Road Safety Fundamentals

UNIT 2: Human Behavior and Road Safety

Concepts, Strategies, and Practices that Reduce Fatalities and Injuries on the Road

U.S. Department of Transportation
Federal Highway Administration

Road Safety Fundamentals: Concepts, Strategies, and Practices that Reduce Fatalities and Injuries on the Road

Updated June 2017

Produced by the Federal Highway Administration,
Office of Safety Research and Development
Through the Highway Safety Information System

Project Manager: Felix H. Delgado, P.E., Program Manager,
Roadway Safety Professional Capacity Building Program,
FHWA Office of Safety, (202) 366-9156, felix.delgado@dot.gov

By contract with the University of North Carolina
Highway Safety Research Center

Lead Editor: Daniel Carter, P.E., Senior Research Associate,
UNC Highway Safety Research Center

Unit Authors

Unit 1: Dan Gelinne, Program Coordinator, UNC Highway Safety Research Center

Unit 2: Bevan Kirley, Research Associate, UNC Highway Safety Research Center

Unit 3: Carl Sundstrom, P.E., Research Associate, UNC Highway Safety Research Center

Unit 4: Raghavan Srinivasan, Ph.D., Senior Transportation Research Engineer; Daniel Carter

Unit 5: Daniel Carter; Jennifer Palcher-Silliman, Communications Manager,
UNC Highway Safety Research Center

Layout and Graphics: Graham Russell, Graphic Designer, UNC Highway Safety Research Center

Technical Editors: Jennifer Palcher-Silliman; Patty Harrison, Communications Specialist,
UNC Highway Safety Research Center; Caroline Mozingo, Senior Manager of
Communications, Education and Outreach, UNC Highway Safety Research Center

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INTRODUCTION

This document is a single unit extracted from a full book consisting of five units. See the Table of Contents for an overview of the topics addressed in the other units. The full book can be accessed online at the FHWA Roadway Safety Professional Capacity Building website: https://rspcb.safety.fhwa.dot.gov.

This book provides an introduction to many of the fundamental concepts of road safety. These concepts cover areas such as the nature of road safety issues, human behavior in the road environment, and identifying and solving road safety problems. The goal of this book is to equip the reader with a broad base of knowledge about road safety. Thus, the focus of the text is in communicating concepts rather than providing instruction in detailed analysis procedures.

The audience for this book is two-fold. First, this is intended for those whose job addresses some aspect of road safety, particularly in a public agency setting. This is especially relevant for individuals who have been tasked with managing road safety but who do not have formal training in road safety management. In order to show practical applications of each road safety concept, this book contains many examples that demonstrate the concepts in real-world settings. Second, this book is intended for professors and students in a university setting who can use individual units or this entire book to add an emphasis on road safety as part of graduate-level work. Each unit provides learning objectives and sample exercises to assist professors as they incorporate content into their courses.

As a final note, this book is intended to lay the foundation of road safety knowledge regardless of a particular discipline. Professionals with a background in engineering, planning, public health, law enforcement, and other disciplines will benefit from the concepts presented here.

ABOUT THIS BOOK

This book is divided into five units according to major topics of road safety knowledge. Each unit is divided into multiple chapters that address the primary concepts of the unit. The beginning of each unit provides a list of learning objectives that indicate what the reader will be able to understand, describe, identify, or otherwise do by the end of the unit.

Each chapter presents call-out boxes, glossary definitions, and references as shown below.

A **Call-out boxes** are provided throughout the book to provide examples of concepts presented in the chapter.

Secretary Hoover called a second conference for March 1926. During the interim between the two conferences, a special committee drew up a model "**Uniform Vehicle Code**" covering registration and titling of vehicles, licensing of drivers, and operation of vehicles on the highways. The code incorporated the best features of the numerous and varied State laws then on the statute books. The second conference approved this code and recommended it to the State legislatures as the basis for uniform motor vehicle legislation.

Studies following this 1926 conference concluded that determining the causes of crashes was far more difficult than they had presumed. The problem warranted a sustained program of research by a national organization. The Conference agreed, and the Highway Research Board (HRB) organized the Committee on Causes and Prevention of Highway Accidents to coordinate crash research nationwide. The HRB played a major part in subsequent efforts to reduce the consequences of crashes.[8]

Federal Government Role in Highway Development

The growing use of motor vehicles during the 1920s was mirrored by the expansion of the Federal Government's role in funding and building roads. In its early form, the Office of Public Roads was organized under the U.S. Department of Agriculture, playing a large role in funding roadways within national parks and forests.

Following the Federal Aid Road Act of 1916, this office would become the Bureau of Public Roads (BPR), charged with working cooperatively with State highway departments on road projects. Work continued on the expansion of highways across the country, and between 1921 and 1939, the distance of paved roads

Balanced Design for Safety

In the 1920s and 1930s, it was good engineering practice to design new highways as much as possible in long straight lines or "tangents." When it became necessary to change direction, the engineer laid out a circular curve, the radius of which he selected to fit the ground with the least construction cost, but which could not be less than a certain minimum fixed by department policy. In practice, engineers made the curves sharper than this minimum when it was cheaper to do so, but with little consistency. Engineers expected motorists driving these roads to adjust their speeds to the varying radii, and on the sharper curves safe design speed might be considerably lower than the posted speed limit.

Increasing concern for road safety led many highway engineers to worry about this inconsistency between posted speed limits and safe design speed on curves. In 1935, highway engineer Joseph Barnett of the BPR proposed that all new rural roads conform to an "assumed design speed," a comfortable top speed for drivers outside of urban areas.

With its adoption by American Association of State Highway Officials in 1938, Barnett's "balanced design" concept became a permanent feature of U.S. roadway design. Today, standards for designing curves, such as design speed, curve radius and superelevation (the tilt of the road through a curve) are provided in A Policy on Geometric Design of Highways and Streets, produced by the American Association for State Highway Transportation Officials.

Uniform Vehicle Code

A code covering registration and titling of vehicles, licensing of drivers, and operation of vehicles on the highways.

8 Source: *America's Highways, 1776-1976: A History of the Federal-Aid Program*. Federal Highway Administration (U.S. Government Printing Office, Washington D.C., 1976).

ROAD SAFETY FUNDAMENTALS UNIT 1: FOUNDATIONS OF ROAD SAFETY 1-13

B **Glossary definitions** are provided along the side of the page. These correspond to words in bold face in the page content.

C **References** to source material are provided along the side of the page. These are numbered consecutively through the unit and correspond to numbers in the page content.

UNIT 2

Human Behavior and Road Safety

LEARNING OBJECTIVES

After reading the chapters and completing exercises in Unit 1, the reader will be able to:

- **EXPLAIN** the systems that drive human behavior and give examples of each
- **EXPLAIN** why it is important to consider the nature of human behavior when designing and implementing systems or programs

Understanding Human Behavior

Introduction

Guinea worm disease is a parasitic infection that occurs in remote parts of Africa. Symptoms of Guinea worm disease can be debilitating and lead to secondary infections, both of which can affect an infected person's ability to perform everyday tasks including working, harvesting food and caring for children. The disease is caused by drinking water contaminated with Guinea worm larvae. When a worm is mature, it creates a painful blister on the infected person's skin. If the person immerses the affected body part in water, it can temporarily relieve the pain from the blister. However, this also allows the worm to release eggs into the water, continuing the infection cycle by spreading the disease to others[1].

There were 3.5 million cases of Guinea worm disease throughout the world in 1986. By 2015, there were only 22 cases. In 30 years the disease has been nearly eradicated — the only human disease to be eradicated besides smallpox[2,3]. How were such large advances made in only 30 years, and what does this have to do with road safety?

Unlike smallpox, there are no known medicines or vaccines that prevent Guinea worm disease. Eradication, therefore, required a different approach: changing human behavior.

The Human Factor

A report from the National Cooperative Highway Research Program (NCHRP) defines "human factors" as follows:

Human factors is an applied, scientific discipline that tries to enhance the relationship between devices and systems, and the people who are meant to use them. As a discipline, human factors approaches system design with the "user" as its focal point. Human factors practitioners bring expert

1 Cairncross, S., Muller, R., and Zagaria, N. (2002). Dracunculiasis (Guinea Worm Disease) and the Eradication Initiative. *Clinical Microbiology Reviews, 223-246.*

2 World Health Organization and the Carter Center, Eradication of Guinea Worm Disease: Case Statement, 2016. Available at: https://www.cartercenter.org/resources/pdfs/health/guinea_worm/2016-gw-case-statement.pdf

3 WHO, Dracunculiasis Fact Sheet. May 2016. Available at: http://www.who.int/mediacentre/factsheets/fs359/en/

knowledge concerning the capabilities and limitations of human beings that are important for the design of devices and systems of many kinds.[4]

In road safety, the term human factors is typically used to describe how people respond to the roadway environment. However, people are not simply users of the transportation system. Humans also design, engineer, build and maintain the roadway environment, the vehicles using it and the laws governing behavior of roadway users and vehicle manufacturers. In that sense, the entire transportation system is a product of human factors. The term human factors conveys an oversimplified notion of the role of human behavior in transportation safety. The human part of the equation is more complex than simply a list of discrete factors.

Key Principles of Human Behavior

To understand human behavior, it is important to bear in mind four key principles.

- Human behavior is guided by two different systems (deliberative and intuitive).
- Humans are not exclusively logical, rational beings.
- Human behavior is heavily influenced by the environment.
- Humans make mistakes.

Let's discuss these concepts as they relate to road safety.

Human behavior is guided by two different systems

Human behavior is largely guided by two different systems – a deliberate, rational system (deliberative) and an implicit, unconscious system (intuitive)[5].

The deliberative system is a conscious system wherein a person considers information using rational thought, logic and reasoning in deciding on an action.

For example:

When driving home after work, a driver decides to change routes to avoid an area that is usually congested at this time of day.

In this example, the driver considered the available information (time of day and previous experience with that location) and made a conscious decision to take another route.

The intuitive system is an implicit, unconscious process by which a person makes nearly instantaneous decisions and takes a resulting action.

For example:

As a driver approaches a signalized intersection, the light turns yellow. Without conscious thought, the driver either proceeds through the intersection or comes to a stop.

In this example, the driver receives information from the environment (the yellow light), combines it with an understanding of the specific circumstance based on the driver's previous experiences, and takes an action almost immediately. It is important to realize the intuitive system acts nearly instantaneously without the driver's awareness of the process.

4 John L. Campbell, Monica G. Lichty; et al. (2012). *National Cooperative Highway Research Program Report 600: Human Factors Guidelines for Road Systems (Second Edition).* Washington, D.C.: Transportation Research Board.

5 Kahneman, D. (2011) Thinking, Fast and Slow. Farrar, Straus and Giroux

We often incorrectly assume that human behavior is largely controlled by the deliberative system when, in fact, most behaviors are a result of the intuitive system. In other words, most human behavior is not the result of conscious, rational deliberation. For most actions, we don't have enough time or available information to do a logical analysis before acting. The intuitive system allows us to act without this time-consuming conscious decision-making process.

To think of this another way, consider the deliberative system as similar to the decision making process of a computer. Computers function exclusively using a deliberative system. They take in information, process it using explicit algorithms and deliver a result. However, humans do not function this way. They generally make decisions that appear to reflect instinctual processes rather than systematic rational considerations.

Humans are not exclusively logical, rational beings

Although people take in and interpret information, they do so in the context of a number of factors, such as prior experience, emotions, cultural norms, moral beliefs, social pressures, convenience, habits and financial considerations, among many others. Rational calculations based on objective evidence are often not even possible, and when they are, they must compete with these other influences. This is why people often make decisions that are not necessarily the most appropriate choice for their health and well-being.

We know that cooking dinner at home may be healthier, but sometimes it is easier and more convenient to have a pizza delivered instead. We know we should exercise more and get the recommended amount of sleep each night, but work, family and other obligations

Flossing and human behavior

At some point in your life, you have probably been told that regular flossing is good for your dental health. Through the years, you've likely had conversations about flossing with your dentist or dental hygienist who encouraged you to floss more. Perhaps they showed you the proper way to floss and sent you home with your own floss in an effort to encourage you to start. For a few days or weeks after the appointment, you may have deliberately flossed more regularly. But if you're like most people, you soon reverted to old habits, and the floss sat unused in a cabinet. Why do we do this?

Typically, programs aimed at influencing human behavior take an educational or informational approach on the assumption that people act a certain way because they lack knowledge about the potential consequences, benefits or alternatives. Surely, if people simply were aware of the benefits of flossing or the consequences of not flossing, they would change their behavior and become regular flossers. This approach appeals to the belief that human behavior is rational.

Although commonly used, this approach fails to take into account the complexities of human behavior. Other factors influence our behaviors – flossing is inconvenient, takes time and can be uncomfortable. The negative consequences of not flossing (e.g., gum disease) are not immediately visible. Although people repeatedly hear messages explaining why flossing is important, rates of flossing among the general population remain low.

can make this difficult. We know we should get a flu shot, but a fear of needles may keep us away.

Humans are largely intuitive beings which means their actions are rarely the result of a systematic, rational decision making process. For years, many people did not brush their teeth daily, even though the benefits of brushing were widely known. It was not until mint flavoring was added to toothpaste that daily brushing became the norm. That is, information about the benefits of brushing did little to change behavior; what convinced people to brush was a desire for the clean feeling they associated with the mint.[6] Because the factors that affect human behavior are complex and interrelated, behavior is not easily changed. When attempting to change the behavior of others, we tend to assume that people are entirely logical and rational beings. However, experience repeatedly shows this is not the case.

This situation is not unique to dental hygiene. We regularly do things that we generally realize are not in our best interest. We don't eat the recommended amounts of fruits and vegetables. We don't get enough sleep. We don't exercise as much as we should. Think about examples from your own life.

Human behavior is heavily influenced by the environment

Often the environment has a much stronger influence on a person's behavior than internal conditions (e.g., attitudes and personality) commonly assumed to be influential. The environment includes the physical environment, as well as social and organizational contexts, such as policies and social norms.

Given that most behavior is intuitive, people generally do not know the true reasons for their actions, nor can they validly articulate what might influence their actions. People can usually provide explanations for their behavior after the fact, but research shows people are often not aware of the strong influence of environmental factors on their behavior. An example in Unit 1 of this book describes a town that aims to resurface and widen a two-lane collector roadway through

Optical Speed Bars

Optical Speed Bars (OSBs) have shown promise in reducing vehicle speeds in advance of hazardous locations[7]. OSBs are a series of white rectangular markings, placed just inside both edges of the travel lane and spaced progressively closer, to create the illusion of increasing speed when traveling at a constant rate as well as the impression of a narrower lane[8]. A compelling characteristic of optical speed bars is that they operate on intuitive, rather than conscious, decisions made by drivers/riders. By creating a sense of increasing speed as riders approach a dangerous curve, they should induce riders to slow down – as an instinctive reaction rather than a conscious decision.

6

Duhigg, Charles. The Power of Habit: Why We Do What We Do in Life and Business

7

Gates TJ, Qin X, Noyce DA. Effectiveness of Experimental Transverse-Bar Pavement Marking as Speed-Reduction Treatment on Freeway Curves. In Transportation Research Record: Journal of the Transportation Research Board, No. 2056, Transportation Research Board of the National Academies, Washington, D.C., 2008, pp. 95–103.

8

Federal Highway Administration. Engineering Countermeasures for Reducing Speeds: A Desktop Reference of Potential Effectiveness. http://safety.fhwa.dot.gov/roadway_dept/horicurves/fhwasa07002/ch7.cfm.

Environment affects behavior

Research has shown that people are more likely to help another person (in a non-emergency situation) if they see someone else helping first. Social psychologist Robert Cialdini demonstrated this by counting donations given to a street musician with and without a colleague first modeling the behavior by donating money. He found that many more people gave the musician money when the behavior was modeled than in the control condition with no behavior modeling (eight donations in the modeled condition versus one donation in the control condition). Further, when people in the modeled condition were asked why they donated, no one realized that they had been influenced by the behavior of another person. Instead, they attributed their donations to something else, such as enjoyment of the song or how they felt about the person playing the music[9,10,11].

a neighborhood with mature trees. However, after completing the project, both speeds and crash severity increased. Behavioral adaptation refers to the unconscious process by which people react to their environment. While driving, people unconsciously assess the roadway and its characteristics and modify their behaviors accordingly.

This may seem counterintuitive, but as discussed, human behavior is an intuitive process that is heavily influenced by the environment. A wider road with limited roadside hazards feels safer and people unconsciously adapt their behavior accordingly. You should assume people would not maintain their original behavior when the driving environment is changed.

Roadway designers must design roads not for the way in which they would like users to behave, but for the way in which users actually will behave. In general, people don't just do what they are told to do — by a sign, a law or another person. Instead, they integrate information from many parts of their environment along with their own historical experience as they determine (usually non-consciously) what they should do in a given situation[12].

Humans make mistakes

Both our deliberative and intuitive systems can lead us to make mistakes. Actions reached by a deliberative process can be mistaken if we fail to consider all relevant information or if we process it incorrectly. Similarly, our intuitive system can lead to errors in situations with which we have little or no experience. Experience helps to refine the intuitive processes, so the likelihood of mistakes declines with exposure to situations. However, mistakes are inevitable and the transportation infrastructure needs to be designed with the recognition that road users will make mistakes and that they will often make them in predictable ways.

Have you ever looked down at your speedometer and realized that you were driving substantially over the speed limit? You probably didn't make a conscious (deliberative) decision to exceed the speed limit. Instead, you reached that speed by taking cues about the proper speed from your environment (intuitive). Characteristics of the road, such as wide lanes, multiple travel lanes, presence of a median and long gentle curves, convey the message

9

Cialdini. R.B. (20005). Basic Social Influence Is Underestimated. Psychological Inquiry, 16: 158-161

10

Cialdini, R.B., Demaine, L.J., Sagarin, B.J., Barrett, D.W., Rhoads, K., & Winter, P.L. (2006). Managing social norms for persuasive impact. Social Influence, 1: 3-15

11

Cialdini, R.B. (2007). Descriptive social norms as underappreciated sources of social control. Psychometrika, 72: 263-268

12

Etzioni, Amitai. Human Beings Are Not Very Easy To Change After All, Saturday Review, June, 1972.

FIGURE 2-1: Example of unconscious clues leading to higher speed

that the road can accommodate high speeds. Additionally, the speed of other vehicles is a particularly salient indicator of the right speed.

Recall this example from Unit 1 (Figure 1-1). Although the posted speed limit is 35 mph, many people drive much faster than that. This is not because they all have a blatant disregard for safety. Instead, they are unconsciously taking cues from their environment, which is telling them it is safe to travel at a higher speed. Add to this the fact that modern vehicles have been engineered for occupant comfort, so many of the auditory and haptic cues (e.g., wind noise, bumps, road noise, etc.) that previously gave drivers feedback about their speed have been eliminated. On a road with very few other vehicles, the only clear clue to one's speed is the speedometer.

Roads constructed according to the recommended design standards may be considered safe, but in reality, they may only be nominally safe. The fact that some road designs encourage higher speeds can make it substantively unsafe. The transportation system is designed, built, maintained, governed and used by humans. It is often cited that human error contributes to more than 90% of traffic crashes, most often referring to a road user error. However, it is important to remember that errors by road users are not the only human errors that can occur.

For example:

On a rural two-lane road, an SUV driver over-compensates when a tire slips off the roadway causing the vehicle to roll over and strike a tree on the opposite side of the road.

Where was the human error in this example? Was it in the driver who didn't stay on the road and overcompensated with steering? Was the road maintained improperly or inadequately? Could the crash have been prevented if edgeline rumble strips had been installed, or if the road had a paved shoulder instead of a soft gravel shoulder? Should the tree next to the roadway have been removed? Could SUVs be designed so they are less susceptible to roll over? The answer is that a combination of several of these caused the crash, not simply the driver's error. Just as in airplane crashes, it is quite rare that any single factor in a motor vehicle crash was the sole reason for the crash or for its severity.

Meeting nominal safety does not guarantee that a crash will never occur, nor does it guarantee that users will behave in the intended way. Those in charge of the road should use professional judgement to prioritize safety improvements and select appropriate designs within a range of options based on consideration of road user behavior. Unit 3 discusses how many kinds of data, such as crash data and behavioral observation, can be used to evaluate the substantive safety of the road.

EXERCISES

- **MAKE** a list of your own driving behaviors. What behaviors involve the deliberative system? What behaviors are intuitive?
- **WORK** with your state department of transportation to identify a crash cluster in your area. It's highly unlikely that many drivers have independently made the same mistake at the same location. What characteristics of the roadway — as designed or built — may have contributed to this cluster of crashes? What modifications might be made that would not be offset by behavioral adaptation?

Changing Human Behavior

Let's return to the Guinea worm disease example. You may be wondering why something so seemingly unrelated to improving safety in a modern transportation system was used to introduce this unit. The fact that Guinea worm disease is nearly extinct in only 30 years is a tremendous achievement. The fact that it was done through behavior change alone, without the use of vaccines or medication, is unprecedented.

Road safety professionals would be wise to consider the successful approach to eradicate Guinea worm disease. Although the desired behaviors may be different, the general strategies for influencing human behavior are the same.

Even though changing human behavior is exceedingly difficult, it is possible to achieve behavior change. However, this requires that we take into account the nature of human behavior instead of assuming that simply providing information is sufficient.

Understanding factors that influence human behavior

To change human behavior, it is important to identify and understand not only the target behavior but also any other factors that influence the behavior. Attempting to change a behavior without a full understanding of the many contributing factors will almost certainly fail.

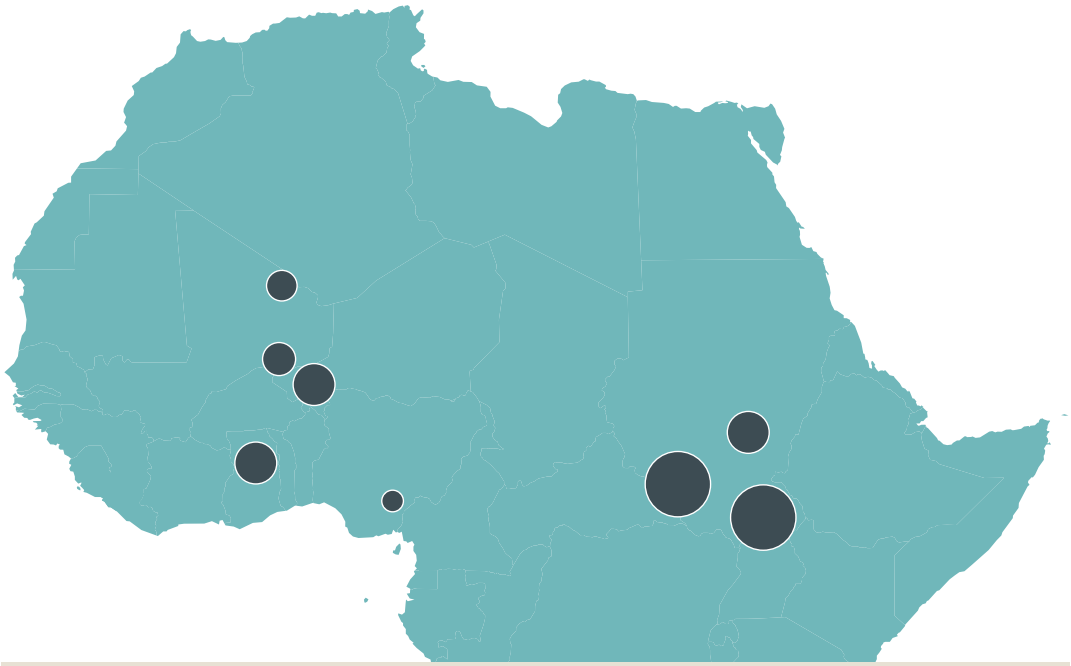

FIGURE 2-2: Guinea worm disease hotspots in Africa

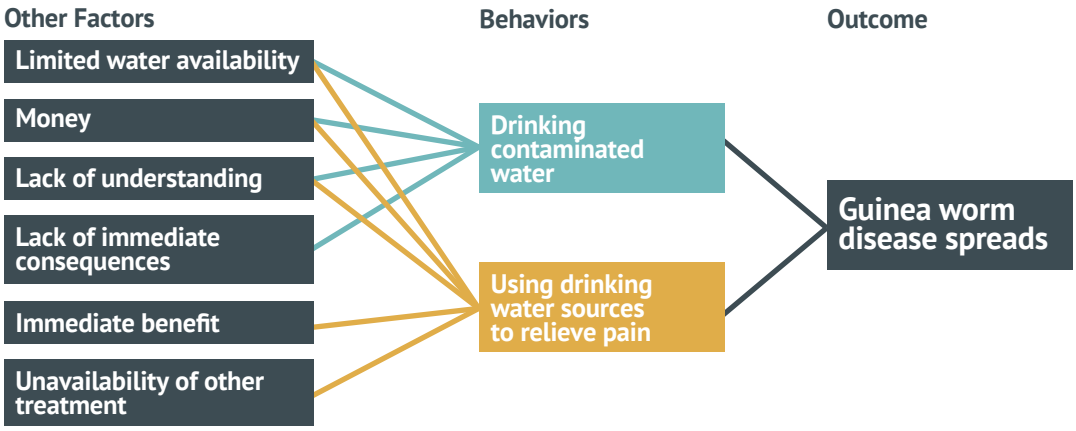

FIGURE 2-3: Guinea worm disease factors, behaviors and outcomes

Doctors knew that Guinea worm disease spreads by people drinking contaminated water, and contamination of the water supply occurred when an infected person used the water supply to temporarily relieve the symptoms of infection. Hence, the eradication campaign focused on two main behaviors:

- Drinking contaminated water
- Using drinking water sources to temporarily relieve the pain caused by the infection

Simply identifying these behaviors was not sufficient. In order to be successful, public health officials considered many other factors influencing these behaviors.

Why were people drinking contaminated water?

- **Availability** – Uncontaminated drinking water may not have been available in the community.
- **Money** – People and communities lacked financial resources to obtain clean drinking water.
- **Understanding** – People did not know that the water was contaminated and/or how the disease was transmitted.
- **Lack of immediate consequences** – Guinea worm disease symptoms did not appear until one year post-infection.

Why were people using drinking water to relieve the pain caused by the infection?

- **Immediate benefit** – Water submersion resulted in immediate pain relief.
- **Limited availability of water** – Because water is scarce, most water sources were used for drinking.
- **Unavailability of alternative treatments** – The lack of medical infrastructure meant limited access to treatment options.
- **Money** – People lacked financial resources to obtain medical treatment even when available.
- **Understanding** – People lacked knowledge about how the disease is transmitted.

A thorough understanding of the factors that influence behavior is necessary to develop a plan for behavior change.

To develop a plan, we cannot merely look for the cause of the outcome, instead we need to look for the weak links in the causal chain and intervene at these links. In the case of Guinea worm disease, the limited availability of water and lack of understanding about the disease and its transmission were factors influencing both behaviors. Thus, these factors were targeted in the intervention.

Public health officials informed the people about the dangers of drinking contaminated water and how the water was becoming contaminated. However, they knew that simply providing this information would not be sufficient.

In order to make the right behavior the easy choice, officials combined education with environmental change – they educated people on guinea worm disease and made clean water more accessible. Water sources known to be contaminated were treated to prevent transmission, and new clean water sources were created. When water sources could not be treated, villagers were given cloth filters to decontaminate their water before drinking. When people had access to clean water, they were less likely to drink contaminated water, thus significantly reducing the chance of infection[13]. This change to the environment (i.e., making clean water available) proved to be key in eliminating the disease.

While this is an oversimplified description of the complex and multifaceted approach that occurred over 30 years, it highlights what can be accomplished when principles of behavior change are at the core of a comprehensive approach.

13

Cairncross, S., Muller, R., and Zagaria, N. (2002). Dracunculiasis (Guinea Worm Disease) and the Eradication Initiative. *Clinical Microbiology Reviews, 223-246.*

Approaches to Changing Behavior

We are constantly exposed to attempts to influence our behavior. Consider the following things that you may encounter in everyday life:

- A brochure in your doctor's office about the benefits of getting a flu shot
- A requirement that restaurants include nutritional information in their menu
- Stores that charge for plastic shopping bags
- Public service announcements (PSAs) about bullying
- Cities that provide large recycling bins and small garbage bins
- A law requiring that everyone wear seatbelts

Most of these attempts either provide information (e.g., a brochure with information about flu shots or a PSA detailing the negative impact of bullying), or they change the environment in such a way to encourage a different behavior (e.g., stores that charge for plastic shopping bags or cities that provide large recycling bins and small garbage bins). Understanding the nature of the problem is important in determining which approach has the best chance of success.

Education, safety messages and raising awareness

Education and awareness-raising campaigns are often the first and only tools tried when attempting to influence behavior. In general, the goal of such campaigns is to communicate information with the

This tip card from the early 1900s was likely ineffective in changing the crossing habits of people since it relied solely on providing information.

assumption that once the audience is aware of the information, they will then act in the desired manner. In other words, educational campaigns appeal to the deliberative system and assume that human behavior is usually a product of rational thought. Because of this, information alone almost never works. However, information can be helpful as part of a more comprehensive program.

Far too often information-based approaches are used in isolation, without careful consideration of whether the problem can be effectively addressed through raising awareness alone. Is the information new to the audience? Is it likely that knowing this information will produce the desired outcome? To draw from a previous example: does simply knowing that you should floss convince you to floss regularly? Consider the effect of an educational campaign on Guinea worm disease. Would an educational or awareness raising campaign be enough to produce lasting and consistent behavior change? On the one hand, there was a lack of knowledge about the disease among those affected, especially about how the disease was transmitted. However, this education cannot influence the additional — and likely more important — factors contributing to the problem. For example, education will not improve the availability of clean drinking water or access to alternative medical resources, nor will it provide the financial resources necessary to increase access to either. Thus, an education campaign, on its own, would not have been a successful tactic. Instead, health officials needed a more comprehensive approach.

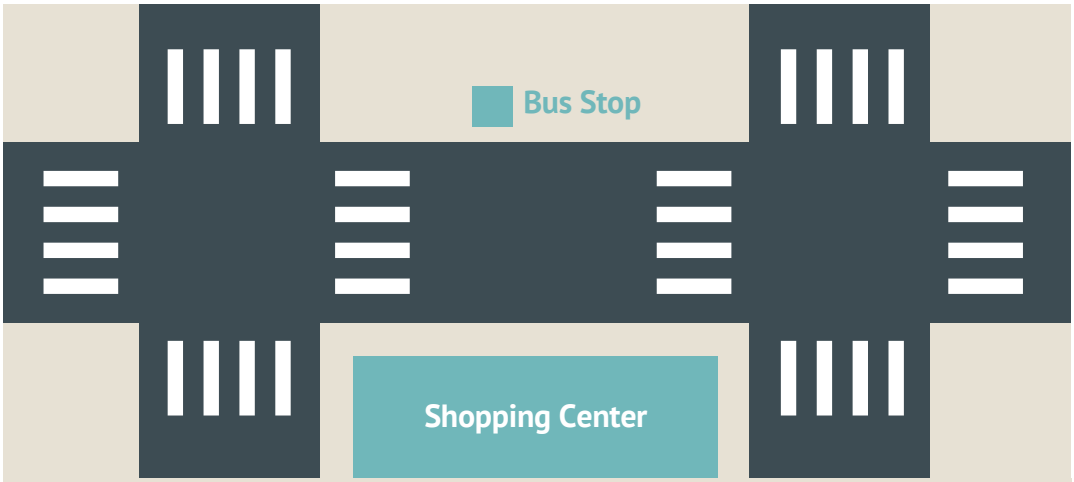

FIGURE 2-4: Example of shopping center and bus stop

The same considerations can be applied to road safety problems. Consider the following example:

Your city manager notices an increase in pedestrian crashes following the placement of a new bus stop on Elm Street, a busy multi-lane road without a median. The bus stop is located in the middle of the block across from a large shopping center (Figure 2-4). The nearby intersections on either side are signalized and have street lights, crosswalks and pedestrian signals. The intersection and crosswalks meet all applicable design standards and are therefore nominally safe. Although city engineers intended that people would cross the street at the intersections, observations show that many people are crossing mid-block from the shopping center to the bus stop, resulting in frequent conflicts with vehicles. The city wants to improve safety in this area and has decided to undertake a media campaign encouraging people to cross only at crosswalks.

What behavior is being targeted?

Crossing Elm Street midblock.

What are the other factors influencing this behavior?

- **Convenience** – Crossing mid-block provides a more direct route to the bus stop. People coming from the shopping center are likely carrying shopping bags, which could be difficult to carry long distances.
- **Previous experience** – It is likely that people have successfully crossed similar streets (or even the same street) in this manner many other times, so their limited previous experience suggests this is a safe option. (we say limited experience because people not likely to be aware of the location's crash history).
- **Time pressure** – Buses run on a schedule, and people may want to cross as quickly as possible to be sure they catch the next bus.

Is an educational or awareness raising campaign targeting this behavior likely to be effective? No. In all likelihood, people who are crossing the street in this spot know there are crosswalks at the nearby intersections. They are crossing the

street here because it is easier and more convenient, and their previous experiences tell them they will be successful. Additional information is unlikely to alter these factors; therefore an informational or awareness-raising campaign alone will not be effective. However, that does not mean that all hope is lost. Improving the safety of pedestrians crossing Elm Street is still possible with the right approach.

Changing the environment

A preferred alternative to education is changing the environment. We know that people act based on information gleaned from the world around them, and that most of our behavior is unconscious and driven by the intuitive system. By changing the environment, people can be moved towards the behavior of interest. In other words – if you can't change the person, change the world so that the person will follow.

We know that people are crossing Elm Street mid-block because it is quicker, easier and more convenient than using the crosswalks at the nearby intersections. Information or awareness campaigns are unlikely to influence this behavior because the behavior is not due to a lack of awareness or information. Instead, we need to change the environment so that the pedestrians are no longer crossing somewhere other than a marked crosswalk.

Possible changes to the environment include building a wall or putting up a fence to deter people from crossing at the mid-block, or building a pedestrian bridge to keep people out of the flow of traffic. These solutions might be cost prohibitive, and research shows that most pedestrians will still cross a street at ground level even when a pedestrian bridge is available.[14,15]

FIGURE 2-5: Pedestrian hybrid beacon *(Source: pedbikeimages.org/Mike Cynecki)*

14

Moore, R.L., Older, S.J., *Pedestrians and Motors are Compatible in Today's World.* Traffic Engineering, Institute of Transportation Engineers, Washington, DC, September, 1965.

15

Rasanen, M, T. Lajunen, F. Alticafarbay, and C. Aydin, *Pedestrian Self Reports of Factors Influencing the Use of Pedestrian Bridges*, Accident Analysis and Prevention, 39, pp. 969-973, 2007.

Another approach would be to move the bus stop closer to the existing crosswalks, assuming people will choose to cross at the crosswalk since it is now more convenient. Finally, another alternative would be to install a marked crosswalk with a pedestrian hybrid beacon close to the area where people are crossing (Figure 2–5). This solution recognizes the factors influencing people's behavior and provides an alternative that would improve safety and be acceptable to pedestrians.

We know that people respond in predictable ways to their environments — far more than to internal conditions like attitudes and personality. Environment can include both the physical (built) environment and things like policies, laws and social norms. Let's revisit the speeding example from earlier in the unit (Figure 2–1). Although the posted speed limit is 35 mph, in reality many people drive much faster than that. What might we do to get drivers to slow down on this road? One option is to post additional speed limit signs or run local PSAs about the dangers of speeding. However, consider whether informational signs would result in lower speeds. Are drivers speeding because they are not aware of the speed limit? Are drivers unaware of the potential dangers of high speeds? The answer to both of these questions is "not likely."

One example of environmental change to reduce driver speed is the use of traffic calming measures. Features such as speed humps and mini roundabouts are examples of physical alterations to the driving environment that influence how road users respond. In the previous speeding example, the overall design of the road has already been established, but the lanes could be narrowed or even reduced to one in each direction to communicate, "This is a road where you should drive slower." Traffic calming addresses the intuitive system in that it results in drivers slowing down without being aware of doing so.[18]

Seat belt usage in the United States

Seat belt use in the United States has a remarkably similar, though opposite trajectory to that of Guinea worm disease. Though seatbelts were required in U.S. vehicles starting in the late 1960s, use of this equipment was low. Observational surveys from the early to mid-1980s found use of 5-14 percent.[16] By 2015, however, observed seatbelt use had climbed to 88.5 percent.[17]

As with Guinea worm disease, no single effort was responsible for increasing seat belt use in the United States. Instead, efforts that focused on changing the environment (e.g., enactment of seat belt and child passenger safety laws) were coupled with high visibility enforcement (e.g., Click-it-or-Ticket). Education played a role in these efforts, but not in raising awareness for the dangers of not wearing seat belts. Rather, education was needed to inform people that belt use is required and, especially, to create the perception among the driving public that police were actively enforcing seat belt laws.

16

Tison, J. & Williams, A.F. (2012). *Analyzing the First Years of the Click It or Ticket Mobilizations* (DOT HS 811 232). Washington, D.C.: National Highway Traffic Safety Administration.

17

Pickrell, T. M., & Li, R. (2016, February). *Seat Belt Use in 2015—Overall Results* (Traffic Safety Facts Research Note. Report No. DOT HS 812 243). Washington, DC: National Highway Traffic Safety Administration.

18

Lewis-Evans, B. & Charlton, S.G. (2006), Explicit and implicit processes in behavioural adaptation to road width. *Accident Analysis & Prevention, 38*, 610-617.

Consider behavior in addressing travel safety

Making strides in road safety is possible. However, as with the near eradication of Guinea worm disease, significant achievements will not happen overnight. When implementing a program or intervention aimed at changing behavior, it is important to remember that any road safety issue is likely the result of a combination of factors. Consequently, it is unlikely that any one program or intervention will completely solve the problem. However, combining behavioral science principles with engineering design can help to produce significant advances. See Unit 4 for a discussion of how to identify and address road safety problems.

Conclusion

In short, human behavior is extraordinarily complex. Consequently, it is difficult to influence. Simple, common sense approaches like merely raising awareness or otherwise providing information about an issue virtually never succeed.

Humans are not exclusively logical, rational beings.

We often assume human behavior is controlled by a logical deliberative process when, in fact, most behaviors are a result of an intuitive process. Many factors influence behavior including education, emotions, cultural norms, religious beliefs, social pressures, convenience, habits and finances. Understanding human behavior and the many factors that influence behavior is crucial to solving safety problems.

People generally don't simply do what they are told to do.

Information and awareness-raising campaigns are often the first tools used in efforts to influence behavior. However, these approaches are too often adopted without careful consideration of whether the behavior is likely to be changed merely with information (which the public often already has).

The environment heavily influences human behaviors. We are constantly processing information and adjusting our behaviors accordingly. Most of this behavior is unconscious and driven by the intuitive system.

Changing behavior requires an understanding of all influencing factors.

Before attempting to influence behavior, it is essential to identify and understand the important factors influencing a behavior. Targeting a behavior without a full understanding of these factors will almost certainly be unsuccessful.

Because so much of what we do is intuitive and heavily influenced by our environment, we sometimes respond to the transportation infrastructure in ways not anticipated by the engineers who designed it. By changing the environment, people can be nudged towards the behavior of interest.[19] In other words, if you can't change the person (and you usually can't!), change the world so that the person will follow.

19 Thaler, R.H., and Sunstein, C.R. Nudge: Improving Decisions About Health, Wealth, and Happiness.

Bus stop with crossing pedestrians in Portland, Ore. *(Source: pedbikeimages.org/Laura Sandt)*

The transportation system is designed, built, maintained, governed and used by humans.

Using the term human factors to refer exclusively to the user perspective (i.e., drivers, pedestrians, etc.) can easily convey an oversimplified notion of the role of humans in the transportation system. From design to use, humans play a role in every step of the transportation system. In that sense, the entire transportation system is a product of human factors. For that reason, safety professionals must consider both the role of the environment (e.g., transportation infrastructure) and the user when trying to understand behavior and develop solutions to safety problems.

In sum, significant advances in road safety are possible, but changes will not happen overnight. Human behavior is not easy to change. With thoughtful, comprehensive approaches that take into account an understanding of human behavior and the environment in which people live, we can develop programs, policies and countermeasures that have a better chance of significantly improving road safety.

EXERCISES

- **CREATE** a causal diagram to model the behavior(s) and environmental factor(s) that contribute to the following.
  - The flu
  - Unhelmeted motorcyclist fatalities
- Using the causal diagrams from exercise 1, **IDENTIFY** the weak links in the causal chain and describe an intervention aimed at changing the target behavior(s).

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