Yielding the Right of Way During Left Turns

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Fault determination during left-turn collisions remains a challenging issue. While such assessments are complicated they rarely involve sufficient investigation to unravel what actually occurred and who was truly at fault. The following real-life example will illustrate some of those difficulties.

A typical scenario unfolds at a typical urban intersection where a significant collision has just occurred and there is chaos everywhere. Figure 1 shows a Google Maps view of the intersection of Dundas Street and Clarke Road in London, Ontario on an afternoon in October of 2016. A Subaru Outback SUV had been travelling northbound on Clarke Road and was attempting to turn left and travel westbound on Dundas when it was struck by a southbound Ford Ranger pick-up truck. Figure 1 shows the approximate area of impact and the final rest positions of the two vehicles.

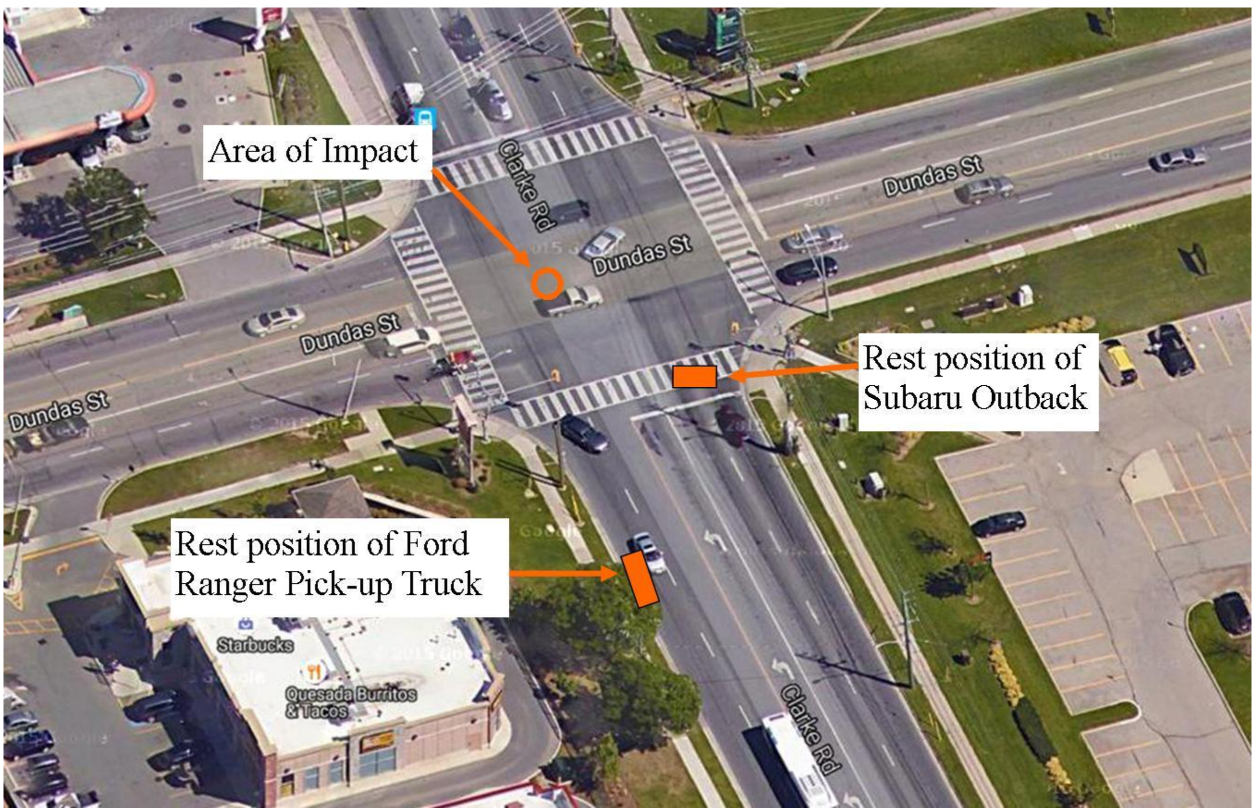

Figure 1: View of the intersection of Clarke and Dundas Streets in London, Ontario where a collision occurred in October of 2016.

Figure 2 shows a view looking south-east just minutes after the collision occurred. The Subaru Outback can be seen at the far side of the intersection.

Figure 2: View, looking south-east at the intersection of Dundas Street and Clarke Road in London, Ontario. A collision has just occurred between a Subaru Outback (visible in the view) and a Ford Ranger pick-up truck.

Looking further to the south Figure 3 shows that a London City Police cruiser has stopped on the south side of the intersection. Figure 4 shows a closer view of the cruiser and we see that it has stopped behind the Ford Ranger pick-up truck which has come to a stop against the west curb of Clarke Road.

Figure 3: View looking further south where a London City Police cruiser has come to a halt on Clarke Road just to the south of Dundas Street.

Figure 4: View looking further to the south where it can be seen that the police cruiser has stopped behind the Ford Ranger pick-up truck which has come to a stop against the west curb of Clarke Road.

As typical, emergency personnel including fire and ambulances have arrived to evaluate the situation. Looking eastward across the intersection, Figure 5 shows the signs of the area of impact.

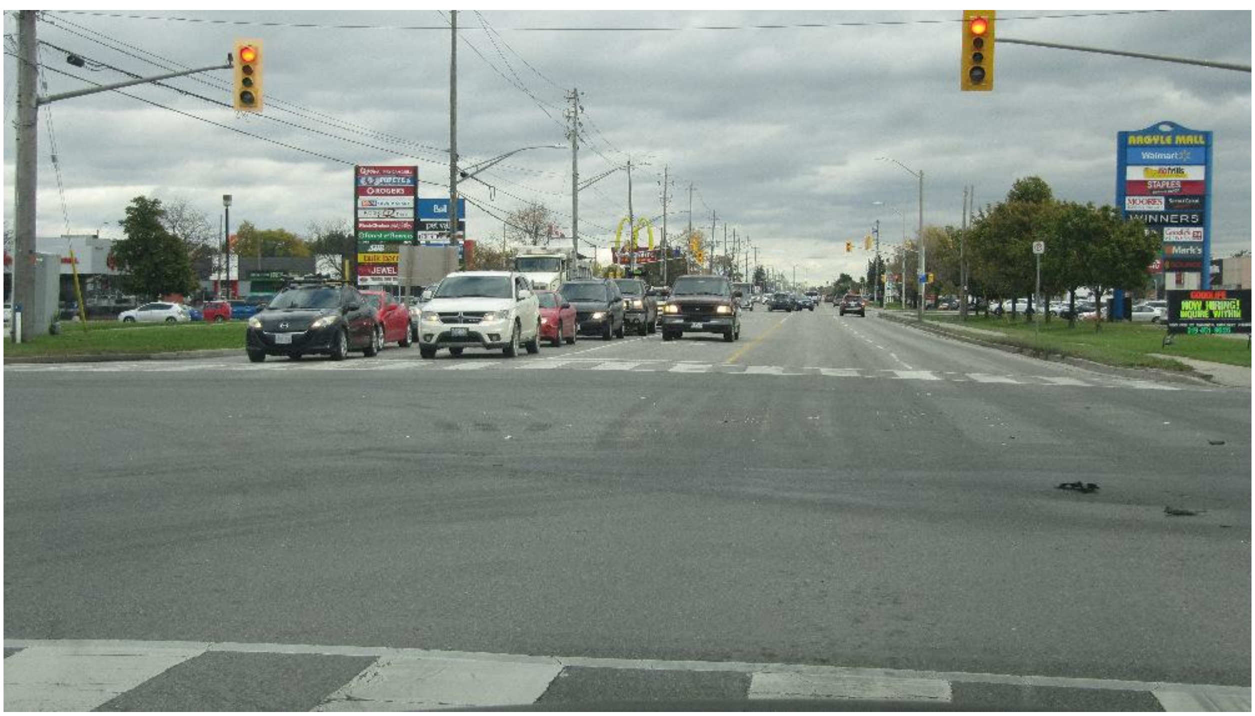

Figure 5: View looking east on Dundas Street across the intersection of Clarke Road. A beginning of the trail of fluid at the left side of this view is a good indicator of the area of impact.

This evidence can be difficult to decipher however the spray of fluid on the pavement can be a clue. The spray originates at the left centre of the view and then it widens and becomes more obvious toward the right. It can be appreciated that the vehicles crush at the point of impact and so containers of fluid (coolant, oil, battery acid, etc) are ruptured. Thus the beginning of the fluid trail is a good indicator of the area of impact.

Unfortunately, when an intersection contains a high traffic volume the fluid trail is quickly spread by the passing tires of other vehicles, as shown in the example in Figure 6.

Figure 6: View of an eastbound vehicle travelling over top of the fluid trail caused by the Subaru Outback.

Figure 5 shows the tire marks of eastbound vehicles as they have carried the fluid eastward along the two eastbound lanes. Also the tire marks of northbound vehicles on Clarke Road that made left-turns onto westbound Dundas can be seen as those tires travelled over the trail of fluid. This is why, when the collision investigation is of major consequence, traffic must be stopped from travelling through the evidence and destroying it.

Figure 7 is a view looking west along the south side of Dundas Street, from east of the accident site. Here we can see the front end of the Subaru and we can see its relationship to the intersection. Remember, the Subaru was northbound and was in the middle of the intersection when the collision occurred. At rest the Subaru is substantially south of the intersection and is facing southeast. Thus the impact caused the Subaru to rotate about 180 degrees. Thus this does not appear to be a mild impact.

Figure 8 is a closer view of the Subaru showing the extent of damage to its front end. An interesting fact is that a portion of the front bumper appears to be missing. Fluid had been escaping from its front end therefore fire personnel had dropped some white, absorbent material onto the puddle in front of the vehicle.

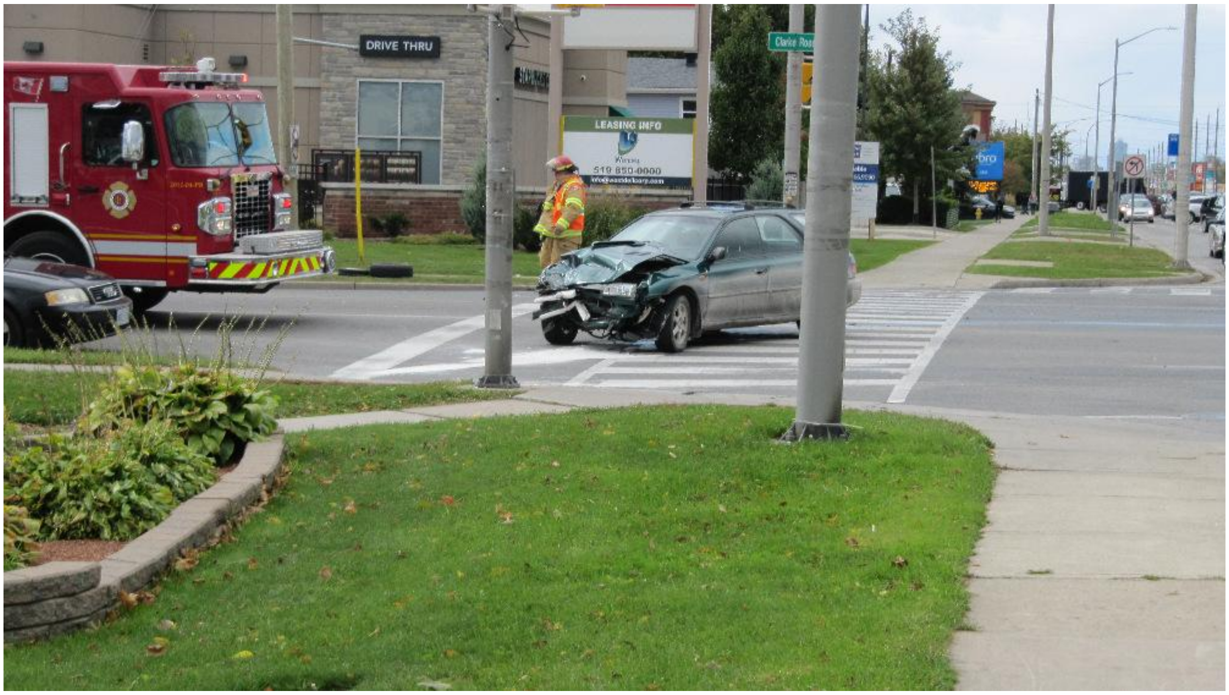

Figure 7: View, looking west from east of the intersection. This view shows how far the Subaru was pushed to the south of the intersection while also rotating about 180 degrees.

Figure 8: View, looking west, at the final rest position of the Subaru Outback. White absorbent material has been placed over top of a fluid stain at its front end. The cover of the its front bumper is missing.

Figure 9 is a view looking north at the final rest position of the Ford Ranger pick-up truck. This vehicle was travelling southbound on Clarke Road and, after impact, it travelled to this location against the west curb of Clarke Road, south of Dundas Street.

Figure 9: View showing the Ford Ranger pick-up truck at its final rest position. Note that the cover of the front bumper of the Subaru is attached to the front bumper of the Ranger.

Recall that we observed the interesting fact that the cover of the front bumper of the Subaru Outback was missing. Well, we can now see that the bumper cover is firmly attached to the front bumper of the Ford Ranger. Figure 10 shows a further view of that attachment. Figure 11 shows the reason for that attachment is that the left frame member of the Ranger is protruding forward as the rest of the structure has been crushed rearward. Thus the Subaru bumper cover is just "hanging" on the frame member.

This evidence provides us with some information about the offset of the two vehicles at impact. As the Subaru would have been turning left it would be at a slight angle to the approaching Ranger. One can observe in Figure 8 that the front wheels of the Subaru are turned to the left and this would be consistent with that turning action. Similarly, the Ranger's front wheels are turned to the right indicating that the driver attempted to steer to the right before impact to attempt to avoid the impact.

Figure 10: View of the cover of the front bumper of the Subaru Outback attached to the front bumper of the Ford Ranger.

Figure 11: View of the left frame member of the Ranger protruding through the hanging bumper cover of the Subaru.

Figure 12 provides an indication of the distance that the Ford Ranger travelled after impact. This view is looking generally northward along Clarke Road, back toward the intersection. One can consider that, as the Ranger was travelling southward, the driver had the opportunity to steer to the right to attempt to avoid the collision. Therefore he might also have had an opportunity to brake before impact. Thus some of the Ranger's speed could have been lost before impact.

Figure 12: View, from the final rest position of the Ford Ranger pick-up truck, looking back toward the intersection. The Ranger has travelled a substantial distance after impact considering that it would have lost a considerable amount of speed during the impact.

Furthermore, we see some substantial crush to the two vehicles and this indicates that there was a significant amount of kinetic energy that was dissipated in that crushing process. Generally speaking the Subaru would not be expected to possess a large amount of kinetic energy because it would likely be travelling relatively slowly because of its left turn. So we would suspect that a large portion of the dissipated energy of the collision was due to the energy possessed by the Ford Ranger. Thus if the Ranger possessed a lot of that kinetic energy then there is a suspicion that it was travelling quite quickly.

Furthermore, we can consider the post-impact travel distances of the vehicles. Given the typical speeds on an urban environment, these travel distances are substantial. The Subaru was driven backwards a substantial distance and it was rotated about 180 degrees. The Ford Ranger travelled a much further distance while its rotation was only slight.

All these general observations lead to the possibility that the Ford Ranger may have been travelling substantially faster than the speed limit as it approached the intersection. But these are just suspicions.

So what actually happened in this collision and who was at fault? We have a left turning Subaru driver who is required by Ontario law not to proceed into his left turn until he is assured that the way is clear, otherwise he will be charged with failing to yield the right of way, or perhaps even a higher level charge.

However, we also see some evidence to support that the Ford Ranger driver may have been travelling above the speed limit. We might ask at what point the driver of the Ranger loses his right of way? Does he still have his right of way at 10 km/h above the posted speed limit? How about at 20 km/h above the speed limit? How about at 50 km/h above the speed limit? Surely there cannot be an infinite right of way that the Ranger driver possesses regardless of his speed because it may be unreasonable to the Subaru driver to expect or detect such a high speed in these urban surroundings.

The first and primary fact that must be determined is the pre-impact speed of the Ford Ranger. Although that in itself may not be sufficient to provide a final verdict.

In modern times the assessment of the Ford Ranger's speed would appear to be quite simple. An expert police reconstructionist can be summoned who will be equipped with a "Crash Data Retrieval Kit" (CDR). This kit is a data transfer and decoding piece of hardware that is connected to a vehicle's event data recorder ("Black Box") from which crash data is retrieved. This crash data is displayed in a report that provides information about the pre-crash and crash status of a vehicle involved in a collision.

Yes, some vehicles are still not equipped to be compatible with the CDR hardware. While pre-crash data first became available on a select number of 1999 GM vehicles, it took a considerable time before other manufacturers agreed to compatibility with the CDR system. Yet, to this day, there are still manufacturers who choose not to be associated with that system. In North America 2013 was the date set by government to attach new responsibilities of motor vehicle manufacturers with respect to event data recorders. Under a new ruling, if a manufacturer installed an event data recorder in a vehicle there had to be a primary set of 15 parameters that must be recorded. Furthermore the ruling also required that the data from these recorders must be accessible by third party examiners such as police, insurance and private investigators, or generally accessible by the "public".

However, the reality is that the public does not have access to this crash data. The cost of the hardware alone is in the thousands of dollars. This makes it difficult for many police jurisdictions to own a proper supply of the equipment and to train enough personnel to deal with the demand. Thus large entities such as government agencies and large research organizations have no problem purchasing the hardware and gaining access to the public's data. Similarly, for the upper tier of severe and fatal collisions selected for reconstruction for prosecution of major crimes, police will also access the data. But very rarely is the data accessible for assessment of fault in less severe incidents or disputes between individuals.

Insurance companies form a contractual relationship with their insureds whereby a premium is paid to take on the defense of that insured when a collision occurs. Thus there should be a responsibility of the insurer to collect the crash data that the insured is unable to do. In the dark coal mine of private insurance operations no one can actually track whether this data is collected, but certainly the data is not available from the insurer when it comes to defend the insured even when traffic charges are of a serious and criminal nature. The insured driver is basically out on their own to spend the money to hire a lawyer, pay for a reconstructionist and pay for all the investigation costs.

For those vehicles that are not compatible with the CDR equipment, the costs of data retrieval are even greater. Some manufacturers have developed their own specialized equipment and there is literally no control over how much they can charge for retrieval of crash data. While there is weak-kneed wording in the government legislation that requires the data to be accessible to third parties, it is obvious that there was no intent by government to enforce those words.

Thus, in this age of equality, it would seem that the speed of a vehicle could easily be determined from the crash data that exists in almost every modern vehicle. Yet it remains that some are still more equal than others and rarely can an average citizen expect to be equally treated.

With the lack of help from crash data, what else can be used to determine the speeds of the vehicles? Traditionally reconstructions have used a combination of two physical principles: The Conservation of Momentum and the Conservation of Energy.

The Principle of Conservation of Momentum states that, in a vacuum, when two particles collide their combined pre-impact momentum will be equal to their combined post-impact momentum. This principle has been translated to the reconstruction of vehicle speeds via several simplifying assumptions. One assumption is that vehicles, much like the particles, also collide in a vacuum where all external forces are of minimal relevance and effect. It is also assumed that a particle can be exchanged with a motor vehicle such that the specifications/dimensions of a vehicle are of minimal importance to the analysis. The analysis is further simplified by considering only the "linear" portion of the momentum such that rotational momentum can be excluded because it should be of minimal relevance. The analysis also assumes that a collision is instantaneous, meaning that nothing of importance happens while the two vehicles are in contact with each other, or that the pre-impact momentum is exchanged into post-impact momentum without any delay in time. In most instances all these simplifications can lead to a reasonably good speed estimate, but not always.

With respect to the Conservation of Energy, it is understood that vehicles in motion possess kinetic energy which is equal to a vehicle's mass (what we call 'weight') multiplied by its velocity. So a vehicle weighing 2000 kilograms travelling at 10 metres per second will have a kinetic energy equivalent to 20000 newton metres or "joules". When vehicles lose their "speed" they transfer that kinetic energy in many ways but primarily through crush of their structures during impact and through resistance occurring between the tires and road surface. This wheel resistance may occur from braking or it may occur from many other sources such as damage that jams the wheels from rotating or by travelling though resisting areas such as earthen fields or deep snow. Thus the reconstructionist can examine the kinetic energy that was apparent in the physical evidence to estimate the vehicle speeds.

With respect to left-turn collisions at intersections, it is possible to conduct a momentum analysis by estimating the post-impact momentum that is apparent from the physical evidence. Of critical importance in this analysis is to establish the speed at which the impacting vehicles leave the point of impact. This is accomplished by considering how much resistance occurred over the path that each vehicle took to its final rest position. Thus a vehicle whose wheels are fully locked and sliding will sustain a higher speed loss than one whose wheels are simply rolling. This calculation is a simple energy dissipation calculation whereby the speed lost is equal to the square root of the constant 254, times the drag factor (i.e. fully locked wheels = 0.7) times the travel distance in meters. Thus a vehicle whose wheels are locked that travels 10 metres after impact would have a departure speed of (Sqrt (254*.7*10) 42.2 km/h.

Momentum analysis also needs a precise estimate of the angle at which the vehicles left their impact. This is not determined by simply drawing a straight line between its position at impact and rest because external forces could be acting during the distance of travel that might re-direct the vehicle to its rest position. Thus physical evidence such as tire marks or scrapes or fluid trails must be used in the vicinity of the impact to make that correct approximation of departure angle.

Momentum is a product of vehicle mass and velocity but it is important to remember that, unlike speed, velocity has a directional component which is critical in the assessment and this is why the departure angle is essential in the process.

Reconstructionists often use trigonometry in momentum equations which make the formulations look very complex to those unfamiliar with the process. Thus if the reconstructionist has to explain his/her calculations to a lawyer or judge the understanding can be essentially hopeless. A simpler alternative is to replace the trigonometry with a vector diagram. Vector diagrams are "visual" representations of the analysis that lay persons can understand much easier. A vector is a line whose length represents the speed of the vehicle and whose direction indicates the direct that the vehicle is travelling. By combining the post-impact vectors of the two vehicles, head-to-toe, a total momentum vector can be drawn from the beginning of the first vector to the end of the second vector. Then the creation of a mirror image of the total post-impact vector establishes the Total Pre-Impact Vector. Separating the Total Pre-impact Vector into its two component parts and dividing each vector by its mass leads to the pre-impact speed of each vehicle. While this wording sounds complicated it is easy to demonstrate when the vectors are actually plotted on a diagram in a courtroom environment. Thus even without being technically minded, the court can clearly see how the process is evolved. With a change to a select input the court is able to see how the vector diagram becomes rearranged. This visual demonstration is far superior to any attempts by the expert to explain why a certain trigonometric function was used in a complex weave of numbers, brackets and functions.

When the applicability of the Momentum analysis becomes arguable it can be accompanied by an independent Energy analysis to ensure that the physical evidence and other inputs have been interpreted correctly. This is very important in intersection collisions involving a left-turning vehicle because a Momentum analysis becomes unstable when the momentum of one vehicle is much larger than the other or when the approach angles to impact are co-linear (similar to a head-on collision).

While these analysis can be done manually with hand calculations the process becomes time consuming and therefore impractical. Some analysts have created their own calculation processes in Excel spreadsheets thus speeding up those manual calculations. However, these Excel methods are reliant on the expertise of the individual. The Excel calculations are relatively easy to set up such that a result will be produced, but they are in jeopardy of lacking the sophistication necessary to take into account confounding factors that can produce false results. This is why, unless the analyst is exceptional in their understanding, training and experience, automated analysis is better left to available computer packages offered by well-known and established vendors. Computer analysis packages such as those employing CRASH, SMAC or PC-CRASH have a long-standing track record of providing reliable results when used properly. The unfortunate problem is that very few police agencies have access to these computerized analysis tools and thus they either rely on their manual hand calculations or the Excel analyses that they believe have been generated by reliable sources. Even so, many police collision analyses do not employ the Excel analyses but are simply based on manual calculations, at best.

The bottom line is that when a police reconstruction is made of vehicle speed, without the availability of event data recorder data, the results can be sporadic, some being as good as the quality of the analyst and some being exceptionally poor, also as good as the quality of the analyst. However, far more often, an objective analysis is not even performed but the basis for a charge comes from witness or driver statements. The basis for a charge may also come from the investigating officer's training that a driver must "yield the right of way" regardless of what the facts may be. This makes it simple since, if a left-turning driver enters into the through lane he or she is automatically guilty, case closed.

The law and legislators can sometimes be likened to the scenario of a bull being sent into a shop of fine china to remove a mouse. Yes, the bull is big and powerful and so legislators can claim that they have done their duty to react with severity to the threat. Yet the bull is mindless; it does not know what it is there to do. The bull does not know the importance of fine china nor its purpose. Thus the bull rages through the shop making a great deal of noise and calamity. It would appear from all this action that something is being done about the presence of our mouse, adding to the conclusion that something useful and important has been achieved. The police are like the bull master who has a rope around the bull to control it. But with the frustration of not having a precise tool to catch the little critter the purpose of controlling the big beast takes less priority than the successful catch. Thus much damage is caused to the innocent china on the justified grounds that the mouse must be caught. The courts are there to determine whether the doors to the shop should be opened to allow the bull's entrance. But very often the courts become the custodian who simply sweeps up after the mess is done, requisition more fine china, straighten the shelves and move onto the next shop and mouse.

Unfortunately the public is the fine china on the shelf. It cannot remove itself from the environment nor can it control the actions of all involved. It can only hope that all involved can think rationally and consider a proper strategy without too much collateral damage. While this example may seem somewhat amusing it is not. The lives of many persons caught up in this real-life game are needlessly destroyed because the process fails to function rationally.

" Yielding the Right of Way" is a simple way of passing many arguable disputes through the justice system but in no way does it achieve the justice that is deserved.

Returning to our real-life example, how would the investigating officer proceed with reaching justice to both parties? Looking at the photos of the site we can see that the intersection is fully engulfed with heavy traffic. Emergency vehicles and their personnel are everywhere, by-standers are everywhere, and there is a need to clear the scene and get the economy moving again. But there is only one police vehicle at the scene and only one police officer. As shown in Figure 13 there are many emergency personnel simply standing around with nothing to do.

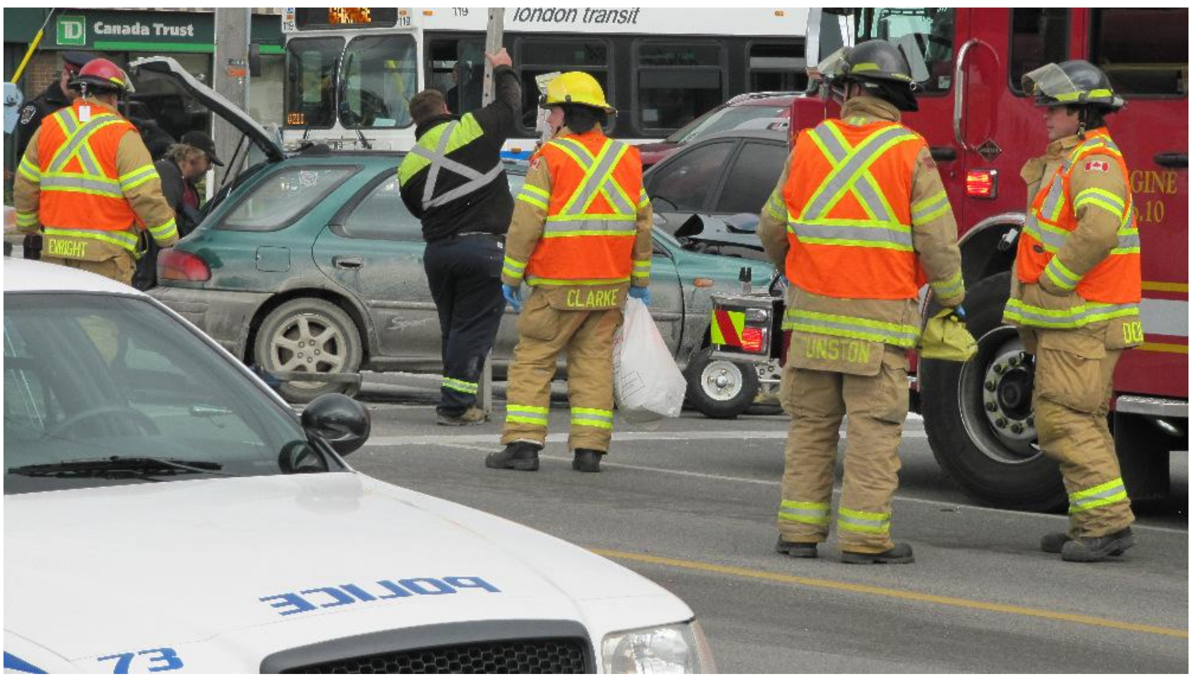

Figure 13: For obvious reasons rescue personnel need to be present in case something gets out of hand, but in a large percentage of incidents those rescue personnel are not needed and end up just standing around.

It is understandable that abundant resources should be deployed to treat potentially injured persons and sometimes an over-abundance is necessary because a shortage could lead to drastic consequences. And similarly, fire personnel need to attend in abundant numbers because removal of an occupant from an unsafe situation such as a burning vehicle could be crucial. And in other instances removing a trapped person may be crucial to that person's survival if essential hospital treatment is delayed. Thus the presence of so many emergency personnel is justified.

However, the abundant presence of police personnel is also a crucial necessity. Even though a collision may not involve life-threatening injuries the financial and social repercussions of a significant collision can also be life changing when fault is not correctly determined. Thus why is a single police officer in attendance in this example case when there is clear evidence that this is not a minor event and that crucial evidence will be lost because the single officer cannot possibly perform all the proper police functions? These deficiencies rarely recognized or acknowledged in the public realm.

We have stated earlier that there is an importance to document the physical evidence and some of that evidence is fragile and quickly destroyed, as shown previously in Figure 6.

The documentation of the final rest positions of the vehicles is crucial in any objective investigation. In the present case that is not a problem because the vehicles are there at their rest positions when the police officer has arrived. But what actually happens? Before the police officer is able to document those rest positions we see the events unfold as shown in Figures 14 through 21.

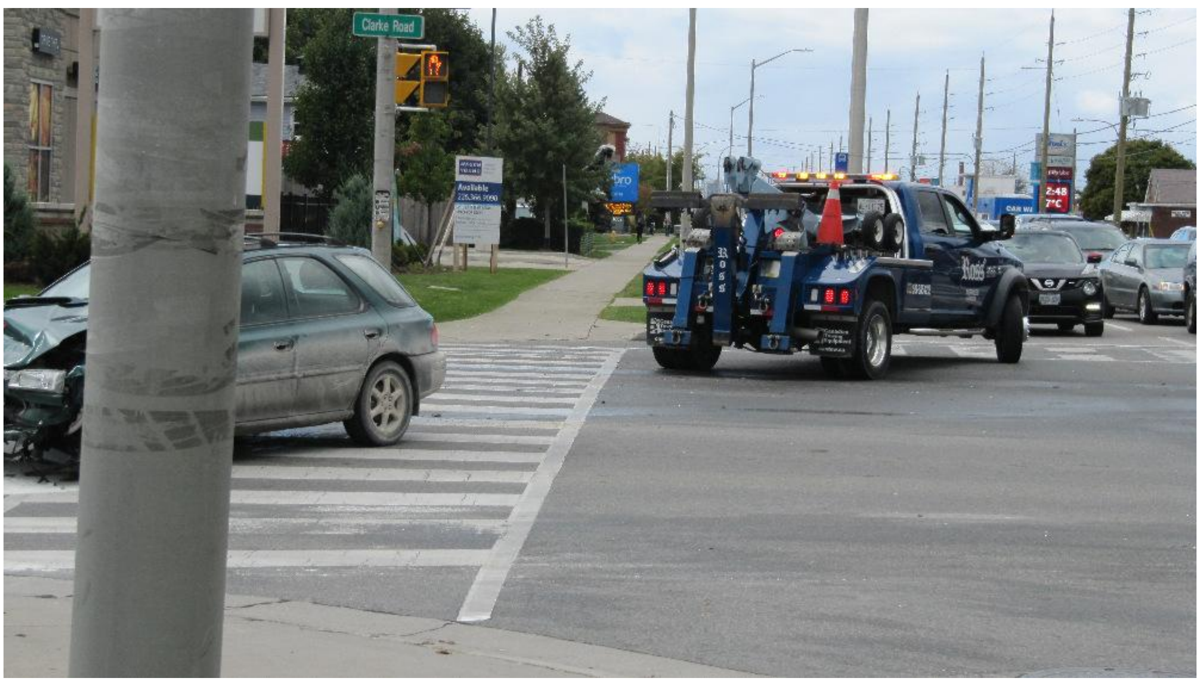

Figure 14: A tow truck is seen backing toward the rest position of the Subaru Outback.

Tow trucks arrive to remove the two vehicles from the site. In Figure 14 a tow truck backs up over the travel paths that both colliding vehicles took toward their final rest positions. Yet, a crucial element of a speed analysis is the documentation of the characteristics of any fluid spills, scrapes or tire marks. If that evidence is destroyed then the estimate of how much drag occurred while moving to final rest becomes more difficult.

Not only does the tow truck back over the evidence on a single occasion. But the operator exits the truck and attaches various hardware to transport the vehicle as shown in Figures 15 and 16. Then the tow truck attempts to leave but there is not enough space so it backs up and moves forward several times, over the collision evidence, before departing, as shown in Figures 17 through 20. A second tow truck then arrives to remove the Ford Ranger, as shown in Figure 21.

Figure 15: The towing operator connects to the back wheels of the Subaru.

Throughout these changes taking place to the evidence, the police officer is busy in his cruiser taking statements and filling out his report.

At this point we expect the officer to become a multi-headed, multi-armed octopus who can write reports, control traffic, take statements and document the collision evidence, all done while being perfectly accurate and correct in all his/her duties. Surely that is unreasonable. Yet the consequences of an error can be tremendous to the parties involved. In this scenario the question must be repeated: Why are there no additional police resources at hand while fire, ambulance and towing personnel are in such abundance?

Figure 16: A small dolly is placed under the front wheels of the Subaru.

Figure 17: The towing operator attempts to move the Subaru but cannot do so in the small confines of the remaining intersection.

Figure 18: The tow truck moves forward...

Figure 19: The tow truck reverses backward...

Figure 20: The tow truck moves forward...all these actions occur over top of any tire marks that would have been generated by the vehicles as they moved from impact to rest.

Figure 21: A second tow truck arrives to remove the Ford Ranger from the site.

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As noted earlier, without EDR data, the collision evidence must be documented in order to perform objective Momentum and Energy analyses and these are needed to capture the pre-impact speeds of the vehicles. At a minimum, the point of impact needs to be established. Meanwhile though these many minutes at the site, traffic has been flowing steadily, un-impeded, through the area of impact, destroying most of the physical evidence that might have indicated the point of impact. We also noted that the objective analysis requires a good estimate of the angle at which the vehicles left the area of impact and that a straight line measurement from impact to rest will not do.

We know that the Subaru rotated about 180 degrees between impact and rest therefore this will create a curving, post-impact travel. A fluid trail created by the front end of the Subaru could have been documented but that will not establish the position of its centre of gravity and this is what is needed. Thus the departure angle of the Subaru would be difficult to determine even if the police officer had the time perform this essential duty.

Meanwhile the investigating officer has had no time to examine any of the wheels of the two vehicles before they were towed away. The extent of lock-up or jamming of the wheels will have a very large effect on the speed calculation. As noted earlier, even sliding distance of 10 metres could result in a post-impact speed estimate of over 40 km/h. But clearly the Ford Ranger moved much further than just 10 metres. But, on the other hand, if the wheels of the Ford Ranger were essentially free-rolling, say at 0.1g, then even a travel distance of 50 metres would result in a post-impact speed estimate of only 36 km/h. Thus wheel jamming or lock-up is extremely important in the analysis.

When wheel lock-ups become difficult to estimate then the momentum analysis could inaccurately depict that one, or both, of the drivers performed an action that would lead to charges. When the impact speed of the Subaru is small then the momentum analysis becomes sensitive to slight changes in the inputs thus suggesting that the Subaru driver was performing an action that did not occur. Similarly, without accurate deceleration data, the speed of the Ford Ranger could be wildly inaccurate.

These problems can be overcome when the investigator measures the extent of crush on the two vehicles. Such an action will enable a determination of the shared impulse (force X time). As the impulse is defined as the "change in momentum" studying in the impulse can lead to an independent assessment of whether the momentum analysis in accurate. As the time of contact between the two vehicles must be equal the remaining task is to determine the force. By knowing a) the stiffness of the structure of each vehicle, b) the extent of crush and, c) that the force has to be equally shared, this process can lead to a separate and independent evaluation of the momentum analysis.

The problem is that extremely few police agencies in North America actually measure the crush of vehicles and conduct this independent assessment of the accuracy of a momentum analysis. While the process could be a tricky manual exercise, computerized collision reconstruction programs such as CRASH have this capability and it can be performed relatively easily and quickly. But as said earlier, police agencies simply refuse to become familiar with such computer analysis and will not purchase such packages for their investigators.

Furthermore, computerized simulation programs also exist that could help in a collision analysis. The most popular vehicle collision simulation program originated in the 1970s with the contracting by the U.S, National Highway Traffic Safety Administration (NHTSA) to develop computer programs for use with their assessment of their road safety programs such as the National Accident Sampling System (NASS). A 2-dimensional program called SMAC was developed in conjunction with the previously mentioned CRASH program. Later various private vendors refined SMAC with additional features such as 3-dimensional capabilities. While these 3-dimensional programs are relatively expensive for a typical, small police agency, the 2-dimensional versions of the program are highly effective and still apply to most collision situations.

The point of this discussion is that, despite this lack of availability of EDR data to the general public, and despite the limitations in police documentation and interpretation of physical evidence, methods and tools are available and could be employed to reduce the effect of these deficiencies.

After the vehicle speeds have been estimated this still leaves additional questions that need to be answered. The most prominent is the issue of the status of the traffic signal at the time that the drivers made the decisions that led to the impact. Increasingly traffic cameras are being installed at many intersections and this could provide conclusive evidence at the signal status. Barring this, many drivers install dash cameras and this too could be source of useful data.

When such objective evidence is not available the analysis can be led astray by witness statements. Although many are led to believe that witnesses are generally reliable in what they report, the reality is quite different. Many years of collision reconstruction has led to the observation that witness information can be quite variable in its accuracy and at times can be completely wrong or untruthful despite being assumed to be independent.

There are also difficulties with respect to understanding how long it should take for a driver to detect, identify and react to an oncoming vehicle. While forewarned of an expected danger and focused on a possible reaction a driver could respond with braking in about 0.5 seconds after the availability to detect the threat. However such a simple situation without complications is rarely available in typical traffic situations. In some cases it may not be apparent to a driver that a reaction is required if there is some ambiguity in the intended actions of the other driver. In other instances a driver may have to content with observing multiple stimuli which might be relevant. At other times a driver may not be looking in the direction from which the danger emerges. And in other instances the driver may have to chose from several reactions such as braking, steering or both. Thus in many pre-crash scenarios "perception-response" times could be 1.5 seconds or even longer. Given the complexity of this subject matter it is a common source of error in a final conclusion as to who was at fault. In reality it is the common fact that both drivers may share fault for the collision even when it is obvious that one driver's fault can be clearly identified.

Thus the presence of alcohol impairment, speeding and distraction of one driver does not remove the possibility that the opposing driver might also have acted improperly. Yet it is extremely rare for investigators and the justice system to consider this possibility. Similarly vehicle mechanical failures and improper roadway conditions are often not investigated once an obvious driver fault has been established.

The reconstruction of left turn collisions at an urban intersection is complicated and often incorrect. Much data, analysis and experience is needed to reach a proper solution. The review of an example case in this article has just scratched the surface what issues and problems commonly exist.

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