Name: _____ Date: _____

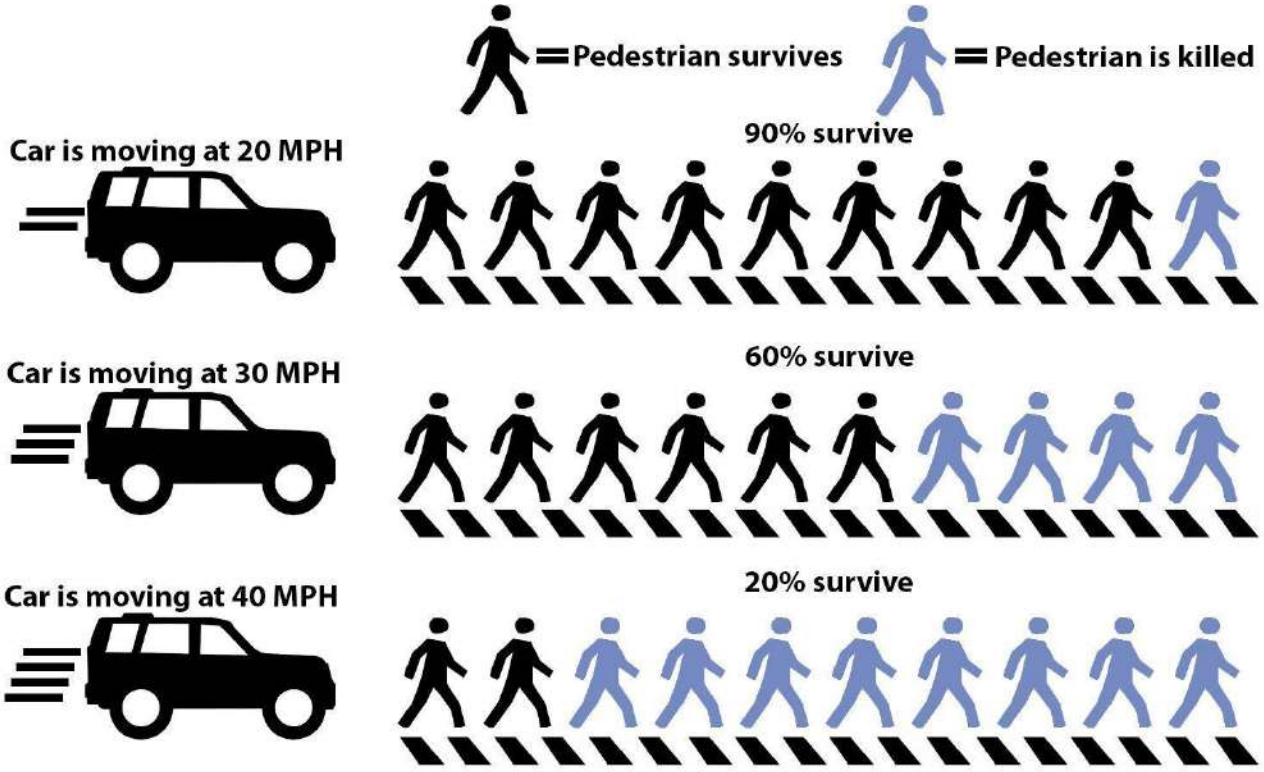
Engineering Faster Reaction Times

Student Content Advisory

This reading presents data on traffic accidents and fatalities. You can refer to the reference your teacher provided for strategies you can apply if you are feeling distressed. If you need social or emotional support, please let your teacher know privately so that they can connect you to additional resources. Be aware that your teacher and/or your classmates may have experienced trauma related to this topic. Approach conversations about car crashes and car safety with respect, guided by your class's community agreements.

Why are faster reaction times important?

According to the Centers for Disease Control (CDC), a government agency that tracks risks to public health, nearly 8,000 pedestrians were killed after being hit by a car in the United States in 2021. That is about one death every 66 minutes. One in six people who died in crashes in 2021 were pedestrians. What can scientists, engineers, and policy makers do to prevent these devastating tragedies?



Data Source: Tefft (2011)

Pause to reflect: *According to the infographic, does speed make a difference in determining whether a pedestrian will survive a collision with a moving car? How can you tell?*

Reaction time is a major factor in determining whether a situation will become fatal. A longer reaction time means hitting the brakes later, resulting in less opportunity to slow down or even stop before a collision. Ideally, a driver will stop the vehicle before a collision occurs. Although, any amount of slow down improves outcomes. The infographic above shows that a pedestrian who gets hit by a car moving at 20 mph is more than four times more likely to survive than a pedestrian who gets hit by a car moving at 40 mph.

Pause to reflect: *What design solutions do you know about that help drivers stop or slow down more quickly in the event of a possible collision?*

Design Solution 1: Speed Limits

One of the simplest and most effective ways to help drivers stop or slow down more quickly is to set a speed limit. The recommended speed limit on a road is based on many factors, including road conditions, visibility, and public opinion.

The time it takes a car to stop can be broken into two periods of time: the *reaction time* and the *braking time*. How far a vehicle travels during the reaction time, known as *reaction distance*, is determined by the speed the car is traveling multiplied by the reaction time. Speed limits may not be able to change our reaction times if we are distracted, but they can decrease the reaction distance that the car moves in that time. This can give drivers a chance to slow down or stop.

Although people often drive faster than the speed limit, if the limit is raised, they will go even faster. Research shows that when speed limits are raised, speeds go up and so do fatal crashes. Lowering speed limits has the opposite effect, slowing people down and saving lives. In 2021, a total of 12,330 deaths, or 29 percent of all motor vehicle fatalities, occurred in speed-related crashes in the United States.

Design Solution 2: Enforcement Cameras

Studies have shown that cameras that can automatically ticket drivers who are speeding can save lives by reducing speeds. People see the cameras and do not want a ticket, so they slow down and obey the speed limit.

But a recent analysis of millions of citations in Chicago, IL, found that households in majority Black and Hispanic zip codes received tickets at around twice the rate of those in white areas between 2015 and 2019. A local political representative from Chicago, Daniel La Spata, insisted that tickets from speed cameras were still important to reduce speeds and save lives, but that "Black and Latino Chicagoans tend to live in the most car-dependent areas, they tend to live in the communities that have the least complete streets and infrastructure" and that this means that these communities are unfairly impacted by fines. This is an example of a design solution that might protect some drivers but has unintended consequences for others.

Design Solution 3: Collision Avoidance Systems

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Collision avoidance systems use a variety of sensors to detect the distance between your car and the car in front of you. This is called the *following distance*. If the system detects that you are getting too close, it will alert you and may even apply the brakes to help you avoid a collision. The system will adjust the following distance based on a number of factors, including the speed of your car, the speed of the car in front of you, and the road conditions. For example, if you are driving very fast, the car will make the following distance longer so that you have more time to slow down.

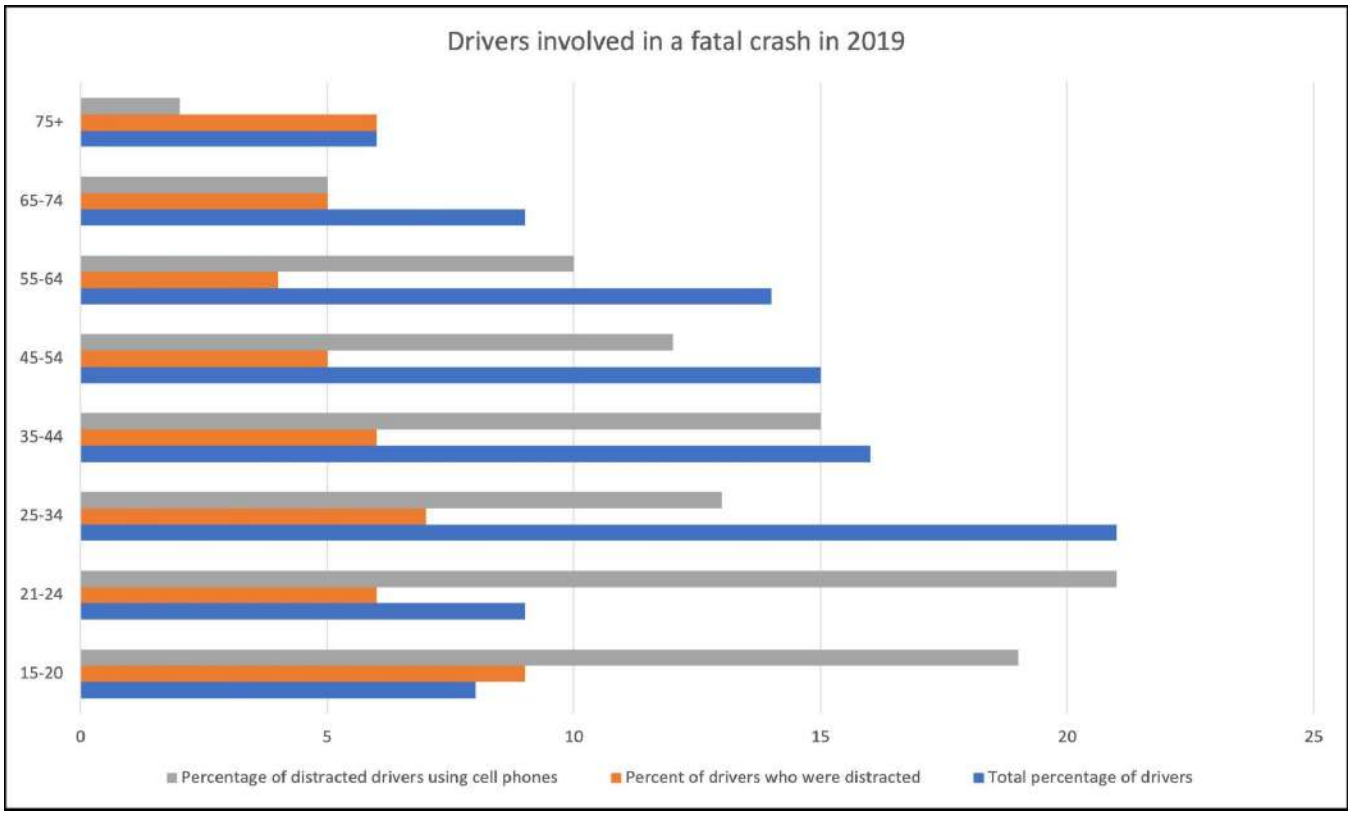
These systems have become an integral part of modern vehicles, not only enhancing safety but also paving the way for the future of autonomous driving. But a collision avoidance system is an expensive option that is only available on newer cars. It is difficult or impossible to install in older cars. Because of this, many drivers will not have access to this life-saving technology.

Pause to reflect: *Why would the ideal following distance be longer if the car is moving faster?*

Design Solution 4: Do-Not-Disturb Phone Settings

Increased cell phone use is likely a major factor in the trends we have seen in vehicle collisions over the past decade. According to a 2019 CDC study, 39% of high school student drivers surveyed reported texting or emailing while driving at least once in the previous 30 days. The survey found that texting or emailing while driving was more common among older students than younger students and more common among white students (44%) than Black (30%) or Hispanic students (35%). Texting or

emailing while driving was just as common among students whose grades were mostly As or Bs as among students with mostly Cs, Ds, or Fs.



Data Source: Fatality Analysis Reporting System (FARS), National Highway Traffic Safety Administration (2020)

Newer cell phone models offer a feature where drivers can choose to turn off certain notifications while driving, making it less likely that they will be distracted by a new text or social media update. If all drivers turned on this option, it could save thousands of lives. But again, there are major constraints on this type of technology. The technology is not automatic and requires the driver to opt in. Some people do not opt in, and some people do not know about the feature. According to the CDC, those drivers who report using their cell phones while driving also report other risky driving behaviors, such as not using a seat belt, so it is less likely that these drivers will choose to utilize the do-not-disturb settings.

Pause to reflect: *How might this technology benefit some people more than others?*

Design Solution 5: Advertising Campaigns

Advertisement efforts aim to prevent cell phone use while driving by increasing the perceived risk of getting a ticket. Officials create ads and billboards to convince people to not use their cell phone. There are major

constraints to this strategy. Fines are not a deterrent for drivers who have a lot of money and other resources at their disposal, leading to inequitable outcomes. In addition, according to the CDC, drivers who report using their cell phone while driving also report other risky driving behaviors, such as not using a seat belt, so it is less likely that these drivers will respond to advertisement campaigns.

Sources:

Centers for Disease Control and Prevention (CDC). (2022). Distracted Driving. Retrieved from https://www.cdc.gov/transportationsafety/distracted_driving/index.html

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Vlachos, G., Papanastasiou, S., Charissis, V. (2008-04-14). "Comparative Study of Prototype Automotive HUD vs. HDD: Collision Avoidance Simulation and Results". *SAE Technical Paper Series*. Vol. 1. doi:10.4271/2008-01-0203.

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