Testing To Estimate How Often Driver's Use Their Mirrors

In motor vehicle accident analysis there has to be a reasonable foundation for conclusions about what a normal driver is capable of perceiving and whether a collision was avoidable. Thus it is important for analysts to conduct a variety testing to understand how a normal driver might function under various driving environments. There are a number of sophisticated analyses that can be accomplished using fairly precise equipment.

At Gorski Consulting we have tried to conduct such in-situ testing using inexpensive, consumer-type video cameras. The present article will discuss our most resent testing to estimate how often driver's might look into their mirrors while travelling in a variety of environments.

Before providing you will the results I first want to display a still frame from our video project that was generated from our testing.

What you see in the image above is the result of placing 5 video cameras in our test vehicle along with a sixth video camera that is mounted in the frame of the eye-glasses worn by the driver. The three views at the bottom are from cameras mounted on a special platform anchored to the dash in front of the steering wheel. The large view looking through the windshield is from another camera anchored near that windshield on the same platform. A fifth camera was placed in the back seat and pointed at the steering wheel where we attached our typical green protractor that has been shown in other articles on this website.

Of particular interest is the special eye-glass frame in which is attached a video camera located approximately at the bridge of the nose of the driver. Obviously this allows us to videotape where the driver is looking. The view from this camera is shown on the far right in the above photo.

Our testing was performed on January 15, 2010 over a time period of about 1 hour. The route taken was in the form of a rectangle, generally on the northern outskirts of London, Ontario, Canada. Our test vehicle (1999 Buick Regal) started in east London, progressing northward on Clarke Road from Wavell until it reached the northern outskirts of the city, then it made a left turn to travel westbound on Sunningdale Road and travelled for several kilometres until it reached the western outskirts of the city at the intersection with Wonderland Road. The test vehicle then turned right to travel north on Wonderland. The vehicle continued to travel north for several kilometres until Ilderton Road where it made a right turn to travel eastbound. The vehicle then travelled back in an eastward direction on Ilderton Road until it reached the intersection with Clarke Road where it made another right turn to travel southbound back to where the testing began. If you look at a map of these directions you will see that the test vehicle travelling along a rectangular route.

This route was chosen because it contained a combination of urban and rural roadway segments. It also contained a number of curves, particularly on Clarke Road and Wonderland Road. Beyond the testing that is reported in this article the data will be used for other purposes in the future, such as to study the actions of drivers as they pass through these curves. If the reader has been following our previous articles it can be noted that we have previously reported some detailed studies performed at an S-curve on Clarke Road just north of Fanshawe Park Road. That curve was included in the route taken in the current testing.

A partial listing of our results from this testing is shown below.

Glances Into Mirrors During Testing of Jan 15, 2010

Commencing from Intersection of Wavell & Clarke Road, London

Brown = Urban Green = Rural Red = Stopped Yellow = Cam Prob

Location & Driving Actions	Glance in Rear View Mirror	Glance in Driver's Exterior Mirror	Elapsed Time Between Glances In RV Mirror (In Seconds)	Elapsed Time Between Glances In Driv Ext Mirror (In Seconds)
NB on Clarke, Travelling Straight Ahead	00:06:39:16			
NB on Clarke, Travelling Straight Ahead		00:06:41:11	18.4	
NB on Clarke; Stopped at intersection of Driveway to Argyle Mall	00:06:57:28			18.23
NB on Clarke; Stopped at intersection of Driveway to Argyle Mall		00:06:59:18	28.97	
NB on Clarke; Accelerating From Stopped Position	00:07:26:27			72.57
NB on Clarke Just N of Dundas; Travelling Straight Ahead		00:08:12:05	47.17	
NB on Clarke Just N of Dundas; Travelling Straight Ahead	00:08:14:02			
NB on Clarke, Travelling Straight Ahead	00:08:51:08		37.2	55.6
NB on Clarke, Approaching Intersection of Oxford Street	00:09:02:11		11.1	
NB on Clarke, Approaching Intersection of Oxford Street		00:09:07:23	35.13	
NB on Clarke, Stopped at intersection with Oxford Street	00:09:37:15			37.47
NB on Clarke, Stopped at intersection with Oxford Street		00:09:45:07	14.93	
NB on Clarke, Accelerating thru Oxford Intersection, Not announced but possibly looked in RV mirror	00:09:52:13			
NB on Clarke, Braking hard for amber traffic signal at Cheapside, Not announced but probably looked in RV mirror	00:10:35:22		43.3	
NB on Clarke, Braking hard for amber traffic signal at Cheapside, Not announced but probably looked in RV mirror	00:10:37:09		1.57	73.43
NB on Clarke, Stopped at intersection with Cheapside,	00:10:41:02		3.77	
NB on Clarke, Stopped at intersection with Cheapside,	00:10:57:04		16.07	
NB on Clarke, Stopped at intersection with Cheapside,		00:10:58:20	17.8	
NB on Clarke, accelerating from stopped position at Cheapside	00:11:14:28		5.17	28.63
NB on Clarke, accelerating from stopped position at Cheapside, Not announced but probably looked in RV mirror	00:11:20:03			
NB on Clarke, Travelling Straight Ahead		00:11:27:09	37.77	3.07
NB on Clarke, Travelling Straight Ahead		00:11:40:11		
NB on Clarke, Travelling Straight Ahead, Just N of Huron	00:11:57:26			19.37
NB on Clarke, Travelling Straight Ahead, N of Huron		00:11:59:22	24.13	
NB on Clarke, Travelling Straight Ahead, N of Huron	00:12:22:00			23.23
NB on Clarke, Travelling Straight Ahead, N of Huron		00:12:22:29	26.77	
NB on Clarke, Travelling Straight Ahead, N of Huron	00:12:48:23		58	84.87
NB on Clarke, Travelling Straight Ahead	00:13:46:23			
NB on Clarke, Travelling Straight Ahead		00:13:47:25	25.9	
NB on Clarke, Travelling Straight Ahead & Approaching Fanshawe Park Road	00:14:12:20		19.97	45.57
NB on Clarke, Travelling Straight Ahead Just Past Fanshawe Park Road	00:14:32:19			
NB on Clarke, Travelling Straight Ahead Just Past Fanshawe Park Road		00:14:33:12	53.6	
NB on Clarke, Just past S Curve N of Fanshawe Park Road	00:15:26:07		0.7	

Here are some explanations regarding the above table.

The column "Location & Driving Actions" is just a description of where the test vehicle was located as it travelled the route and also what the driver was doing at the time that the he looked in the particular mirror.

The next column "Glance in Rear View Mirror" shows the time code of the video at the time that the eyes of the driver began to move toward the mirror's location. So it is not the time when the eyes have reached fixation on that target, but it is the time when the eyes start to move or the start of the saccade between the fixations. Recall that the definition of a saccade is the abrupt movement of the eye from one location to another.

The column "Glance in Driver's Exterior Mirror" is the start of the saccade as the driver looks in the mirror that is anchored outside of the driver's door.

The column "Elapsed Time Between Glances in the RV Mirror" refers to the elapsed time between the start of the saccade toward the rear view mirror and the start of the saccade for the next fixation into that mirror. So, for example, a driver looks in the rear view mirror, then looks in the driver's exterior mirror and then looks back in the rear view mirror. The elapsed time we refer to is the time between looking in the rear view mirror as if the look in the driver's mirror never occurred. So far I have not conducted any calculations of how long the driver fixates on each mirror.

The column "Elapsed Time Between Glances in the Driver's Ext Mirror" is similar to the previous description. We look at the time when the driver's eyes first move toward the target mirror and then we look at the start of the next instance when the driver's eyes start to move toward that mirror. The difference between those two times is the elapsed time being referred to.

I have tried to separate the data into the types of action that the vehicle was involved in when the glances occurred. So I separated those instances when the test vehicle was stopped for a traffic signal or at a stop sign. I also tried to separate the data into those conditions where the test vehicle was travelling through an urban landscape versus a rural one.

In the original table the rows showing the urban landscape were shaded in a brown colour and the rural was in green. I suspect that those shades did not show up very well when I copied the table into this article. The best I can do for now is to indicate that the first 22 rows of the table are in an urban landscape while the remaining 11 rows are rural. The rows where the vehicle was stopped are shaded in bright red and that seems to show up quite well.

A yellow shade was also included in the original table but it is not visible here because the full table has not been attached in this article. That yellow shade was used to indicate two instances where we had to stop the test vehicle to make repairs to the mounting of the video cameras.

To demonstrate how one might interpret the data we can look at an example at the beginning of the table. We see that the test vehicle is at the following location and performing following action: "NB on Clarke, Travelling Straight Ahead" and at the precise time code of "00:06:39:16" the driver's eyes/head starts to move to the right to look into the rear view mirror. Next, at "00:06:41:11" the driver's eyes/head begin to move toward the driver's exterior mirror. Next, at "00:06:57:28" the driver's eyes/head begin to move toward the right again to look into the rear view mirror again. The elapsed time between the first movement toward the rear view mirror and the second movement is the value of 18.4 seconds shown in the 4th column.

The results from this analysis are not detailed at this time but I can make the following comments. The test vehicle was travelling through an urban landscape for about 21.5 minutes and through a rural landscape for about 33 minutes.

During the travel through the urban landscape there were 39 instances where the driver looked in the rear view mirror and 18 instances of looking in the driver's exterior mirror.

This would mean that 1.81 glances per minute occurred in the rear view mirror and 0.84 glances per minute occurred in the driver's exterior mirror.

During travel through the rural landscape there were 60 instances where the driver looked in the rear view mirror and 23 instances where the driver looked in the driver's exterior mirror. This would mean that 1.82 glances per minute occurred in the rear view mirror and 0.70 glances per minute occurred in the driver's exterior mirror.

Now for some caveats. This testing was performed with only a single male driver. This driver's behaviour could be different from the average or normal driver. The driver was very alert through the process because he kept providing a verbal description of where he was looking and what was drawing his attention. This verbal description was documented on the audio of the six video cameras. In my opinion, in a normal driving situation, a driver would not be so alert.

The durations of travel in the urban and rural environments were in several pieces and these were truncated to whole seconds, so you should not quote the per-minute values precisely but understand the numbers as "about" and not "exactly". I may do a more exact analysis later or if asked by someone to do so.

Preliminarily I noted that, as the driver approached a curve or travelled through it there were very few instances of looking in the mirrors. My preliminary thought is that the driver's attention was focused on the changing geometry of the road and in making minor adjustments to steering and speed to keep the vehicle within the travel lane. This need to apply additional attention to this task in a curve may indicate how a loss of control might occur. Simple events that might take the driver's attention away from the road might not be of much consequence when the vehicle is being driven along a straight road and the driver does not have to make many adjustments to steering and speed. However a similar distraction might cause the driver to fail to make a correction in speed or steering at the required time and cause the vehicle to wander out of the travel lane. This should be a greater problem when the curve has a smaller radius, or in other words, when the curve is "sharper" or the change in direction is more abrupt. Similarly, a curve should have a relatively constant radius so that there is a minimum of steering adjustment required.

And finally a curve should contain a minimum of crests or sags (hills, valleys) to prevent the vehicle from changing its speed without the driver's input. We must remember that the effect of crests and sags in a curve causes the vehicle to either speed up or slow down and this has the same effect as if the driver steered left or right in the curve. This may not be obvious but you can test this concept by keeping the steering wheel at a constant steering input while travelling around a curve and then try light braking or acceleration and you will find that the vehicle either drifts to the outside of the curve (acceleration) or is pulled into the curve (braking) even though the steering wheel is kept at the same angle.

If a driver has to look into one of his mirrors while passing through a curve that might be sufficient to cause problems depending the individual circumstances of each case.