INVESTIGATION OF THE MOTORCYCLIST/Car Driver COLLISION

RECONSTRUCTION REPORT July 31, 2010

1. Introduction

This two-vehicle collision occurred May 22, 2007, at about 4:30 *p.m.*, on Prospect Street, in Ewing, Mercer County, New Jersey. The collision involved a 1991 Dodge Spirit passenger car, driven by Car Driver, and a 2001 Suzuki motorcycle, operated by Motorcyclist.

Car Driver was turning left from northbound Prospect Street into Dawes Avenue when she collided with Motorcyclist, who was southbound on Prospect Street. Both Car Driver and Motorcyclist were injured in the collision.

This investigation was performed to determine if Car Driver's driving was improper in a manner that was a cause of the collision.

2. Information Available

2.1 New Jersey Police Crash Investigation Report, by Ofc. Patrick Wesner, of the Ewing Police Department.

2.2 Photographs from the Prosecutor's office:

- 2.2.1 One hundred three color digital photographs of the crash scene. These show the area and both damaged vehicles.
- 2.2.2 Twenty-eight color digital photographs of Car Driver and Motorcyclist in the hospital.

2.3 Prosecutor's file, which contains the Police Report, statements from witness Tony Brown and Car Driver, and medical records for Car Driver.

2.4 Motorcyclist's answer to Form A Interrogatory Number 2.

2.5 Car Driver's answers to Form C, C(1) and supplemental interrogatories, which include

- 2.5.1 Recorded Statement of Witness, taken August 9, 2007.
- 2.5.2 Black and white photocopies of photographs of the collision site, and the Dodge.
- 2.5.3 Report of Roger E. Rozsas, dated November 2, 2007.
- 2.5.4 Black and white photocopies of photographs of the motorcycle.

2.6 Deposition transcripts:

- 2.6.1 Car Driver May 26, 2010.
- 2.6.2 Motorcyclist May 26, 2010

3. Collision and Site Description.

The Police Report,

> Preliminary investigation revealed that V1 [Car Driver] was traveling N/B on Prospect St. and was attempting to make a left turn onto Dawes Ave. when she was struck V2 [Motorcyclist], who had been travelling S/B on Prospect St. After impact D2 [Motorcyclist] was ejected from the motorcycle and thrown about 96 feet striking a tree.
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> …
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> Investigation revealed that V1 had been making a left turn from N/B Prospect St. on to Dawes Ave. at the time of the collision. V1 had been travelling extremely slow and D1 had no visible obstructions of the S/B flow of traffic. V2 had been travelling S/B at a high rate of speed and D2 ha no visible obstructions of the N/B flow of traffic at the time of the collision. At the point where Prospect ST. and Dawes Ave. Intersect V1 turn directly in front of V2, due to V2's rate of speed V2 was unable to safely stop and a collision occurred.

Prospect Street is a local street, with medium density housing both sides. The speed limit is 25 mph. The street is curbed with sidewalks on both sides. The pavement is asphalt.

The Police Report shows the weather was clear, the pavement was dry, and it was daylight.

4. Analysis

4.1 Vehicle damage.

1991 Dodge Spirit

The post-crash photographs of the Dodge show that contact damage is confined to the left front. The contact damage starts at about the midpoint of the bumper, and gets more intense moving to the left front corner. There is a deep impression in the bumper to the left of center. There are scrapes and a black mark running diagonally across the left front corner of the hood. The hood is buckled. The left front fender is buckled.

The driver's air bag is deployed. There is no other damage to the car.

2001 Suzuki motorcycle

The post-crash photographs of the motorcycle show the gasoline tank separated. There is extensive damage to the entire motorcycle. Fairing components and other parts of the motorcycle are strewn about. The rear wheel has a mark showing that the tire was recently skidded. The front wheel shows angled scuffs.

Photos taken of the motorcycle in a garage show the wheelbase of the damaged motorcycle to be 4'-2".

4.2 Testimony and Statements.

Witness, statement of May 22, 2007, with the Police Report.

- He passed Car Driver as Motorcyclist was approaching.
- He saw the collision in his rear view mirror.
- "The motorcycle tried to avoid hitting the blue car, by trying to go around the blue car."
- The motorcycle's speed was ~45 mph.
- The Dodge was going very slow.
- He did not notice any turn signals prior to the collision.

Witness, statement of August 9, 2007.

> I was behind the...ah...the 91 Dodge. While she...she was negotiating a left turn. The lady was going real slow. Like, you know, she didn't know what she was doing actually. That's what it seemed like to me. Ah, she didn't know if she wanted to make the left turn or what, but she was going real slow...real slow. Then, we...she finally went on and made the turn. When I got around her, I went around her and I'd seen the motorcycle coming towards me. Ah, he wasn't, you know...he was going pretty fast, and I looked in my rear view mirror and the next thing I knew, he had hit this lady while she was still negotiating the turn. Um, I saw him fly through the trees. I seen him, geez, oh man...he was...it was like Superman. I seen him fly through the top of the trees, and ah, when I'd seen... when I seen the accident in my rear view mirror, I quickly made a u-turn and went right by where the guy was driving the motorcycle landed and tried to assist him; but he was in really bad shape.

- He saw a left turn signal on the car.
- He passed the car to the right.

> Yeah, he tried to avoid her. You know, she had plenty of time to make the left hand turn. I don't know why she was going so slow. I...like I said, I don't know why she was going so slow. I...like I said, I don't know if she was trying to turn around or make the left turn. I don't know. It didn't make sense to me. She had plenty of time to get out of his way. I guess he scared her, ah, and she just stopped. And when she stopped, making the left turn, he tried to avoid her by, you know, swinging out to his right and the next thing I know, he contacted with her.

- …she stopped. I mean, ah, I don't know if she was trying to turn left or she was trying to turn around.
- The motorcycle tried to slow.

Car Driver, statement of May 23, 2007, with the Police Report.

- Her speed at the collision was ~15 mph.
- She heard a loud noise behind her prior to the collision.
- She did not see the motorcycle prior to the collision.
- She "…turned on my turn signal and made a left onto Dawes Avenue when the motorcycle struck the rear of my vehicle."
- She was going home.

Car Driver deposition of May 26, 2010.

- She was going slow and making a left to Dawes Avenue, until she heard a noise.
- Then the air bag hit her.
- The noise was from the back right.
- She didn't see the motorcycle.
- She thought she got hit in the rear.
- She could see almost to Spruce Street.
- There were no obstructions to her view of oncoming traffic.
- She put her turn signal On to make the left turn.

Motorcyclist deposition of May 26, 2010.

- He has no memory of the collision.

4.3 Reconstruction.

The damage to the car indicates the motorcycle made first contact with its front tire at the mid front of the car. The motorcycle then was deflected to its right, as it was still travelling into the car. This produced buckling of the hood and scraping across the front of the car. The motorcycle then travelled to its right and came to rest on the raised lawn of 1 Dawes Avenue.

Motorcyclist was ejected when the motorcycle's forward speed was suddenly stopped. He went high into the air, as seen by Brown. As he came back to the ground he hit a tree ~3 feet above the ground. This tree was located by Rozsas as being 76.4 feet south of the south curb of Dawes Avenue.

The Police Report also did not document any roadway marks that would establish the location of the car at impact, and I don't see any in the scene photos.

According to the Police Report measurements, the right front of the Dodge was ~ 7" north of the south curb of Dawes Avenue. Therefore, Motorcyclist travelled at least 77 feet from impact with the Dodge to impact with the tree[1]. For these conditions, I calculate Motorcyclist's speed at impact to have been 35 mph[2].

Figure 1 is a to-scale aerial photo of the intersection, on which I have drawn the final rest positions of the car, the motorcycle and Motorcyclist, as well as the tree struck by Motorcyclist. Figure 1 also shows the path of Car Driver had she made a normal turn and the location of the Dodge and motorcycle at impact for this idealized turn. If impact occurred as shown in Figure 1, Motorcyclist travelled 94 feet to impact with the tree and his speed at impact was 38 mph.

Figure 1. Layout of vehicle movements and final rest positions

[1] The police reported that Motorcyclist was thrown about 96 feet. This would be the total distance of his travel, which would include movement along the ground.

[2] The method used is to consider Motorcyclist as a projectile. His seated height was roughly the same as the height of the mark he made when he hit the tree. Therefore, the difference in elevation between takeoff and landing were about the same. Applying Exhibit 16 of *Traffic Crash Reconstruction*, by Fricke, 2010, page 222, yields the minimum takeoff speed. This speed is also a reasonable estimate of Motorcyclist's speed because of the height of Motorcyclist's trajectory.

The motorcycle's post-collision wheelbase was measured to be 4'-2", or 50". The specifications[3] for this motorcycle show the wheelbase to be 55.5". The change in wheelbase can be used to determine the motorcycle's impact speed into a car[4, 5], assuming the motorcycle stops at impact. The 5.5" shortening is equivalent to 28 mph.

The Police Report did not document any post impact skid or gouge marks from the motorcycle. The only potential post impact marks seen in the scene photos are in the slope of the lawn. Considering the distance the motorcycle travelled post-impact from the two positions, applying a drag factor of .35[6], and combining the energy dissipation while sliding with the speed from shortening of the motorcycle's wheelbase, yields an impact speed of 34 to 35 mph. This is consistent with Motorcyclist's impact speed calculated using the projectile method.

Motorcyclist's speed at impact was 34 to 38 mph.

There was no documentation in the police report of Motorcyclist having produced a skid mark prior to impact. However, the photos of the motorcycle's tires, particularly No. 99, show that he did brake prior to impact.

The final rest position of the car is against the curb at the southwest corner of the intersection. This is not a reasonable location for the car to have been hit. Therefore, there was post-impact movement by the car. This movement is evident in Photo No. 27.

[3] http://www.gsx-r.eu/History_gsxr1000.html, accessed July 28, 2010.

[4] SAE 2002-01-0551, Seventeen Motorcycle Crash Tests into Vehicles and a Barrier, Adamson, Kelley, et al.

[5] *Traffic Crash Reconstruction*, by Fricke, 2010, page 409.

[6] See Fricke, page 402.

For the purpose of analysis, I will assume Car Driver was making her left turn at a normal location and in a normal manner, as shown in Figure 1. With this turn, Car Driver would have travelled ~20 feet from a normal northerly path to impact. In the Police Report statement, Car Driver said that her speed at impact was 15 mph. In her response to Form C Interrogatories, Car Driver said that her speed at impact was 5 mph. For these speeds, Car Driver travelled the 20 feet in 0.9 to 2.7 seconds.

During the 0.9 to 2.7 seconds that Car Driver took to turn from a northerly direction to impact, Motorcyclist and his motorcycle were 45 to 150 feet from impact. The road geometry for Motorcyclist's approach is shown in Figure 2. As seen in the scene photos, it is easy to see from Dawes to Spruce Street, a distance of over 500 feet. Car Driver testified that there were no obstructions to her vision and that she could see almost to Spruce Street. Therefore, Car Driver should have seen the approaching Motorcyclist and his motorcycle. Yet, Car Driver said that she didn't see Motorcyclist and his motorcycle prior to impact.

Car Driver did not see the motorcycle that was there to be seen. Car Driver was not driving attentively.

If Motorcyclist had been travelling at the speed limit of 25 mph, he would have been 33 to 99 feet away when Car Driver started her turn. These distances are not significantly different from the 45 to 150 feet that Motorcyclist was from Car Driver when she started her turn. Motorcyclist's speed in excess of the speed limit was not a cause of Car Driver not seeing him when she started her turn.

To avoid a collision, a driver needs to detect the presence of a roadway hazard in enough time to react and bring the vehicle to a stop.

AASHTO, the American Association of State Highway and Transportation Officials, is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia, and Puerto Rico. AASHTO has committees which formulate and recommend highway engineering policies. The committees assemble and analyze relative data and prepare a tentative draft publication. The draft is extensively reviewed by the member states and the Federal Highway Administration (FHWA) and other interested parties, and adopted by a two-thirds vote of the member states before publication[7].

AASHTO defines Brake Reaction Time (BRT) as.

> Brake reaction time is the interval from the instant that the driver recognizes the existence of an obstacle on the roadway ahead that necessitates braking to the instant the driver actually applies the brake. (Page 110)

The median BRT time for a reasonably attentive driver confronted with an unexpected roadway obstacle is 1.5 seconds. The 85th percentile BRT time for a reasonably attentive driver confronted with an unexpected roadway obstacle is 2.6 seconds. (Pages 51, 52)

AASHTO states:

> Both recent research and the studies documented in the literature show that a 2.5-s brake reaction time for stopping sight situations encompasses the capabilities of mot drivers, including those of older drivers. (Page 111)

Car Driver took 0.9 to 2.7 seconds to turn to impact. From Brown's observations, this movement may not have been clear to Motorcyclist. Nevertheless, Motorcyclist did brake prior to impact. Therefore, I conclude that Motorcyclist was alert and reacted promptly to the unexpected condition of Car Driver turning across his path.

Car Driver's inattentive driving was the cause of this crash.

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[7] *A Policy on Geometric Design of Streets and Highways*, AASHTO. 2004.

5. Findings

Based on the information available, subject to change with new information, and to a reasonable degree of professional certainty, I conclude:

1. Motorcyclist's speed at impact was 34 to 38 mph.

2. Motorcyclist and his motorcycle were 45 to 150 feet from impact when Car Driver started to turn.

3. There were no obstructions to Car Driver's view of the oncoming Motorcyclist and his motorcycle.

4. Car Driver should have seen the approaching Motorcyclist and his motorcycle. Yet Car Driver said that she didn't see Motorcyclist and his motorcycle prior to impact.

5. Car Driver did not see the motorcycle that was there to be seen. Car Driver was inattentive.

6. Motorcyclist's speed in excess of the speed limit was not a cause of Car Driver not seeing him when she started her turn.

7. Motorcyclist was alert and reacted promptly to the unexpected condition of Car Driver turning across his path.

8. Car Driver's inattentive driving was the cause of this crash.

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