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A Workable Solution for Reducing the Large Number of Vehicle and Pedestrian Accidents Occurring on a Yellow Light

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Abstract

Traffic intersections are incredibly dangerous for drivers and pedestrians. Statistics from both Canada and the U.S. show a high number of fatalities and serious injuries related to crashes at intersections. In Canada, during 2019, the National Collision Database shows that 28% of traffic fatalities and 42% of serious injuries occurred at intersections. Likewise, the U.S. National Highway Traffic Administration (NHTSA) found that about 40% of the estimated 5,811,000 accidents in the U.S. during the year studied were intersection-related crashes. In fact, a major survey by the car insurance industry found that nearly 85% of drivers could not identify the correct action to take when approaching a yellow traffic light at an intersection. One major reason for these accidents is the "yellow light dilemma," the ambiguous situation where a driver should stop or proceed forward when unexpectedly faced with a yellow light. This situation is even further exacerbated by the tendency of aggressive drivers to inappropriately speed up on the yellow just to get through the traffic light. A survey of Canadian drivers conducted by the Traffic Injury Research Foundation found that 9% of drivers admitted to speeding up to get through a traffic light. Another reason for these accidents is the increased danger of making a left-hand turn on yellow. According to the National Highway Traffic Safety Association (NHTSA), left turns occur in approximately 22.2% of collisions—as opposed to just 1.2% for right turns. Moreover, a study by CNN found left turns are three times as likely to kill pedestrians than right turns. The reason left turns are so much more likely to cause an accident is because they take a driver against traffic and in the path of oncoming cars. Additionally, most of these left turns occur at the driver's discretion—as opposed to the distressingly brief left-hand arrow at busy intersections. Drive Safe Now proposes a workable solution for reducing the number of accidents occurring during a yellow light at intersections. We believe this fairly simple solution will save lives, prevent injuries, reduce damage to public and private property, and decrease insurance costs.

Keywords

Traffic Accidents, Yellow Light, Traffic Light, Signals, Intersection, Crashes, Collision, Traffic Fatalities, Traffic Injuries, Vehicles, Safety, Speed Limit, Driving, Pedestrians, Bicyclists, Motorcyclists, Caution Line, Yellow Light Dilemma, Left Hand Turn on Yellow, Distance, Smart Road Technology, Signs, Signage, Autonomous Vehicles, AVs, Road Safety, IoT, Internet of Things, Infrastructure, Accident Reduction, Driving Habits, Stop Line, Red Light Jumping, Pedestrian Safety, Caution Light, Stopping at Intersection, Safety at Intersections

1. Introduction

Traffic intersections can be incredibly dangerous for drivers and pedestrians. One study conducted by the U.S. National Highway Traffic Safety Administration (NHTSA) found that about 40% of the estimated 5,811,000 accidents that occurred in the United States during the year studied were intersection-related crashes [1].

Moreover, the U.S. Federal Highway Administration has found that more than 50% of the combined total of fatal and injury crashes occur at or near intersections [2]. Many of these involve someone taking a left turn at the intersection.

Similarly, in Canada, according to the National Collision Database (looking at data for the year 2019), 28% of traffic fatalities and 42% of serious injuries occurred at intersections [3].

One of the major identifying characteristics of intersection-related crashes is the presence of a traffic control device or traffic light. A traffic control device presents two major problems that frequently contribute to accidents at intersections:

- Yellow light dilemma;
- Left-hand turn on Yellow.

This paper proposes a workable solution for reducing the large number of vehicle accidents occurring at intersections during a yellow light, especially as a result of the yellow light dilemma or a left-hand turn on yellow.

This solution is also expected to integrate well with and have a positive impact on both current and future smart road technology development efforts.

2. Two Major Problems

2.1. Yellow Light Dilemma

The "yellow light dilemma"—whether a driver should stop or proceed forward when unexpectedly faced with a yellow light—is a frequent contributor to intersection crashes at a traffic light.

An article that appeared in the Canadian Underwriter explains it quite succinctly: "If you are far away from an intersection (*i.e.* 10 seconds away) when traffic signals change from green to yellow, the decision to stop your vehicle is obvious and there is no dilemma. Further, if your vehicle is positioned nearly within the intersection when the light changes from green to yellow, the decision to proceed into the intersection is also obvious since it is physically impossible to stop your vehicle before encroaching into the intersection. However, there is a region between these two areas in which the decision to stop or go is less clear; this region is the dilemma zone" [4].

This situation is even further exacerbated by the tendency of aggressive drivers to inappropriately speed up on the yellow just to get through the traffic light. A survey of Canadian drivers conducted by the Traffic Injury Research Foundation found that 9% of drivers admitted to speeding up to get through a traffic light [5].

Yellow traffic lights pose one of the more dangerous obstacles that people encounter on the road. A major survey by the car insurance industry found that nearly 85% of drivers could not identify the correct action to take when approaching a yellow traffic light at an intersection [6].

2.2. Left-Hand Turn on Yellow

In addition to the yellow light dilemma, there are also many accidents attributable to the confusion of making a left-hand turn on yellow. For drivers in the U.S., turning left is one of the most dangerous moves on the road. Approximately 61% of all crashes that take place at intersections involving a left-hand turn [7]. This would also include left turns on a yellow light where there is a traffic control device.

According to the National Highway Traffic Safety Association (NHTSA), left turns occur in approximately 22.2% of collisions—as opposed to just 1.2% for right turns. Moreover, a study by CNN found left turns are three times as likely to kill pedestrians than right turns.

The reason left turns are so much more likely to cause an accident is because they take a driver against traffic and in the path of oncoming cars. Additionally, most of these left turns occur at the driver's discretion—as opposed to the distressingly brief left-hand arrow at busy intersections.

The number of accidents, fatalities, and injuries related to these accidents have prompted many experts to recommend limiting certain types of left-hand turns and increasing the duration of time for a yellow light. Most of these proposals have fallen on deaf ears.

Below is a workable solution for reducing the number of accidents occurring during a yellow light at intersections that addresses both the yellow light dilemma and making a left-hand turn on yellow. The authors of this white paper believe this fairly simple solution will save lives, prevent injuries, reduce damage to public and private property, and decrease insurance costs.

The solution involves placing a yellow "caution line"—using standard paint or reflective materials—on the road a specific distance before the actual intersection or zebra crossing.

When there is a yellow light, cars that have already passed or are passing the caution line are safe to proceed through the yellow light. Cars that are behind the caution line during a yellow light should prepare to stop at the light.

3. Calculations

The suggested distance for placement of the yellow caution line on the road should be approximately **50 meters** before the intersection or zebra crossing. This distance has been calculated as follows—based on an assumed driving speed of 60 kilometers per hour (KMPH):

$$60\frac{\text{km}}{\text{h}} = \frac{60,000\text{ m}}{3600\text{ s}} = 16.66\text{ m/s}$$

$$\text{Yellow light duration} = 3\text{ sec}$$

$$\text{Distance} = \frac{16.66\text{ m}}{\text{s}} * 3\text{ sec} = 49.99\text{ m}$$

This calculation was made assuming ideal and smooth driving conditions. However, it may not be applicable for some of the following circumstances or examples:

- Snow, wet, or icy conditions;
- Traffic congestion;
- Slow or faster than allowed speed limit range;
- Emergency vehicle at the intersection or passing by.

3.1. Design

With this solution, there is the ability to make improvements and adjustments as needed. Caution line distances can be adjusted to match different speed limits, conditions, weather, rules, driving habits, infrastructure, expectations, and the government's need to meet specific results.

The use of a caution line would also make infrastructure more future-ready for autonomous vehicles (AVs) using smart roads and intersections. Through the implementation of smart road technology, future designs or iterations of a caution line can incorporate different visual patterns, as shown in **Figure 1**, while leveraging Internet of Things (IoT) sensors that can be adjusted to improve efficiency and accuracy as required.

These IoT sensors can also gather information and provide analytics about intersections with high collisions. It can help planners determine other mitigating measures that might be taken to increase road safety involving signals, signage, or speed limit changes.

Ultimately, smart road equipment deployed in intersections—such as a caution line activated with IoT sensors—can also provide alerts that enhance safety for vulnerable road users including pedestrians, bicyclists, and motorcyclists.

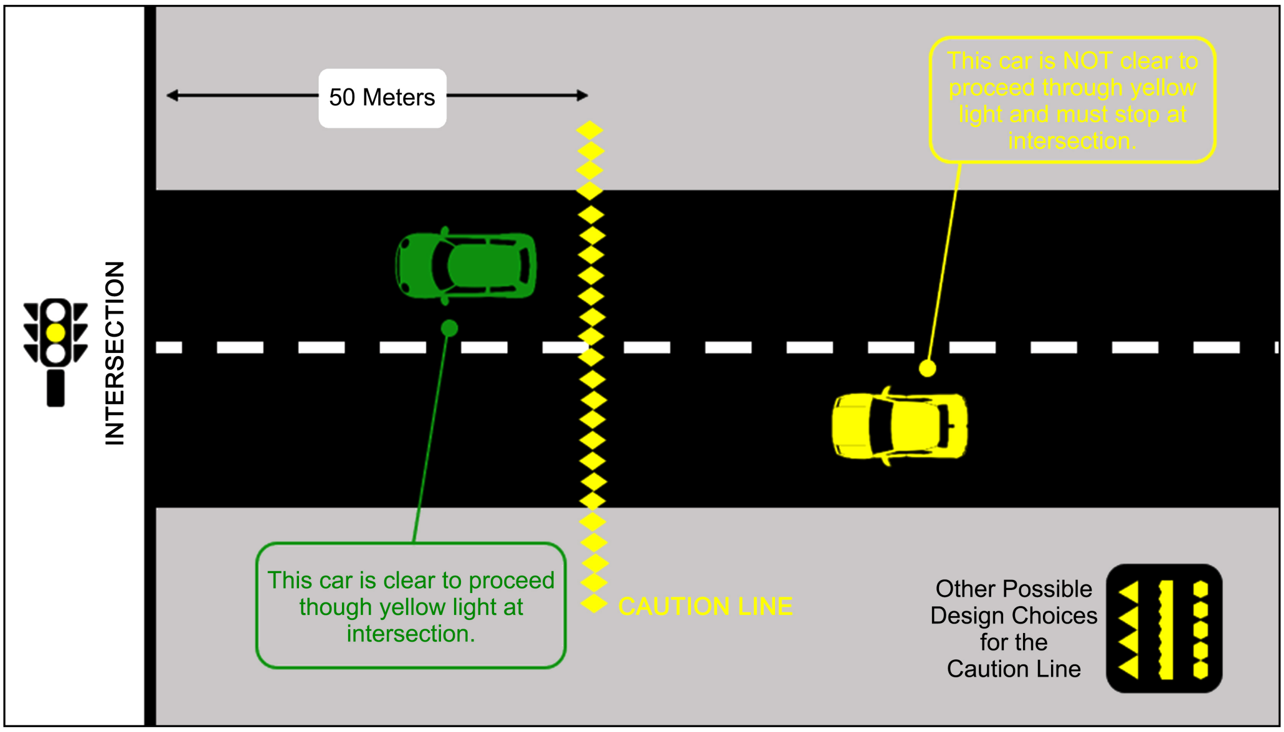

Figure 1. Schematic diagram for the caution line and other possible design choices.

3.2. Conclusions

A well-designed caution line placed 50 meters before an intersection will provide a secondary signal to a driver about the best course of action to take while approaching a traffic signal that is in the yellow light phase.

The solution involves placing a yellow "caution line"—using standard paint or reflective materials—on the road a specific distance before the actual intersection or zebra crossing. When there is a yellow light, cars that have already passed or are passing the caution line are safe to proceed through the yellow light. Cars that are behind the caution line during a yellow light should prepare to stop at the light. The suggested distance for placement of the yellow caution line on the road should be approximately 50 meters before the intersection or zebra crossing. Caution line distances can be adjusted to match different speed limits, conditions, weather, rules, driving habits, and infrastructure.

To learn more, the authors of this paper invite you to contact them at inquiry@drivesafenow.com or (647) 574-3101.

4. Authors and Affiliations

Pranav Gupta is an engineer and business development executive, brings 15 years of experience in product development, program management, and manufacturing to his company Drive Safe Now.

As a recognized expert, he has worked extensively with a range of lighting, optics, and spectroscopy equipment along with other new technologies including an earthquake simulation system. He is most excited to develop and provide practical solutions for reducing risk and preserving human lives through the introduction of safety-first features to products and processes.

Dr. Silki Arora is an educator and counselor, has dedicated 20+ years to "shaping and transforming" lives for the better on many fronts. With outstanding organizational and problem-solving skills, she specializes in providing customized action plans for unlocking human potential and maximizing results.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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