

# DRIVER COMPLIANCE WITH TRAFFIC SIGNALS IN STELLENBOSCH

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Phone (021) 8083838, Fax (021) 8084361, msinclair@sun.ac.za Background

## ABSTRACT

Traffic signals are designed to control the flow of traffic approaching a junction from different directions. They are internationally accepted to be one of the cornerstones of safe traffic flows, and rely on a high level of recognition and compliance to be effective. Anecdotal evidence from across South Africa indicates that noncompliance with traffic signals has become an endemic part of SA driving behaviour, yet this has not yet been evaluated in terms of increased risks that it poses for South African road users. This paper examines the behaviour of drivers at a range of signalised intersections in Stellenbosch and quantifies levels of non-compliance at each junction. The age and gender of the driver responsible for each encroachment, and the presence or absence of passengers, is also examined. Finally, justifications for red-light running decisions, ascertained in a survey of drivers within the town of Stellenbosch, give some insight into why drivers encroach in specific circumstances.

## 1. BACKGROUND

### 1.1 Signal-controlled intersections

Traffic collisions in South Africa are responsible for thousands of deaths and injuries each year. A great deal of academic attention is devoted to understanding the causes of this national crisis. Little work has as yet focused on intersection-related collisions as a specific hazard type. In fact the national collision database currently makes it impossible for any meaningful national study to be conducted into collisions that occur at intersections or signalised intersections in particular.

Internationally, intersections are acknowledged to be particularly hazardous locations (PIARC 2003). While pedestrians are obviously often more exposed to injury at these locations, collisions between multiple vehicles are also over-represented. In Norway, 40% of all collisions resulting in injury occur at intersections (Elvik, R. and Vaa, T 2004). Similarly, some 43% of collisions in the United States occur at or near intersections (Lord, Manar & Vizioli 2005). Eighty-six percent of these involved collisions between vehicles.

Intersections that are controlled through the use of traffic signals are one of a number of intersection types. In the signalised intersection rules of advancement are clear, and compliance with the signals is of critical importance. Traffic signals are programmed and coordinated to efficiently direct the flow of traffic and to give all drivers an ordered turn with which to go their chosen directions. When advancements are made out of turn, it is natural to expect interference and collisions with the other streams of traffic, sometimes with

severe consequences. The scale of the problem associated with non-compliance with traffic signals is only partially understood. In South Africa the inaccuracy and incompleteness of collision reports makes it impossible to distinguish collisions at traffic signal intersections, and we thus have no real sense of the scale of the problem here. In the USA, however, it is estimated that around 5% of all injury collisions occur at signal controlled junctions. More importantly, in the words of Retting (1999), “Red-light running crashes are more likely than other crashes to have produced some degree of injury” (Retting, Williams & Greene 1998).

There is a multiplicity of factors that affect the safety levels of signal controlled-intersections, including geometric design, signal timing, intersection approach conditions, speed limit etc. The behaviour of drivers is also an area that is of relevance but less attention has been paid to this in the literature than is deserved. Relatively little is known about the characteristics of red-light runners and the circumstances which may prompt them to run a red light. International research into red light running suggests that drivers who run red lights are likely to be involved in other risky driving behaviour as well. They have been found to be more likely to have multiple traffic violations (Retting, Ulmer & Williams 1999) and to be less inclined to wear seatbelts (Deutsch, Sameth & Akinyemi October 1980, Porter, Berry 2001). It has been suggested that red light runners may also be typical aggressive drivers (Shinar, Compton 2004). To date, however, little research has been carried out into red-light running in the South African context, so the relevance of these findings for the SA context is untested.

Stellenbosch, like many other towns and cities in South Africa, has a number of signalised intersections and an associated problem of red-light runners. Over the course of 2011, 2079 red light offences were recorded at intersections within the town (data received from Syntell, January 2012). However these are just the tip of the iceberg – not all intersections are monitored by camera enforcement, and cameras are not active all of the time.

The purpose of this study is to begin to investigate the behaviour of traffic through three signalised intersections in Stellenbosch, paying particular attention to the drivers of vehicles that ignored the traffic signals and crossed or cleared the intersection after the light had turned from yellow to red. The primary goals of the project were to determine frequency of red light running and to document the characteristics of those drivers who risked crossing after the end of the intergreen interval. A qualitative component of the research project allowed the inclusion of drivers’ self-reported behaviour in specific intersection scenarios and their perception of risks associated with red-light running.

## 1.2 Red Light Running – international scales

Red-light running is defined as a prosecutable offence, under the National Road Traffic Act 1996 (Act No. 93 of 1996) as “failing to comply with any direction conveyed by a road traffic sign displayed in the prescribed manner”. In South Africa the offence is deemed valid for vehicles that cross the stop line after the signals have turned red. This is, in fact, a slightly problematic definition as it does not fully reflect the full spectrum of red light encroachments, specifically those who cross the stop line during the green or yellow signal phases but who clear the junction only some time after the light signal has changed, or after their priority phasing has lapsed. This will be discussed more fully later on in the paper.

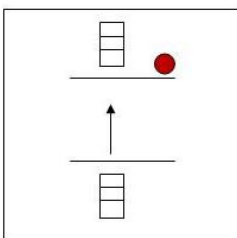
International research offers a range of offences per hour which allow us to develop a sense of what is considered ‘normal’ for other countries. In Australia, for example, a study of fifteen signalised intersections yielded an overall average of 2.4 red light running

violations per hour (Green 2002). These figures were significantly lower than those produced by Wooley (1998) at a particular intersection in Adelaide, where the highest incidence on a specific approach was 17 incidents per hour (Woolley, Taylor 1998).

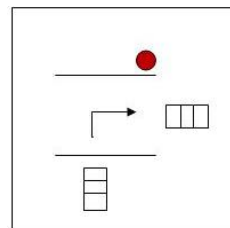
In the USA, a number of similar studies have been done. In the publication “Making Intersections Safer: A toolbox of Engineering Countermeasures to Reduce Red Light Running” (McGee 2003), reference is made to a particular study that appears to be considered exceptional. This intersection in Raleigh, North Carolina recorded a violation rate of 18 vehicles per hour. Reference was also made to a study done in the state of Virginia, which found a morning peak violation rate of 12 incidents per hour at a high volume intersection in the city of Arlington. At a lower volume intersection in the same city, an evening peak rate of 3.4 violations per hour was observed.

### 1.3 Injury risks

In the event of a red light infringement, two primary types of collisions can occur. The first is a rear end collision, where the red light runner, either travelling straight or making a right turn, collides with the tail of vehicles that have already gone through the light but are travelling slowly or are ‘backed-up’ due to congestion. The figures below illustrate this scenario:

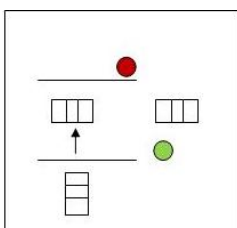


**Figure 1: Rear end impact (straight)**

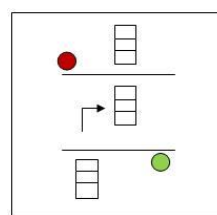


**Figure 2: Rear end impact (turning)**

The second type of collision is a side impact collision, where a vehicle running the red light collides perpendicularly with another vehicle while either travelling straight or making a right turn. The sketches below illustrate:



**Figure 3: Side impact (straight)**



**Figure 4: Side impact (turning)**

In a study that concentrated on the state of Maryland (USA), Farmer et al reported that mortality rates for side impact intersection collisions were of far higher significance than was commonly understood, and in fact were twice as high as for frontal collisions (Farmer, Braver & Mitter 1997). According to this research, 30% of traffic fatalities were the result of a side impact collision. A study that examined fatal car-to-car collisions in Sweden found that all fatal collisions between modern cars at intersections between 2003 and 2009 were the result of side impact collisions (Sunnevang et al. 2011). Head-to-head, or rear-end collisions did not result in a single death through intersections in this period.

The high mortality rate associated with side impact collisions is primarily the result of the fact that serious injuries are most frequently sustained to the chest, head and abdomen. Advances in vehicle safety have largely been concerned with enhancing the protection of

occupants involved in head-on collisions, and crumple zones in particular have been extremely efficient in reducing forces travelling along the length of a car. Side impacts are more difficult to absorb and redirect.

The study by Farmer et al (1997) investigated the role of the occupants' positioning inside the vehicle in the likelihood of serious injuries, and found that near-side occupants were more likely to sustain serious injuries than those found on the far-side of a collision. It was also found that elderly occupants (65 years and older) were three times more likely to sustain serious injuries than younger occupants (younger than 25) and occupants in the 25 to 65 group; this for both near-side and far-side impacts.

An important element of Farmer's conclusion was that the speed of vehicles had a direct and measurable impact on the probability of serious injury. The speed limit affecting the striking vehicle was considered and it was shown that for each 5 mph (8km/h) increase in the limit, the risk of serious injury was increased by 34% for near-side occupants and 40% for far-side occupants. It is assumed, then, that the same can be said for every 8 km/h increase in the striking vehicle's speed. This is of concern when one considers that many motorists tend to significantly increase their speed when trying to beat a red light.

## **2 METHODOLOGY**

The study comprised a series of observations of traffic moving through a sample of signalised intersections as well as a qualitative component involving face to face interviews with drivers in Stellenbosch.

For the observational study, three signalised intersections in Stellenbosch were monitored at different times of the day over a series of two hour shifts. A total of 50 hours of video footage was recorded, with approximately 16 hours per intersection. Thirty hours were spent examining both frequency and driver characteristics and a further twenty hours were dedicated solely to confirming the frequency of red light running.

The research initially focused on those drivers who intentionally crossed the stop line after the end of the intergreen interval, but fieldwork observers noted that other categories of encroachment were occurring on a regular basis, so the research focus expanded to include them. These categories are discussed in the 'Results' section of this paper.

The three intersections observed were:

- Junction 1: Intersection of the R44 (Adam Tas) and Bird Street.
- Junction 2: Intersection of Dorp Street and the R44 (Strand).
- Junction 3: Intersection of Helshoogte Pass and Cluver Street.

The junctions were selected because of the high volume of traffic they carry, and also because each represents distinct intersection geometry within a 60 km speed limit.



Intersection 1 is an intersection of two four lane, bidirectional roads. The Bird Street and R44 (Adam Tas) intersection directs a very high volume of traffic (morning peak volumes show that approximately 3,140 vehicles enter the junction per hour). A total of seventeen lanes enter and exit the intersection. Traffic lights give sequential right of way to each of these lanes. The traffic light thus has distinct phases for turning vehicles.

Intersection 2 is located at the intersection between Dorp Street and the fast moving R44. This junction is characterised by tightness of space; Dorp Street is the historic access road into the town of Stellenbosch and is characteristically narrow with pavements contained by the presence of 'lei-water' canals. Dorp Street is predominantly two lane but widens locally to offer a third lane at the junction in the westerly direction. This facilitates a left turn lane onto the southbound R44. On the western side of the junction Dorp Street continues with only a single lane in either direction. The R44 itself comprises a divided carriageway with two lanes in each direction in the southerly direction and a third turning lane on the southern side of the northbound direction. This intersection also carries high volumes of traffic with approximately 3,200 vehicles entering per hour at morning peak.

Intersection 3 is the intersection between Cluver Street and Helshoogte Road. This intersection is spacious relative to the other two junctions with wide lanes and dedicated turning lanes on three of the four approaches. Volumes are lower than the other two intersections but speeds along Helshoogte Road are generally higher as the road operates as a semi-rural distributor between Stellenbosch and Franschoek. The steep Helshoogte pass also impacts the speed of downhill (westbound) vehicles.

Observations were carried out at peak and non-peak times. For the study, data was recorded only for those crossing on the red light signal while travelling straight and those crossing on a red light or red arrow signal to turn right across a stream of traffic that had right of way. Those turning *left* for the few moments after a signal had turned red were not considered, even though they had by definition run a red light. This was both because it was impractical to try and record all of this extra information for each cycle and because drivers turning left present a very small contribution in terms of collision risk.

### 3 RESULTS

#### 3.1 Categories of encroachment

After some initial observations of the three junctions it was clear that crossing after the end of the intergreen interval was not only common but that different categories of such behaviour were identifiable. Not all of these would be deemed, under the legislation, to be a traffic offence, yet all contravened other vehicles' rights of way, resulting in congestion and increased collision risk to other road users. The decision was thus made to widen the

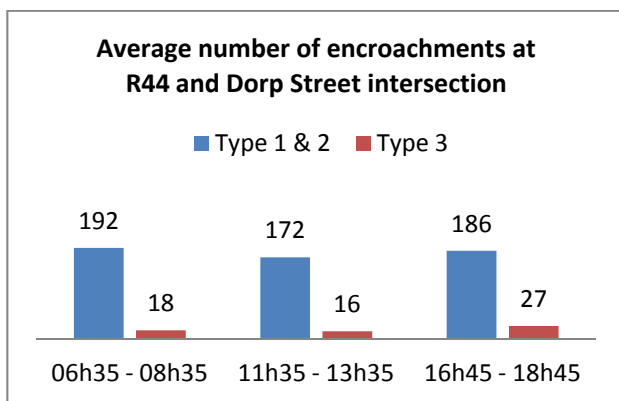
definition of red-light running beyond traditional offences to all cases where safety was compromised. As such the term ‘encroachment’ is used to define and categorise all instances where a vehicle cleared the intersection after the end of the intergreen interval.

Three types of red light encroachment were observed. Type 1 includes those who wait to cross on the green light signal within the junction i.e. beyond the stop line, but who only have opportunity to clear the junction after the intergreen interval is complete. Type 2 includes those who stop and wait behind the stop line but their eagerness to progress caused them to push across the stop line after the intergreen interval has ended and the red light signal is displayed. The speed of these vehicles is typically low as they proceed from a stationary position. Types 1 and 2 are distinct from drivers who intentionally proceed, without stopping, through the red light signal in spite of having every opportunity to stop (Type 3). Types 1 and 2 influence the level of congestion and increase the risk of collisions in two distinct ways. Firstly, because of their position in mid-junction, waiting vehicles are forced to exit the intersection only after the traffic signal has turned red in order to clear the junction and allow the green light vehicles access. Secondly, vehicles wanting to turn right across the traffic were frequently observed exceeding the time allocated to them in the dedicated turning phase of the traffic signal, thus crossing against the flow out of sequence, and forcing oncoming vehicles to delay their own passage across the intersection. Because of the relatively low level of risk that these encroachments pose they have, for the purpose of this analysis, been aggregated into a single group.

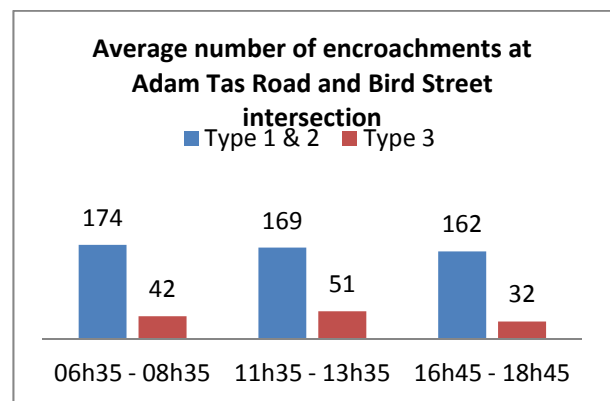
Type 3 encroachments were classified as vehicles that entered the junction after the intergreen interval had ended and the traffic light signal had turned red, and hence constitute potentially the most dangerous form of encroachment. These vehicles typically do not stop or even slow as they approach the intersection and may even accelerate to clear the intersection before traffic in the opposing directions builds up.

### 3.2 Frequency of encroachment

Although three types of encroachment were identified during the observations it was expedient to count Types 1 and 2 as a single category, as they were similar in behaviour and both were very distinct from Type 3 offences in intent and potential outcome. Types 1 and 2 are not traditionally treated as traffic offences yet these vehicles were observed clearing the intersection some time after the light had changed or after their dedicated turning phase had ended. These created not only out-of-sequence delays for other drivers, but also potential collisions risks as well.



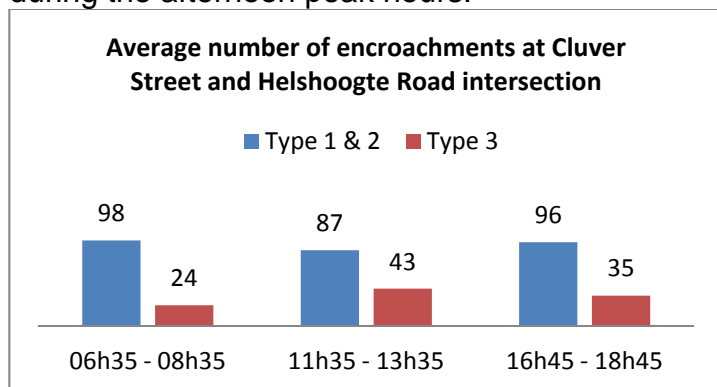
**Figure 8: Type and volume of encroachments at R44/Dorp St.**



**Figure 9: Type and volume of encroachments at Adam Tas St/Bird St**

For the two intersections on the R44, an average of 103 encroachments were counted per hour. Types 1 and 2 collectively ranged from 81 to 96 vehicles per hour. Type 3 encroachments ranged from 9 to 26 per hour, with highest levels recorded at the intersection between Bird Street and Adam Tas Street. At this intersection there was a slightly elevated number of Type 3 encroachments during non-peak periods but Type 1 and 2 encroachments were fairly constant throughout the day.

At the intersection of Dorp Street and the R44, fairly low levels of Type 1 encroachments were recorded, possibly because of the limited space that this junction offers. The junction displays significantly higher levels of congestion with little opportunity to enter the junction after the light has changed. That said, there were 13-14 encroachments recorded per hour during the afternoon peak (16h45 – 18h45), which still represented a significant risk. The dominant form of encroachment at this intersection was a combination of Type 1 and 2, particularly related to those queuing to turn right into Dorp Street against the southbound traffic flow. During off-peak flows the number of Type 1 and 2 encroachments stayed constant at around 86 per hour, and Type 3 encroachments were marginally elevated during the afternoon peak hours.



**Figure 10: Type and volume of encroachments at Cluver St/Helshoogte Road**

The intersection at Cluver and Helshoogte recorded a lower frequency of encroachment in general, but with a higher proportion of Type 3 encroachments than was recorded at the R44/ Dorp Street intersection. The junction is spacious and offers more opportunity for a clear run through the junction than the more crowded junction at Dorp Street.

Even if the study concentrated only on Type 3 encroachers – i.e. those intentionally running the lights after they had changed - the numbers recorded are high. This is evident when comparing the Stellenbosch results with the international literature, where 18 offences an hour were seen to be exceptional. The graph below presents the hourly numbers of Type 3 encroachments recorded in this study for the three intersections.

**Table 1: Hourly encroachments of Types 1, 2 and Type 3 encroachments at the three study intersections.**

Adam Tas Rd and Bird Street			R44 and Dorp Street			Cluver Street and Helshoogte Road		
	Hourly Average Type 1 & 2	Hourly Average Type 3		Hourly Average Type 1 & 2	Hourly Average Type 3		Hourly Average Type 1 & 2	Hourly Average Type 3
06h35 - 08h35	<b>87</b>	<b>21</b>	06h35 - 08h35	<b>96</b>	<b>9</b>	06h35 - 08h35	<b>49</b>	<b>12</b>
11h35 - 13h35	<b>85</b>	<b>26</b>	11h35 - 13h35	<b>86</b>	<b>8</b>	11h35 - 13h35	<b>44</b>	<b>22</b>
16h45 - 18h45	<b>81</b>	<b>16</b>	16h45 - 18h45	<b>93</b>	<b>14</b>	16h45 - 18h45	<b>48</b>	<b>18</b>

The lower severity encroachments (Types 1 and 2) which result in significantly more vehicles an hour clearing the junction after it has turned red, add to the congestion at the intersection and contribute to an elevated collision risk.

### 3.3 Turning encroachments vs. straight through encroachments

In general the rate of right-turning offenders was higher than was expected at the outset of this study. The fact that dedicated turning phases have been provided led the team to expect a well-ordered turning population. However right turners on red were common and constituted around one quarter of the Type 1 and almost half of the Type 2 encroachments that were recorded. This behaviour, to some extent, was encouraged by the provision of 'Wait' lines for right turn lanes, which allowed vehicles safe space to wait within the intersection but which also contributed to the fact that multiple vehicles were queuing to turn after the signal had changed to red. These queues were themselves frequently the result of red light encroachments in the straight ahead vehicle population, who persistently crossed even after the light had turned, forcing right turning vehicles to significantly exceed their allocation of time within the intersection. Such vehicles were frequently observed causing frustration to vehicles whose passage they were now blocking, and often forced to reverse to get back into the queue.

Interestingly, during less congested periods, there appeared to be a degree of tolerance or expectation on the part of straight-ahead drivers that multiple right-turners would proceed after the red light was displayed. Such vehicles would automatically hold back from moving ahead and allow right turners opportunity to clear the intersection without evidence of frustration or displeasure.

At peak hours, right turning vehicles were dominant in all three types of encroachment. For the Type 3 encroachment in particular this raises a particular concern given the reported risks of side impact injuries at higher speeds. During off peak periods, straight through Type 3 offenders were more common, taking advantage of lower traffic volumes to accelerate through red lights, and on many occasions were estimated to have been exceeding the speed limit. No speed readings were recorded, however, so this is not yet substantiated.



## 4 DRIVER CHARACTERISTICS

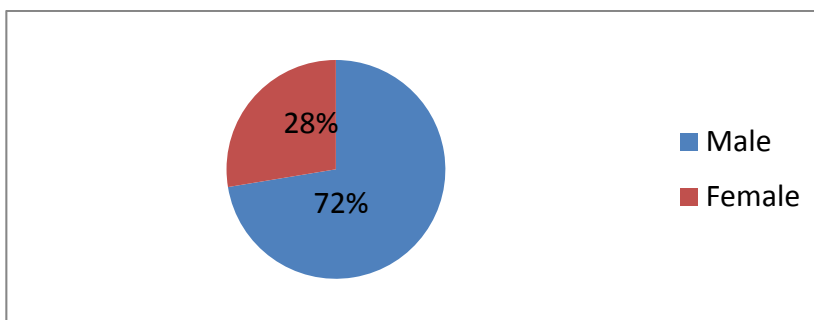
The table below provides a summary of the characteristics of the drivers of the 1624 vehicles that were counted encroaching during the 50 hours observation.

**Table 2: Driver Characteristics - Combined Results**

	Gender		Age			Passengers present		
	Male	Female	Young	Middle-aged	Senior	Yes	No	Unclear
Totals (peak)	837	329	351	677	145	409	677	88
Totals (non-peak)	339	119	104	285	62	134	261	55
Totals	1176	448	455	962	207	453	938	143

### 4.1 Gender

Previous traffic observations in the Stellenbosch area have identified similar numbers of male and female drivers in the driving population (Liebenberg, C. and Sinclair, M. 2011). All things being equal, we would have expected to see similar numbers of male and female red light encroachers, but, as is evident in Figure 10 below, males were overrepresented in this group. In fact for every female there were almost three male drivers ignoring the lights. This ratio is higher than other observational reports from the USA or Europe. In the USA, for example, Retting et al (1999) found red light running to be split 58:42 (males to females); and Yang and Najm (2007) could not identify any gender trends in their study of red light offenders in Sacramento, California, for the period 1999-2003 (Retting, Ulmer & Williams 1999, Yang, Najm 2007). While observational studies abroad do not indicate a marked gendered pattern, the analysis of injuries sustained in red-light collisions indicate more injuries and deaths sustained by males than females. A UK based study, for example, revealed that male drivers killed or seriously injured as a result of red light running were far higher in number than female drivers (Lawson 1991). A large body of literature exists which addresses gender differences in driving and which documents males (particularly young males) likelihood to engage in risky behaviour. The involvement of males in red-light collisions is thus well supported by the understandings around gendered behaviour. The dominance of males in red light running, across all three types of encroachment identified in the Stellenbosch study, suggests a higher than average likelihood which is of particular interest.

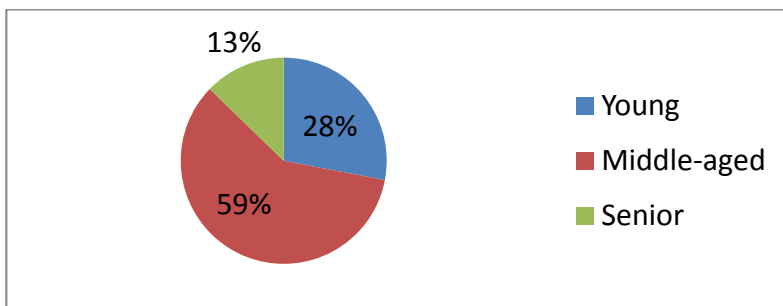


**Figure 11: Gender of encroaching drivers- combined results**

#### 4.2 Age:

The classification used for this study was to define younger drivers as being between the ages of 18 and 30 years, middle-aged drivers being between the ages of 30 and 55 years, and senior drivers classified as those over 55 years. These age groups represent different population sizes and incorporate an unavoidable element of subjectivity on the part of the observers meaning that the measure itself is crude. In spite of this it gives some idea of the tendency to encroach by driver generation.

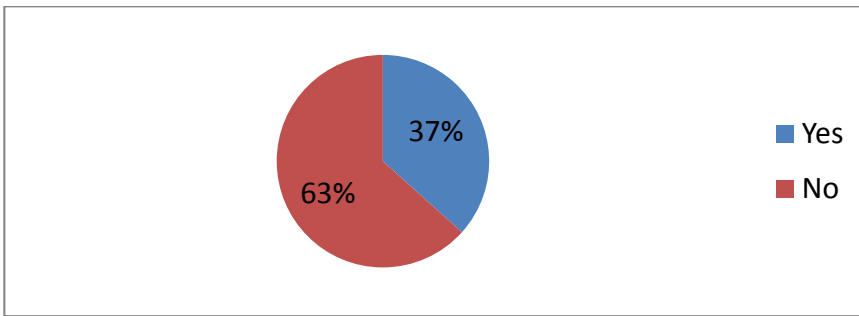
Fifty-nine percent of encroachers were classified as middle aged; 28% were young and 15% were identified as seniors. The low number of senior encroachers is most likely a reflection of the low numbers of drivers of this age in the town of Stellenbosch, rather than an indication that they are more careful or law abiding. The low number of young people in the count was interesting, given that Stellenbosch is home to a large number of students associated with the University and young people – both as students and young professionals – are well represented in the driving population of the town. The international studies already referred to in this paper almost unanimously agree that young drivers are more likely to be observed running red lights than older drivers, and collision statistics bear out this trend. In their study of red light runner characteristics, for instance, Porter et al noted that only age was a significant predictor of red light running, specifically drivers under 35 years of age (Porter, Berry 2001). This finding was repeated in the Kristie (2006) study on red light offenders in Virginia USA, and Yang and Najm noted that “motorists in the age group 20-29 are more likely to violate the red light signal compared to drivers in other age groups” (Yang, Najm 2007). Results from the Stellenbosch sample are thus interesting but more analysis in this area is necessary to confirm the contradictory finding for this town and to explain it.



**Figure 12: Age of drivers - Combined Results**

#### 4.3 Passengers present

The observations confirmed that more single occupancy vehicles ran red lights than multiple occupancy vehicles (63% to 37%). This needs further analysis, however, given that the study did not investigate the proportion of single occupancy vehicles in the overall vehicle population. International literature supports the notion that passengers tend to reduce the likelihood of drivers running red lights. In a study in Michigan, USA (Porter, Berry 2001), for example, the authors noted: “Red light running tendencies were higher when drivers were alone than when they were with passengers, particularly child passengers. This is interesting because red light running prediction and likelihood calculations may be linked to an easily observable factor”. It should be noted that 37% of the vehicles in the SA sample did include passengers. This presents an increased risk of injuries in the event of a collision occurring.



**Figure 13: Passengers - Combined Results**

## 5 QUALITATIVE COMPONENT

The research included interviewing a randomly selected sample of 46 drivers in the Stellenbosch area. The interviews were based largely on scenario-building exercises, where respondents were asked to predict their behaviour on the approach to a signalised intersection in a range of contexts.

The interview engaged the respondents around two driving scenarios, one mid-morning with light traffic conditions, and the other at peak hour in a context of high traffic volumes and slow-moving traffic. In both cases, respondents were asked to select the actions they were likely to take. In the free-flowing traffic scenario, 27 (59%) respondents confirmed that they would stop at the red light and wait until it turned green again before proceeding. These were split almost equally between male and female respondents (13 males, 14 females). The number of respondents that would speed up to beat the red light was 12 (6 males, 6 females), while seven said that they would slow down to see if there was any other traffic and then proceed through the red light if the intersection was clear. For the congested traffic scenario, a slightly higher percentage 29 (63%), comprising 16 males and 13 females, confirmed that they would stop and wait for the next green light under congested driving conditions, however the remaining 17 (7 males and 10 females) indicated that they would accelerate and attempt to beat the light. From this small sample it would appear that there is a higher likelihood of drivers choosing to attempt to beat the red light when traffic volumes and driving pressure are high, and that females are either more likely to go through a red light signal or are more candid in a self-reporting scenario.

Some interesting differences were picked up around age compared with the on-site observations. For the young drivers (under 30 years), 45% of respondents indicated that they would slow down and stop for a light as it was turning red; 35% reported that they would be likely to drive through it, and 20% noted they would approach with caution and proceed if it was safe to do so. Of the middle-aged drivers, however, 85% said they would slow down and stop; 6% noted that they would drive through and 9% said they would approach carefully and proceed if they decided it was safe to do so. The cautious driving behaviour described by the middle-aged sample did not manifest itself in the observed driver behaviour.

Of the twenty-seven respondents who would stop and wait for the signal to turn green again, sixteen (59%) said that they would do so because it was the safe thing to do or because they feared the risk of a collision. Only 37% of those who would stop would do so because it is required by law. Overall, only 16 of the 46 respondents, 35%, recognised or articulated a safety risk to red light running.

Amongst those drivers that said that they would run the red light, 67% said that they would do so because they saw no apparent risk in their action, while 17% of drivers gave other reasons including feeling unsafe while stopped at a traffic light late at night. This was a regular response from young females. Other reasons included being impatient and not perceiving any risk in skipping the red light.

A further question sought insight into people's beliefs about the likelihood of getting caught and prosecuted for running a red light. Of the 46 respondents, two did not answer this question, but of the remaining respondents 77% believed that there was a 50% or less chance of being caught. This finding is particularly interesting when we consider literature that suggests that compliance with traffic legislation by an individual is directly related to their perception of the risk of detection and penalty (Retting, Williams & Greene 1998, Fitzsimmons et al. 2009).

The interview also asked respondents about the likelihood of them running a red light when driving alone as compared to when they were transporting passengers. The overall trend was that drivers tended to admit a higher likelihood of red light running when they were alone than when they were carrying passengers, with 72% of respondents confirming a decreased likelihood, 24% confirming that the presence of passengers would make no difference to the likelihood of them running a red light, and 4% indicating a higher probability of running the red light when transporting passengers.

It is interesting to note that the reasons for not stopping at a red light during non-peak times, particularly at night and amongst female respondents, included references to alleged fears of other risks such as hijacking, 'smash-and-grab' or any other criminal actions that occur to a driver who is alone and vulnerable at an intersection. Interestingly, these reasons were given in a project on non-stopping at stop streets in the Stellenbosch area (Verlinde, K.J.S. and Bester, C. 2011), so the perceived risk of crime at standstill is apparently fairly widespread among the Stellenbosch population in spite of there being very little crime of this nature reported in the area.

## **6 CONCLUSION**

Unfortunately, in South Africa there is a lack of statistics on collisions that are caused by red light running, as relevant details are not routinely recorded by police at collision scenes. It is thus difficult to draw correlations between red light running frequency and the probability of a collision. The aim of this study was thus limited to improving our understanding of the frequency of red light running in Stellenbosch, and to begin to develop a knowledge base of the characteristics of red light runners, and the perceptions of the risks associated with red-light running.

The study identified three different types of intersection encroachment, all of which add to collision risk but only one of which is currently subject to regular prosecution. Conventional definitions of red light running ignore the reality that the presence of vehicles inside an intersection at signal change creates an enhanced risk of collision. A knock-on effect was identified where encroachment of turning vehicles was precipitated by late light runners from through traffic, and the combination of frustration and intentional violation of the law created a crossing context that presents a significant risk. More research needs to be carried out to fully understand the relationship between these three categories, and to ascertain whether any of the categories can be reduced by improved phasing and timing of traffic signals.

The analysis of the characteristics of red light runners in the study identified a higher than expected incidence of male drivers in all three categories of encroachment. It would be interesting to determine whether this pattern is in fact reflected in the number of males killed or injured in collisions at signalised junctions in the SA context. The presence of passengers appeared to reduce driver's tendencies to run red lights, and this finding is common in much of the international literature. Contrary to international findings, however, middle-aged drivers in the Stellenbosch study were found to be more likely than young drivers to be running red lights. This is a finding that requires more examination.

Driver perceptions of risks associated with red light running were reportedly low – only seventeen of the 46 drivers interviewed articulated a safety concern about red light running. The absence of credible enforcement was cited by 77% of respondents to explain the increased likelihood of running the lights. This could suggest that increased and more effective enforcement might well be one approach to reduce this behaviour in the future.

To conclude, the research carried out in this study is a preliminary analysis into red light running in the South African context. It has raised some interesting results and begun the important process of documenting a type of driving behaviour that is all too common, but seldom recorded, on South Africa's roads. Running traffic controls is considered to be a significant contributory factor in fatal collisions worldwide. More research into red light running in South Africa is definitely indicated if we are to understand, and eventually resolve, this problem locally.

## References

- Deutsch, D., Sameth, S. & Akinyemi, J. October 1980, "Seat-belt usage and risk taking behavior at two major traffic intersections.", *24th Conference of the American Association for Automotive Medicine*.
- Elvik, R. and Vaa, T 2004, *The Handbook of Road Safety Measures.*, Elsevier Science, Amsterdam.
- Farmer, C.M., Braver, E.R. & Mitter, E.L. 1997, "Two-vehicle side impact crashes: The relationship of vehicle and crash characteristics to injury severity", *Accident Analysis & Prevention*, vol. 29, no. 3, pp. 399-406.
- Fitzsimmons, E.J., Hallmark, S.L., Orellana, M., McDonald, T. & Matulac, D. 2009, "Investigation of violation reduction at intersection approaches with automated red light running enforcement cameras in Clive, Iowa, using a cross-sectional analysis", *Journal of Transportation Engineering*, vol. 135, no. 12, pp. 984-989.
- Green, F.K. 2002, "Red light running", *Research Report ARR*, , no. 356.
- Lawson, S. 1991, *Red light running: Accidents and surveillance cameras.*, AA Foundation for Road Safety and Birmingham City Council, Basingstoke.
- Liebenberg, C. and Sinclair, M. 2011, "User Behaviour at a Four-way Stop", *Southern African Transport Conference*.
- Lord, D., Manar, A. & Vizioli, A. 2005, "Modeling crash-flow-density and crash-flow-V/C ratio relationships for rural and urban freeway segments", *Accident Analysis & Prevention*, vol. 37, no. 1, pp. 185-199.

- McGee, H.W. 2003, *Making intersections safer : a toolbox of engineering countermeasures to reduce red-light running : an informational report*, Washington, DC : Institute of Transportation Engineers, Washington, DC.
- PIARC 2003, *Road Safety Manual*, Cedex, World Road Association.
- Porter, B.E. & Berry, T.D. 2001, "A nationwide survey of self-reported red light running: measuring prevalence, predictors, and perceived consequences", *Accident Analysis & Prevention*, vol. 33, no. 6, pp. 735-741.
- Retting, R.A., Williams, A.F. & Greene, M.A. 1998, "Red-light running and sensible countermeasures. Summary of research findings", *Transportation Research Record*, , no. 1640, pp. 23-26.
- Retting, R.A., Ulmer, R.G. & Williams, A.F. 1999, "Prevalence and characteristics of red light running crashes in the United States", *Accident Analysis & Prevention*, vol. 31, no. 6, pp. 687-694.
- Shinar, D. & Compton, R. 2004, "Aggressive driving: An observational study of driver, vehicle, and situational variables", *Accident Analysis and Prevention*, vol. 36, no. 3, pp. 429-437.
- Sunnevang, C., Boström, O., Lie, A. & Stigson, H. 2011, "Census study of fatal car-to-car intersection crashes in Sweden involving modern vehicles", *Traffic Injury Prevention*, vol. 12, no. 4, pp. 333-338.
- Verlinde, K.J.S. and Bester, C. 2011, "Africa on the Move - but not too fast.", *Southern African Transport Conference*.
- Woolley, J. & Taylor, M. 1998, "Red light running in Adelaide", *Proceedings - Conference of the Australian Road Research Board*, pp. 191.
- Yang, C.Y.D. & Najm, W.G. 2007, "Examining driver behavior using data gathered from red light photo enforcement cameras", *Journal of Safety Research*, vol. 38, no. 3, pp. 311-321.