

TALKING, EATING, DRINKING AND UNCONTROLLED STEERING: A SOUTH AFRICAN EXAMPLE OF DISTRACTED DRIVING

K VENTER

CSIR Built Environment, Infrastructure Systems and Operations, P O Box 395 Pretoria 0001 Tel: 012 841 3856; Fax: 012 841 4044 E-mail: kventer@csir.co.za. Building 2, Meiring Naude Road, Pretoria 0001

ABSTRACT

Road safety reports indicate that “the human” is the largest contributory factor in South African fatal crashes. Yet little is known about human factors in South African road safety. A better understanding of contributing behaviours such as distraction could assist in addressing road safety behaviour. Internationally a good deal of research has been dedicated to investigating the contribution that distracted driving practices play in crashes and near-crashes.

This research paper provides an overview of how the Naturalistic Driving Studies (NDS) methodology was utilised in a small (non-representative) experiment to observe South African driver behaviour in an everyday setting. The findings provided insight related to a number of driver behaviour issues such as traffic conflicts, traffic violations and distracted driving. The most prominent distracted driving behaviours identified included: adjusting the radio, eating and drinking while driving (which led to uncontrolled steering behaviour) and mobile phone use.

The focus of this paper is to disseminate findings related to distraction while driving in a South African setting. The paper provides an overview of the NDS methodology followed, findings from the experiment related to distractions and driving and concludes with the identification of possible research questions for future consideration.

1. BACKGROUND

Road traffic crashes in South Africa annually lead to some 14 000 deaths, 7 000 permanent disabilities and approximately 40 000 serious injuries (National Department of Transport, 2006). In 2010, the costs of road traffic crashes and fatalities were estimated to be in the region of 100 billion South African rand (Arrive Alive, 2010). South Africa’s objective of reducing its fatal crashes by half by 2014 is in accordance with the 2006 Millennium Development Goals (National Department of Transport, 2006) and the Accra Declaration (WHO, 2007). This resolution was again strengthened in 2009 through the Moscow Declaration and the adoption of ‘A Decade for Road Safety Action’ launched worldwide 11 May 2011 (WHO 2011). The statistics released by the Road Traffic Management Corporation (RTMC) in 2009 indicated that South Africa seriously lagged behind its goals set in this regard for 2014. Two years later the RTMC Road Traffic Report 2011 states that for the period 2010 to 2011 a decrease in the number of fatal crashes and fatalities is being observed. The 0.94 % decrease in fatal crashes is still not nearly enough to reach South Africa’s commitment to halving fatal crashes by 2014. Furthermore the RTMC Road Traffic Report 2011 indicates that the overall offence rate monitored for 2010/2011 was approximately 4.2 %. This constitutes an overall decrease of 1.4% from

the previous year. Human factors account for 80% to 90% of fatal road traffic crashes in South Africa (Botha, 2005; Gainewe and Masangu, 2010). The human factors (offences) monitored include: speed, barrier line violations, and seatbelt, alcohol and traffic offences. Distraction is not mentioned as a contributory factor in this report.

To address the crashes on South African roads, new information and a new understanding of what causes crashes are needed. Insight into the behavioural causes of crashes will inform the design of appropriate interventions to address this contributing factor within the context of the vehicle and the driving environment.

The fact that little driver behaviour research has been conducted in South Africa over the years is further complicated by a lack of law enforcement (due to available policing resources) as well as a general lack of skills to investigate the contribution of human factors in road traffic crashes.

2. DATA COLLECTION THROUGH NATURALISTIC DRIVING STUDIES (NDS)

The CSIR along with the Universities of Stellenbosch, Pretoria and Chemnitz Technical University in Germany investigated the possibility of utilising a new methodology for understanding South African driver behaviour in the context of the vehicle and the environment. Naturalistic Driving Studies (NDS) is considered a comprehensive data collection method which has successfully been tested and applied internationally. A large volume of data is collected from cameras facing the driver (inside and outside of the vehicle) along with data from sensors connected to the vehicle. Advances in the technology enable researchers to conduct in-depth research not only into crashes and offences but into normal, every-day driver behaviour.

Test drives were conducted on two occasions. The first test drives took place in January 2011. Two initial experiments were conducted. Both initial drives were conducted by the same company driver. These drives took place on two routes on two separate occasions. The second set of test drives took place during October 2011. Both test drives was conducted for approximately one week. Image material and data collected from the sensors were downloaded and stored for future analysis.

3. TOPIC OF THIS PAPER

Although a number of observations was made the purpose of this paper is to discuss the findings pertaining to distracted driving practices as observed in the first set of test drives conducted in January 2011.

4. METHODOLOGY

4.1. Instrumentation used in the test vehicle

The test vehicle was sponsored by a private company. The test vehicle is a Ford Fiesta 2010 model with a 1400 cc engine capacity, which was fitted with a data acquisition system (DAS). The DAS instrumentation consisted of two high-resolution, monochrome fire-wire cameras - one front-viewing to observe the road environment), and the other camera facing the driver of the vehicle. The DAS included a global positioning system (GPS) module, a Linux-based on-board computer with an external hard drive and a 15-inch flat-screen monitor.

4.2. Description of driver

One driver conducted both test drives, with two different data sets being compiled and compared. The driver, a male in his mid-20s, is a professional driver with a professional driver permit (PrDP) and had been driving for the company for eight years. Duties of the driver include the delivery and transfer of court and legal documents to clients, attorneys and court houses within the Gauteng province of South Africa.

4.3. Description of routes

The driver was requested to drive on two routes - Route A and B, Route A was the longer drive and part of a normal working day for the driver. Route B was the shorter test drive with a passenger in the vehicle. Due to the fact that the sample size was so small, it is not possible to generalise the findings. Rather, the study aims to investigate the possibilities that NDS research can provide in conducting human factor research in the SA road traffic environment.

Route A formed part of a typical working day's drive for the driver within the City of Tshwane. The trip took approximately three hours. No passengers were present during this trip.

Test Route B constituted a shorter trip, from the CSIR campus in Pretoria East to the centre of the City of Tshwane. The driver was accompanied by a single passenger who ensured that all equipment was functioning correctly. The duration of this trip was approximately twenty five minutes.

4.4. Analysis of data

Analysis of the data for the first test drives in January 2011 was conducted making use of a behavioural analysis tool and a statistical programme (Microsoft Excel).

Relevant driver behaviour was coded and analysed. Four categories of driver behaviour were identified:

- a) Eye and head movement: These movements were observed as part of the driver's normal driving task. Elsewhere in the world, extensive research has been conducted with regard to eye movement as a predictor of behaviour for example: in understanding the biological consequences of eye movement and vision in driving (Van Orden et al., 2000); in detecting fatigue while driving; and in changes in visual task performance. Currently no similar research or information on this topic exists for South Africa.
- b) Traffic conflicts: Possible conflict situations that could potentially lead to a crash were observed. Traffic conflict measurement started in South Africa in the late 1980s (Nel, 1989). Based on the West German method, which is described as a controlled observation method to understand conflicts in traffic environments to evaluate the possible development of dangerous situations. In previous years these observations were conducted manually. The NDS as a data collection method could in future simplify traffic conflict measurement through the use of technology.
- c) Adherence to traffic rules and regulations: Unsafe road user behaviours are partly classified by the RTMC as moving violations/offences that contribute to fatal crashes. Moving violations are not the only unsafe behaviours of note, but are used to identify human factor contribution through road traffic offence surveys. Pedestrians as a vulnerable road user group are one of the country's main concerns. This study, however, focused on driver behaviour. Driver behaviour cited as problematic in South Africa include high and inappropriate speeds, unsafe following distances, fatigue and ignoring traffic signals, as well as unsafe overtaking and turning in front of oncoming traffic (RTMC, 2009; RTMC 2011). NDS is considered a suitable tool to observe, identify and classify driver behaviour in an attempt to influence roadway design as well as the design of education and awareness campaigns.
- d) Distraction: "Driver distraction is defined in terms of an object or event that draws one's attention from the task of driving. It is this presence of a triggering event that distinguishes distraction from other forms of driver inattention, which might result from drowsiness or simply being preoccupied by other thoughts" (Stutts et al, 2005).

Stutts et al (2001) identified 13 categories of distraction: Eating or drinking; outside person, object or event; adjusting radio, cassette, or CD; other occupants in vehicle; moving an object in vehicle; smoking; talking or listening on a mobile phone; dialling; using a device/object brought into vehicle; using device/controls integral to vehicle; adjusting climate controls; other and unknown distractions.

Distractions observed in this study that corresponds with the US study included:

- Uncontrolled steering (cell phone use etc.)
- Eating and drinking while driving;
- Other distractions that influenced control over the steering wheel, such as searching for papers or reading documents while driving.

5. FINDINGS FROM TEST DRIVE (I) JANUARY 2011

5.1. Distraction

Different types of distracted driving were observed during the test drives. Distracted driver behaviour was observed during 5.66% of the time in Test Route A and 18.98% in Test Route B.

Although Test Route B was shorter, the results indicated that the driver was far more distracted during the shorter than the longer drive. The presence of and interaction with a passenger during Test Route B may have contributed to the additional distraction.

5.1.1. Uncontrolled steering

In Test Route A, uncontrolled steering was observed 8.08% of time. In Test Route B, uncontrolled steering - with one or both hands not on the steering wheel - was one of the main behaviours observed (14.1% of all behaviours observed).

This behaviour included hand gestures while talking and driving as well as picking-up and looking at delivery documents or GPS and eating or drinking while driving. In the US study moving objects within the vehicle contributed to 4.3% of crashes.

In order to show the occurrences of uncontrolled steering in the two drives, uncontrolled steering was analysed for the 25 minutes of driving time in Test Route B and 30 minutes (of 3 hours) of in test route A.

The findings were as follows:

Test route A: A total of 69 different steering manoeuvres were observed for Test route A. Thirty-five minutes of driving time constituted approximately 1800 seconds.

652 seconds (four minutes) of this was while stationary at the office or at the petrol garage when the equipment was switched on. Twelve seconds were while stationary and putting on a seatbelt.

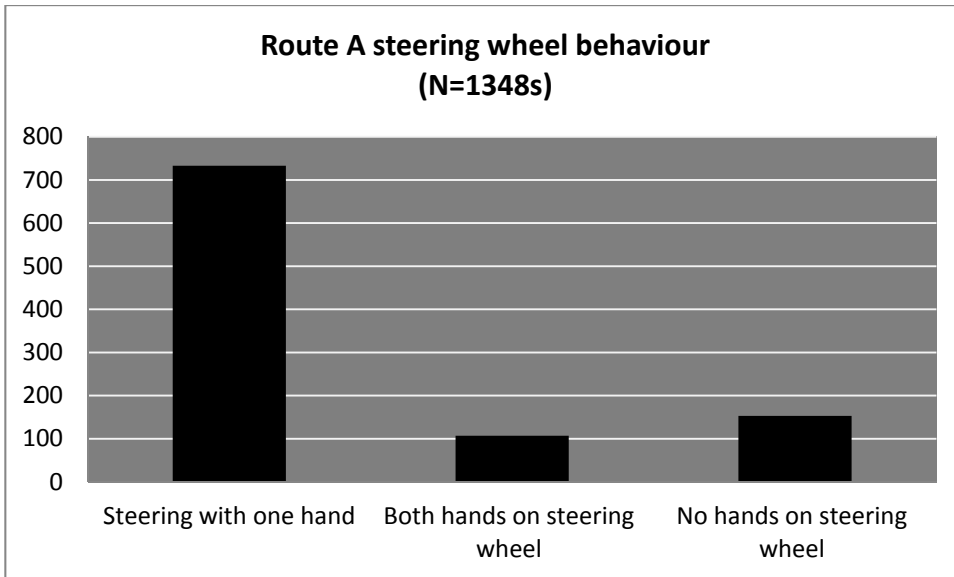


FIGURE 1: ROUTE A STEERING WHEEL BEHAVIOUR.

Steering with one hand was observed in 35 of the 69 steering manoeuvre observations for Test Route A. Steering with one hand constituted 733 seconds - almost half of the driving time (approximately 12 minutes of the total driving time analysed).

- 71% of this behaviour were observed while driving straight;
- 1% of this time was spent holding his head;
- 1% spent talking on a cell phone;
- 27% was spent eating and drinking.

Steering with both hands was observed for only 107 seconds of the drive (a little over 1 and a half minutes). Steering straight (with both hands on the steering wheel) was observed for 17 seconds, the remaining 90 seconds when turning.

Steering with no hands was observed in 153 seconds (2 minutes 55 seconds).

- 58% of this time was spent eating a pie;
- 25% of the time the driver was steering with his elbows while eating a pie;
- 1% he was scratching his head;
- 9% of the time he was talking on his cell phone;
- 4% of the time he was opening and drinking his cool drink;
- 3% of the time for other reasons e.g. adjusting controls etc.

Test Route B: A total of 152 steering manoeuvres were coded for Test Route B (+25 minutes of driving).

Twenty-five minutes of driving time constitutes to approximately 1444 seconds. 32 of these seconds could not be allocated to a specific behaviour due to the position of the sun on the camera, obscuring the driver. The remaining 1412 seconds were allocated to steering behaviour.

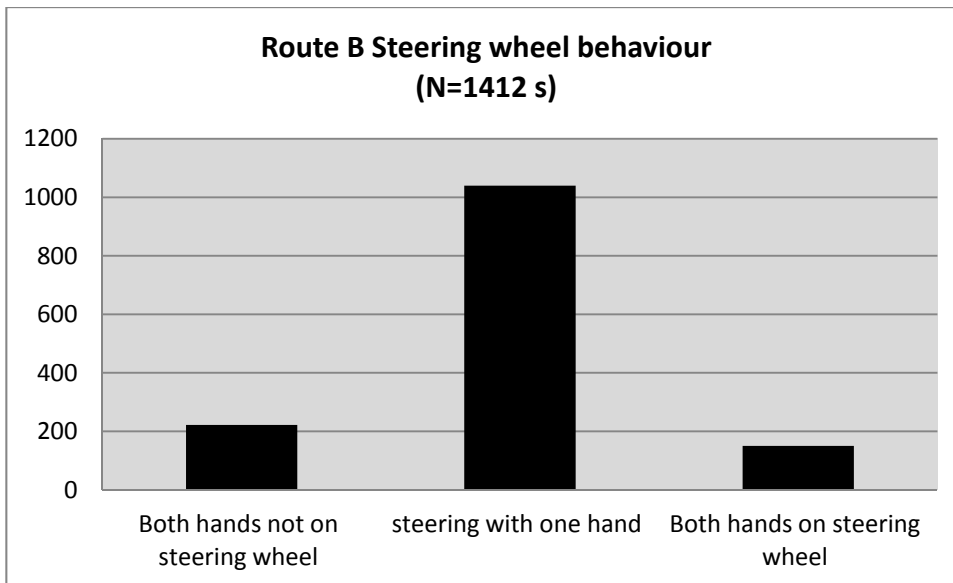


FIGURE 2: TEST ROUTE B-STEERING WHEEL BEHAVIOUR

Steering with only one hand was observed in 73 instances. Steering with only one hand was the main steering behaviour exhibited by the driver. Steering with only one hand was observed in 1040 seconds (17 minutes) of the drive. Of these 1040 seconds, 54 were spending fiddling with and talking on a cell phone.

No hands on the steering wheel were observed 36 times. A total of 222 seconds were observed where the driver did not have any control over the steering mechanism of the vehicle. During this 3.7 minutes that the vehicle was not controlled the behaviour observed included:

- In 51% of the incidents the driver was standing still at a traffic light no hands on the steering wheel;
- 5% of the time he was adjusting something in the vehicle;
- 7% of the time he held his head;
- 13% of the time he was talking/texting on the cell phone;
- 24% of the time he was explaining something to the passenger with both his hands.

Driving with both hands on the steering wheel was observed in 40 instances. Driving with both hands was dedicated to changing lanes (9 seconds), turning manoeuvres (97 seconds) and driving in a straight lane (43 seconds). This constitutes less than 3 minutes in which the driver throughout the journey had both hands (full control) on the steering wheel.

5.1.2 Talking to a passenger

In test route B a passenger was present in the vehicle. The driver and the passenger had discussions throughout the trip. However for approximately 193 seconds of the trip the driver was completely turned to the passenger while engaged in a conversation. For these 3 minutes the driver did not have his eyes on the road at all.

6. DISCUSSION AND SIGNIFICANCE OF FINDINGS

Sayer, Devonshire and Flanagan (2005) investigated the frequency and conditions under which drivers engaged in secondary tasks while driving. The researchers found that drivers engaged in secondary behaviours in approximately 34% of the video clips obtained from the in-vehicle recordings. The data from the video recordings were correlated with information from the in-vehicle sensors to identify factors such as the mean variable speed, mean variability throttle speed, steering angle and lane position. Contextual factors such as road type, curves and environmental conditions were also taken into account. The

most common secondary tasks that drivers engaged in were talking to a passenger (15.3%), grooming (6.5%) or using mobile phones (6.3%). The findings indicated that engagement, in particular secondary tasks while driving, affected particular vehicle mechanisms. The research study (Sayer et al, 2005) also suggested that drivers perform differently when participating in diverse secondary tasks and that their decision to engage in a secondary task depends on the road and traffic conditions. Younger drivers were found to more easily engage in secondary tasks while driving.

Cellular phone use was not the main focus of the analysis in this study. However it was found that cell phone usage during the experiment contributed to uncontrolled steering. Horberry, Anderson, Regan, Triggs and Brown (2006) state that many potential sources of in-vehicle distractions exist, of which the most reported are probably the use of mobile phones while driving. Other studies on the effect of mobile phone-use on driver performance correlated incidents with age and gender-males were overall more confident in the use of mobile phones while driving where as a decline in confidence was seen in especially older women (Lesch and Hancock, 2004). Beede and Kass (2006) found that driving performance was influenced negatively when a driver was talking on a mobile phone and that this increased a driver's potential to violate traffic rules and regulations, influenced the ability to maintain a specific level of driving, contributed to attention lapses as well as negatively influencing response times in traffic. In our experiment mobile phone use was more prevalent in the test drive where a passenger was present. It is uncertain whether the phone calls were work related (as no sound was available on the video data). It did seem however that the driver only *answered* calls while driving and *did not make* (initiate) the calls. This could however have implications for the scheduling of work, obtaining directions and so forth before the driver commences on his journey. Route planning and route scheduling could improve road safety and exposure to risk as the driver then would not have to answer calls while driving. The Automobile Association of South Africa recently issued a statement indicating that 7.04% of the 2497 drivers surveyed was talking or texting on a cell phone while driving (<http://www.aa.co.za/content/720/distracted-driving>, accessed 1 May 2012).

In-vehicle distraction, such as adjusting the radio, was also found to influence driving performance. Distractions influence the cognitive and perceptual abilities of drivers negatively (Horberry et al., 2006). Rosenbloom (2006) found that the following distance between the vehicle in front and the one behind that decreased when drivers in the following vehicle used mobile phones while driving. Rosenbloom stipulates that the drivers were not significantly aware of this occurrence while engaged in secondary tasks when driving (Rosenbloom, 2006). In our study it seems that the frequency with which the test driver engaged in distracting behaviour was much higher in the short drive than in the long drive.

In a much larger NDS experiment (70 instrumented vehicles over a period of 1 week) it was found that most of the inside vehicle distractions revolved around drinking/eating while driving, adjusting the radio and reaching/searching for objects in the vehicle (Stutts et al., 2005). Research conducted in the United States (Stutts et al., 2001) indicated that eating and drinking was the seventh (list of 10 distracted driving behaviours) most common type of distraction that contributed to crashes. According to the US research eating or drinking was a contributory factor in 1.7% of crashes. In the present study, eating while driving was a main distraction observed in Test Route A. When the driver was eating he failed to adequately control the vehicle with both or one hand.

In conclusion, the driver failed to adequately control the vehicle most of the time only steering with one hand. Engagement in secondary tasks that resulted in uncontrolled steering was prevalent in both test drives. Although the findings can not be compared to international studies due to our small sample the pattern of findings from the study seems to correlate positively with work done internationally. In both studies it was found that

eating and drinking while driving as well as searching and reaching for objects were the predominant type of distractions. This behaviour leads to conditions where the driver neglected to put his hands on the steering wheel which obviously increases exposure and risk of being involved in a crash.

What did we learn about the driver?

- Talking on a cell phone, looking away from the road for long periods of time and eating/drinking while driving is “normal” behaviour
- The driver is used to steering the vehicle with only one hand on the steering wheel.
- Both hands on steering wheel were mainly used when turning or changing lanes.
- The driver is used to engage in secondary tasks that lead to situations where no hands are present on the steering wheel, with little control over the vehicle.

The behaviour exhibited by the driver has through the years become a habit. These behaviours are reinforced every time that the driver successfully completes a journey.

7. POTENTIAL RESEARCH QUESTIONS FOR THE FUTURE

This experiment is too small to be representative but illustrates the value that NDS could have for driver behaviour research in SA. No monitoring of distraction (other than cell phone use) as a contributory human factor is currently conducted in South Africa. This could partly be due to the fact that it is complicated to measure human behaviour. NDS provides an opportunity to monitor and report on different types of driver behaviour in road safety, including distracted driving. Without adequate information related to the frequency with which drivers engage in distracting behaviours, it is difficult to pinpoint the potential impact on driving safety. Furthermore local South African research could facilitate a better understanding of the role of distraction in road traffic crashes. Research questions to be included in future research are listed below:

- How often drivers engage in behaviours that might be distracting (frequency)?
- Under what conditions drivers engage in such behaviours (light/dark; sunny/raining; type of roadway; type of environment urban/rural)?
- Does the type of road and length of trip influence distracted behaviour (congested freeways; built-up areas/rural)
- What is different distracted behaviour observed among drivers according to age, gender, occupation?
- What could the severity of consequences of these behaviours be in the long run?

8. REFERENCES

Arrive Alive. 2010, Road accidents take a toll on the economy. Retrieved 03 August 2010, from Arrive Alive: <http://www.arrivealive.co.za/news.aspx?s=2&i=657>.

Automobile Association of South Africa. 2011, Distracted Driving. Retrieved 1 May 2012 from AASA: <http://www.aa.co.za/content/720/distracted-driving>.

Botha, G. 2005. Contributory factors to road traffic crashes. In proceedings of the 24th Annual Southern African Transport Conference 11 - 13 July 2005 "Transport challenges for 2010", CSIR Pretoria: Document Transformation Technologies.

Creamer Media Reporter. 2010. SA: Ndebele: Address by the Minister of Transport, at the launch of the Eastern Cape Road Safety Council, East London. Retrieved 17 September 2010 from Polity.org.za: <http://www.polity.org.za/article/sa-ndebele-address-by-the->

minister-of-transport-at-the-launch-of-the-eastern-cape-road-safety-council-east-london-13092010-2010-09-13.

Gainewe, M. and Masangu, N. 2010. Factors leading to fatal crashes and fatalities on South African roads: 2005-2009. Proceedings of the 29th South African Transport Conference (pp. 541-551). Pretoria: Document Transformation Technologies cc.

Horberry, T. A. 2006. Driver distraction: The effects of concurrent in-vehicle tasks, road environment complexity and age on driving performance. *Accident Analysis and Prevention* , 38, 185-191.

Lesch, M. F. and Hancock, P.A. 2004. Driving performance during concurrent cell-phone use: are drivers aware of their performance decrements? *Accident Analysis and Prevention* , 36 (3), 471-480.

National Department of Transport. 2006. National Road Safety Strategy 2006 Onwards. Pretoria: NDoT.

Nel, P. 1989. Traffic conflict measuring techniques: A User's Manual. Pretoria: Division of Roads and Transport Technology, CSIR.

News 24. 2011. Road carnage must end-Minister. Retrieved 03 June 2011 from <http://www.news24.com/SouthAfrica/News/Road-carnage-must-end-minister-20110601>.

Rosenbloom, T. 2006. Driving performance while using cell phones: an observational study. *Journal of Safety Research* , 37 (2), 207-212.

Road Traffic Report 31 March 2011, Road Traffic Management Corporation. Retrieved 24 January 2012, from <http://www.rtmc.co.za/RTMC/TrafficReports>.

Sayer, J.R., Devonshire, J.M. and Flangan, C.A. 2005. The Effect of Secondary Task Analysis on Naturalistic Driving Performance. University of Michigan Transportation Research Institution.

Stutts, J., Reinfurt, D.H., Staplin, L., Rodgeman, E.A. (2001). The role of driver distraction in traffic crashes. Washington D.C. AAA Foundation for Traffic Safety.

Stutts, J. Feaganes, J., Reinfurt, D., Rodgeman, E., Hamlett, C., Gish, K. and Staplin, L. 2005. *Accident Analysis and Prevention* (37) 1093-1101.

Van Orden, K., Ping Jung, T. and Makeig, S. 2000. Combined eye activity measures accurately estimate changes in sustained visual task performance. *Biological Psychology* , 52 (3), 221-240.

World Health Organisation. 2007. Ministerial Round Table African Road safety Conference. Retrieved 05 October, 2010, from World Health Organisation-Economic Commission for Africa.

World Health Organisation. 2010. Status Report on Road Safety in Countries of the Africa Region. Brazaville: WHO Regional Office for Africa.

World Health Organisation. 2011. A Decade of Road Safety Action 2011-2020. Retrieved 06 April, 2011, from http://www.who.int/roadsafety/decade_of_action/en/.