982	0	1.157	0.001	0.002	0.942	0.002
Int3	0.635	0.934	0	1.099	0.001	0.003	0.942	0.002
Int1	0.539	0.792	0	0.932	0.001	0.002	0.942	0.002
Att3	0	0	1.011	0	...	...	0.003	...
SN4	1	0	0	0	...	...	...	...
YTP	0.353	0.519	0	0.611	0.001	0.002	0.938	0.002
Att2	0	0	1.011	0	...	...	0.003	...

TABLE 37 Standardized direct effect in the TPB model of violation of yielding to pedestrians

	Standardized Direct Effects (Group number 1 - Default model)				Standardized Direct Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)			
	SN	PBC	ATTITUDE	INTENTION	SN	PBC	ATTITUDE	INTENTION
INTENTION	0.578	0.849	0	0	0.001	0.003	0.942	...
PBC3	0	1	0	0	...	...	...	...
PBC1	0	0.942	0	0	...	0.003	...	...
PBC2	0	1.264	0	0	...	0.003	...	...
SN3	1.151	0	0	0	0.001	...	...	...
SN1	1.057	0	0	0	0.003	...	...	...
Int4	0	0	0	1	...	...	...	...
Int2	0	0	0	1.157	...	...	...	0.002
Int3	0	0	0	1.099	...	...	...	0.002
Int1	0	0	0	0.932	...	...	...	0.002
Att3	0	0	1.011	0	...	...	0.003	...
SN4	1	0	0	0	...	...	...	...
YTP	0	0	0	0.611	...	...	...	0.002
Att2	0	0	1.011	0	...	...	0.003	...

TABLE 38 Standardized indirect effect in the TPB model of violation of yielding to pedestrians

	Standardized Indirect Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)					Standardized Indirect Effects - Two-Tailed Significance (BC) (Group number 1 - Default model)				
	VYTP	intention	PBC	Attitude	SN	VYTP	intention	PBC	Attitude	SN
intention	0	0	0	0	0	...	...	...	...	...
PBC	0.218	0	0	0	0	0.004	...	...	...	...
Attitude	0.219	0	0	0	0	0.01	...	...	...	...
SN	0.167	0	0	0	0	0.023	...	...	...	...
Att4	0.142	0.279	0	0	0	0.01	0.014	...	...	...
att3	0.174	0.341	0	0	0	0.009	0.016	...	...	...
pcb3	0.107	0.319	0	0	0	0.474	0.006	...	...	...
pcb2	0.096	0.286	0	0	0	0.456	0.014	...	...	...
sn4	0.138	0.271	0	0	0	0.023	0.026	...	...	...
sn1	0.115	0.225	0	0	0	0.02	0.021	...	...	...
sn3	0.143	0.28	0	0	0	0.023	0.025	...	...	...
Int4	0.427	0	0	0	0	0.003	...	...	...	...
Int2	0.462	0	0	0	0	0.003	...	...	...	...
Int3	0.478	0	0	0	0	0.003	...	...	...	...

Appendix 7. Further details for ordinal regression models

TABLE 39 Model fitness, the goodness of fit and Pseudo R^2 for PLUM ordinal regression analysis on pedestrian data

			MFI			GOF		
Model	DV	IV	intercept	Final	Sig	Pearson	Deviance	Nagelkerke
1	VYTP	Age, Sex	127.070	121.978	0.078	0.559	0.372	0.035
2	P-Tlk	Age, Sex	140.683	126.606	0.001	0.649	0.698	0.092
3	P-Msc	Age, Sex	142.648	139.374	0.195	0.089	0.011	0.022
4	P-Txt	Age, Sex	150.527	138.247	0.020	0.055	0.032	0.081
5	P-Cont	Age, Sex	130.448	122.430	0.018	0.870	0.865	0.054
6	VPNC	Age, Sex	128.712	119.123	0.008	0.022	0.002	0.066
7	VPNC	VYTP	56.207	54.906	0.240	0.796	0.610	0.009
8	VPNC	P-Tlk	62.579	56.670	0.015	0.797	0.799	0.041
9	VPNC	P-Msc	59.566	59.248	0.573	0.444	0.396	0.020
10	VPNC	P-Txt	86.629	74.566	0.001	0.002	0.002	0.081
11	VPNC	P-Cont	56.848	56.189	0.417	0.836	0.845	0.005

TABLE 40 model fitness, the goodness of fit and Pseudo R^2 for PLUM ordinal regression analysis on driver's data

			MFI			GOF		
Model	Dv	IV	intercept	Final	Sig	Pearson	Deviance	Nagelkerke
11	VYTP	Age	33.247	31.631	0.433	0.288	0.274	0.007
12	VYTP	DRIVEX	33.44	32.86	0.445	0.974	0.974	0.006
13	Speeding	Age	52.827	52.421	0.524	0.26	0.21	0.004
14	Speeding	DRIVEX	55.621	55.31	0.579	0.369	0.3	0.003
15	PU	Age	47.348	44.673	0.102	0.233	0.236	0.028
16	PU	DRIVEX	53.708	51.325	0.123	0.605	0.592	0.025
17	DD	Age	23.995	23.89	0.745	0.813	0.799	0.001
18	DD	DRIVEX	34.617	33.708	0.34	0.266	0.164	0.011
19	VPNC	Age	29.875	29.849	0.87	0.365	0.342	0
20	VPNC	VYTP	25.335	24.623	0.399	0.261	0.255	0.008
21	VPNC	Speeding	32.842	27.432	0.02	0.847	0.834	0.06
22	VPNC	PU	38.16	27.731	0.01	0.75	0.703	0.114
23	VPNC	DD	28.501	23.235	0.022	0.275	0.105	0.059

Appendix 8. Graphical version of the 2nd and 3rd objectives results

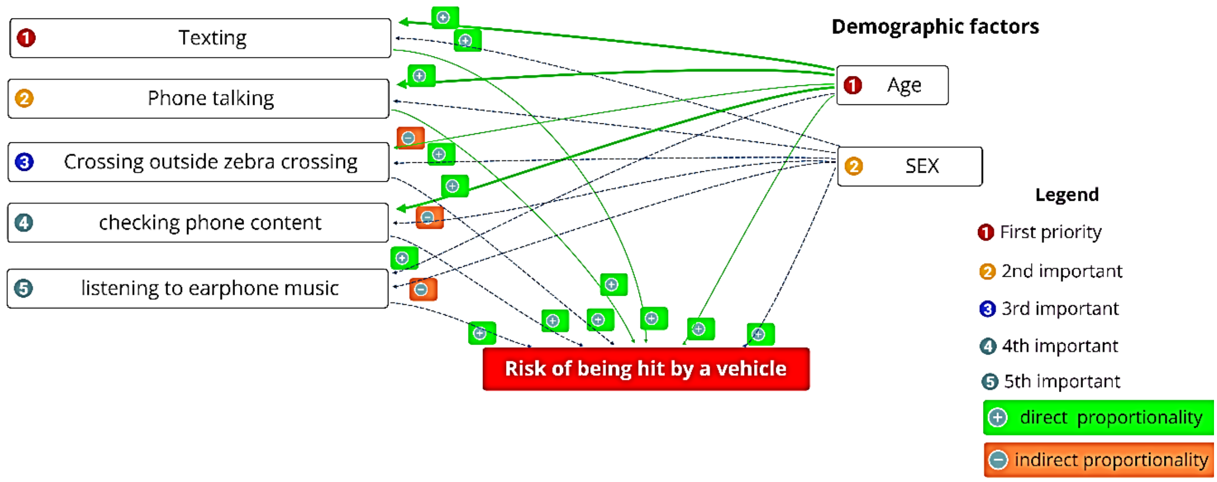


FIGURE 26 Summary of the results for 2nd and 3rd obectivers on pedestrians factors

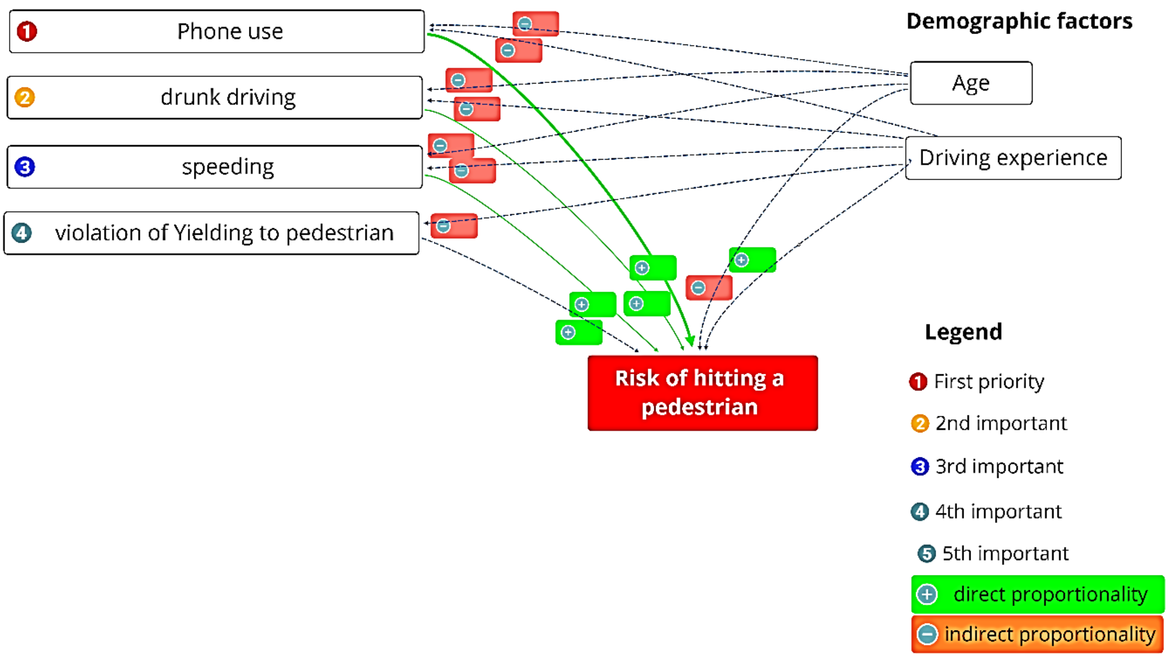


FIGURE 27 Summary of the results for 2nd and 3rd obectivers on drivers factors