



THE SCIENCE AND BEST PRACTICES OF BEHAVIORAL SAFETY

The Source for Reducing Injuries on the Front Line

Timothy D. Ludwig and Matthew M. Laske



The Science and Best Practices of Behavioral Safety

This book presents the scientific principles and real-world best practices of behavioral safety, one of the most mature and impactful applications of behavioral science to reduce injuries in industrial workplaces.

The authors review the core principles of behavioral science and their application to modern safety processes. Process components are discussed in detail, including risk analysis and pinpointing, direct observation, performance feedback, reinforcing engagement, trending and functional analysis, behavior change interventions, and program evaluation. Discussions are complemented by industry best-practice case studies from world-class behavioral safety programs accredited by the Cambridge Center for Behavioral Studies (CCBS), which provide compelling evidence of the effectiveness of these behavioral science principles in reducing injury.

The Science and Best Practices of Behavioral Safety is essential reading for safety professionals, process safety engineers, and leaders in companies who have implemented, or are considering implementing, behavioral safety; or as an aid to learning more about the scientific background behind effective and practical safety practices. Researchers, expert consultants, and students who are already familiar with the practice will also find the book a valuable source to further develop their expertise.

Timothy D. Ludwig, Ph.D., has more than 30 years of experience in research and practice in behavioral safety. Dr. Ludwig is a Distinguished Graduate Professor at Appalachian State University; serves on the Cambridge Center for Behavioral Studies (CCBS) Commission for the Accreditation of Behavioral Safety; and disseminates his writings on Safety-Doc.com.

Matthew M. Laske, M.A., received his master's in industrial-organizational psychology from Appalachian State University and is completing his doctoral degree at the University of Kansas. Matthew has designed, implemented, and assessed behavioral safety programs in multiple industries and is recognized by the CCBS as a Distinguished Scholar.

“As a researcher and teacher for more than 50 years, I’ve seen remarkable reductions in workplace injuries with applied behavioral science. This teaching/learning text reviews the research-based evidence and shows how to apply the principles to make optimal impact.”

E. Scott Geller, Ph.D., *Virginia Tech,
Safety Performance Solutions, USA*

“The science is what my company relied on to deliver behavioral safety programs with confidence. This book locks in the principles and evidence that our community has used for the past 40 years to reduce injuries.”

Terry McSween, Ph.D., *Quality Safety Edge, USA*

“There are several on the market but this book’s details would help actually make changes without consultants. You see what it actually takes to make changes with enough examples and data proving that behavioral science can be implemented in complicated corporate settings.”

Angie Lebbon, Ph.D., *Eastman Chemical, USA*

“A thorough review and contemporary analysis of what behavioral safety is and what best practices make it effective in reducing worker injuries. Essential reading for safety professionals and practitioners of applied behavioral science.”

Cloyd Hyten, Ph.D., *Director of Safety Solutions, USA*

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THE SOURCE FOR REDUCING INJURIES
ON THE FRONT LINE

**Timothy D. Ludwig and
Matthew M. Laske**

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DEDICATION

This book is dedicated to the safety professionals, executives and, most importantly, the dedicated workers who strive daily to make behavioral safety successful in reducing human suffering for their workforce and, through dissemination, the world. We thank all these individuals, who have taught us valuable lessons to help us disseminate their best practices to the world. We would also like to show appreciation to our life partners, Lori and Maira, for their constant support both throughout the development of this book and in life.

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CONTENTS

Preface viii

Acknowledgments x

Chapter 1. Why Behavioral Safety? 1

Chapter 2. Risk Analysis and Pinpointing 17

Chapter 3. Direct Observation 30

Chapter 4. Performance Feedback 36

Chapter 5. Reinforcing Engagement 43

Chapter 6. Trending and Functional Analysis 54

Chapter 7. Behavior Change Interventions 72

Chapter 8. Evaluation 85

Chapter 9. Conclusion 124

References 129

Index 145

PREFACE

Behavioral safety is one of the most mature and effective applications to reduce injuries in industrial workplaces. Not everyone gets it right; others have had great success and want to take it to the next level. We saw the need for a guidebook that takes everything we know about behavioral safety and puts it in one place. But not some consultant's proprietary behavior-based safety (or whatever they call it) package in a marketing book based on their sales version of their process. Instead, we need to cut through the marketing and look at the underlying science behind behavioral safety. That's right—*science*.

Behavioral safety, from its beginnings to the present, has been built on the foundation of behavior analysis—otherwise known as the *science of behavior*—started by B.F. Skinner. But sometimes this science can get somewhat complicated and can be hard to decipher. Our goal with this book is to translate the science into bite-size chunks that you can put into practice. Don't worry, we will teach you the science as well: we've included "Science Moments" throughout the book, for those interested, to explain some of the core scientific concepts for your deeper understanding. As you learn about the science of behavior and how it has been applied, you will begin to appreciate that behavioral safety is not just some made-up process that happened to become popular. Instead, you will learn that it has been built meticulously, tested over and over, and is continually improving as we learn new things! So, in a way, this book is a textbook teaching the science behind behavioral safety. The authors of this book, Tim Ludwig and Matt Laske, are behavior scientists with a deep understanding of behavior. We will guide you through this science.

Science without practice, however, is just a bunch of scholars writing esoteric, hard-to-read publications for each other. How do we know the science works in the real world? We have to go and do it; fail; find success; grow that success; learn from both the successes and the failures; and finally go back to the science and test it all over again. We've been doing this since the early 1970s and have a lot to show for it. In 2005, a group of scientists who also have decades of experience in the practice of behavioral safety created the Commission for the Accreditation of Behavioral Safety as part of their work with the not-for-profit Cambridge Center for Behavioral Studies (CCBS). As part of this work, they went around to the very best behavioral safety programs in the world to find out what makes them great. Upon awarding its prestigious accreditation, the Commission documented the programs' best practices and evidence of success. This book presents these

best practices in a way that is easy to understand and easy to implement. So, in a way, this book is also a guidebook, leading you through the steps to implement these best practices.

Behavioral safety aims to prevent harm and reduce human suffering by targeting risk and intervening to promote safe behaviors. This book:

- reviews the core components of a behavioral safety process;
- highlights modern behavioral safety methods (e.g., behavioral systems analysis); and
- reviews best practices from world-class behavioral safety programs accredited by the CCBS.

Whether you are just starting your behavioral safety process or want to take it to the next level, we hope the science and practice documented in this book will lead you to success in reducing harm in the workplace.

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The authors would like to thank the Cambridge Center for Behavioral Studies (CCBS) (behavior.org), Dwight Harshbarger and Bill Hopkins for the vision to document the best practices of behavioral safety programs through the CCBS Commission on Behavioral Safety Accreditation. We would also like to thank the members of the CCBS Commission—including Siggi Sigurdsson, Angie Lebbon, Oliver Wirth, Mark Alavosious, Don Kernan, Sandy Knott, Alan Cheung, and Distinguished Scholars Andressa Sleiman and Nicholas Matey—for documenting and reviewing the behavioral safety programs whose efficacious practices we present in this book.

1

WHY BEHAVIORAL SAFETY?

Why Behavioral Safety?

A man died as he slid under a shredder to remove a jam. He had neglected to follow the lock-out tag-out process, opting for a quick fix. When he removed the compressed cotton blocking a blade, the machine kicked into operation and he was shredded instantly. He was a supervisor with 30 years of experience. This event shocked a young HR executive and galvanized his lifelong passion for safety. He was trained in applied behavior analysis, had spent some time as a scientist and now was applying his science in the real world of industry and risk. He immediately engaged his company in a worldwide campaign to apply behavioral safety—a method designed and tested by many in his science—to transform safety, quality, and the work lives of the thousands of workers under his care. He did the same in his second executive appointment with a shoe company, whose workers in overseas plants were getting injured at unacceptable rates. Consumers in America and Europe would not put up with reports of unsafe plants causing harm to vast workforces laboring in faraway countries. Investments were made in these plants, the equipment, and facilities; but injuries continued at high rates. Something had to be done. This was a problem across industries around the world. A new approach to safety was to be found in the behaviors of workers and the science studied in applied labs across academia.

It all started as a sort of movement among researchers who attempted to translate the science of behavior analysis into real-world applications to better society. These were scientists who studied human behavior. B.F. Skinner was still an active thought leader in the early 1980s and began to imagine utopias where the science of behavior could be applied to relieve human suffering and bring out the best in people. Behavioral safety is firmly rooted in the scientific field called “applied behavior analysis.” Behavior analytic terms and principles can be quite esoteric (meaning that few people can understand what they mean). Therefore, we have inserted “Science Moments” throughout the book. Science Moments are flagged in the text like this: SM. In these Science Moments, we will briefly explain the scientific terms and principles behind behavioral safety. This way, you can better understand the integrity and precise operations behind human behavior. Our first Science Moment provides a brief history of applied behavior analysis^{SM-1.1}.

Science Moment 1.1

A Brief History of Applied Behavior Analysis

Applied behavior analysis is the application of the principles of behavioral science to socially significant behavior. The roots of applied behavior analysis are often attributed to the experimental work done by B.F. Skinner (Morris et al., 2005). Skinner was interested in what variables influence behavior. Although Skinner primarily worked with pigeons and rats, he knew the principles could be applied to humans. Skinner's *Science and Human Behavior* (1953) described how behavior analysis could be applied to socially important human behavior. What came next was an explosion of applied behavioral research; behavioral applications to workplace behavior were not far behind and increased dramatically. Applications to workplace safety were quick to follow, with Beth Sulzer-Azaroff publishing the first application of behavioral principles to workplace safety in 1978.

It was a challenge to take a science whose roots were in animal research, expand its principles through human research, and then find efficacious ways to apply the science to real-world problems with evidence and best practices. A legion of professors, students, and consultants began to test behavioral principles with great success in industry and business. When the world began calling for a better way to protect frontline workers from harm in hazardous manufacturing, petrochemical, distribution, mining and construction sites around the world, the science of behavior answered the call.

Dwight Harshbarger had studied behavior since his undergraduate days at West Virginia University. His studies took him to Berkeley, the University of North Dakota and Harvard before an appointment with the faculty of West Virginia University. Dwight had a keen need to help people, grounded in his rural upbringing. He witnessed the plight of families of workers injured in West Virginia's mines and began to document how some of the world's largest companies were putting their workers and communities at risk. Thus, he ventured away from academia to lead a community mental health center in southern West Virginia. Now he set his sights on applying his science to safety, first as a consultant and then as an executive within the corporate world responsible for the safety of international workforces.

Galvanized by the fatality under his watch, Dwight called on his good friend Beth Sulzer-Azaroff, a top researcher at the University of Massachusetts Amherst breaking new ground in behavioral applications to safety. She was following up on the work of Judith Komaki (Komaki et al., 1978) and Kent Anger (M.J. Smith et al., 1978)—both giants in the field—targeting behaviors related to safe work performance through direct observation and analyses (Fellner & Sulzer-Azaroff, 1984; Sulzer-Azaroff & Fellner, 1984; Sulzer-Azaroff, 1978). Dwight took Beth to one of his most challenged plants in Thailand and

engaged the workforce in one of the many initial behavioral safety programs that were fast becoming a global phenomenon.

Behavioral safety was quickly developed, tested, and deployed by a peerless generation of behavior scientists into evidence-based programs marketed to industries eager to reduce injury rates under the moniker “behavior-based safety” (Agnew & Snyder, 2008; Geller, 2001a; Krause, 1997). Behavioral safety programs like the one Beth and Dwight implemented back in the 1970s are still going strong some 50 years later because of their demonstrated success in reducing injuries. A lot has been discovered in the science of behavior over these past 50 years and much has been learned in the practice of behavioral safety. Fortunately, the discipline of documenting the science has resulted in hundreds of published research articles validating different components of behavioral safety. Professional conferences and journals have allowed experienced practitioners to share their translation of the science and best practices discovered through implementing behavioral safety in real-world scenarios.

Dwight went on to become the executive director of the Cambridge Center for Behavioral Studies (CCBS) (behavior.org). The CCBS is a not-for-profit organization founded in 1981 whose mission is “to advance the scientific study of behavior and its humane application to the solution of practical problems, including the prevention and relief of human suffering.” In 2005, Dwight teamed up with Bill Hopkins—himself a top researcher in behavioral safety—to establish the CCBS Commission on Behavioral Safety, which sought to accredit the world’s best-in-practice behavioral safety programs. Since Dwight and Bill’s first accreditation of the behavioral safety program of Eastman Chemical’s Acetate Fibers Division, the CCBS has accredited over 30 behavioral safety programs, verifying that their processes are based on behavior science and have been proven effective by significant reductions in injuries (under industry standards) for at least three years after implementation of the program. This book presents the science behind behavioral safety and celebrates the programs that have translated the theory into best practices.

Let’s begin by understanding why behavioral safety is still as important today as it was 50 years ago, when it was first applied from the science. It’s all about the people. Workplace injuries have serious personal costs. The Bureau of Labor Statistics (2020ab) reported 5,333 work-related deaths and 888,220 lost-time injuries in 2019 in the United States. These are real people whose lives have changed just because they went to work to support their families. Pain and disability due to injury cause substantial limitations in activities such as exercise, household chores, and family interactions (Dembe, 2001; Strunin & Boden, 2004). In an estimated 40% of cases, a family member had to reduce time committed to their household, work, and/or schooling activities to replace contributions truncated by the injured worker’s limitations (Hensler et al., 1991). Getting hurt can be expensive too. Lifetime costs

for a person suffering a nondisabling workplace injury have been estimated to average \$10,000, rising to \$30,000 for injury-caused disabilities (Marquis & Manning, 1999). This is in addition to lost earnings ranging between \$42,100 and \$68,100 (Reville et al., 2001); workers' compensation benefits replace only between 32% and 41% of 10-year pretax losses.

In addition to the humanitarian and social implications of severe injury and death, many organizations experience increasing monetary costs related to injuries in the workplace. The Liberty Mutual Workplace Safety Index (2021) has estimated the U.S. cost of injuries to be \$58.61 billion annually. Most of these are direct costs, such as when injured employees' medical expenses are billed to the employer. Indirect costs—such as administrative time costs, increased insurance rates, lost production time, and damaged reputations—may be four times the price of direct costs (Safety Management Group, n.d.). The National Safety Council (2021) estimated the combined total of direct and indirect costs to be \$171 billion in 2019. The estimated cost for a death averages \$1.22 million, whereas that for a medically consulted injury averages \$42,000. These costs may escalate for uninsured employees.

Fortunately, over the decades that behavioral safety has been applied, there has been a notable decline in personal occupational injuries in the United States and abroad (Cooper, 2019; McSween & Moran, 2017). We are making progress based on the hard work of safety professionals, consultants, and researchers as we engage in processes that make an empirical difference in safety outcomes like injuries, as well as cultural outcomes like employee engagement in safety and voluntary reporting. That progress includes contributions from behavioral safety programs.

This is why the CCBS accreditation compares the reductions in injuries at sites with behavioral safety programs with the industry average. This first figure (Figure 1.1) shows the original data from Eastman's Acetate Fibers Division showing its injury reduction in comparison to the industry average. Most industries have seen their injuries decrease over the same period, reflecting the impact of other modern safety management systems implemented by the professional safety community. We investigated the impact of behavioral safety programs *over and above* these other systems to find the best evidence-based practices to share in this book.

We hope to convince you that behavioral safety is not just a safety management fad that represented a marketing opportunity for consultants. Instead, we want to reveal the science behind the different components of behavioral safety to show it is rooted in decades of laboratory and field research in applied behavior analysis. We want to show you how the science has been successfully translated into real-life practices in our accredited sites, with real-life results. Finally, and most importantly, we want you to learn about these best practices to improve your behavioral approach to safety.

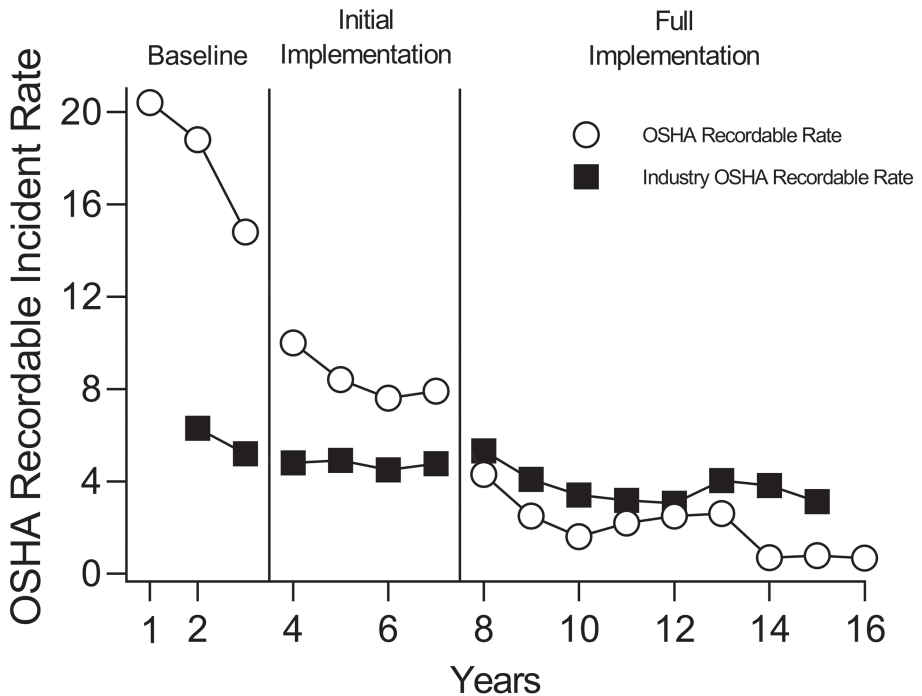


Figure 1.1 Eastman's Acetate Fibers Division Recordable Rate and Industry Standard

Occupational Health and Safety Administration (OSHA) recordable incident rate on the y-axis and consecutive years on the x-axis. White circles indicate Acetate Fiber's OSHA recordable rate. Black squares indicate the industry standard OSHA recordable rate. Phase lines indicate baseline, initial behavioral safety implementation, and full behavioral safety implementation. Data are adapted with permission from CCBS.

THE LIMITATIONS OF SAFETY MANAGEMENT SYSTEMS

We have really made great strides in managing safety in our industries. Many safety improvements over the past decades can be attributed to maturing safety management systems such as the policies, procedures, and activities that promote and maintain the safety of our workforce (Vinodkumar & Bhasi, 2010). The analysis of injuries is the bedrock of most safety management systems. When safety incidents are effectively analyzed, events surrounding injuries can be identified and the causes of the incident mitigated to avoid future injuries. Incident analyses can provide valuable insights into what went wrong and how to fix it.

Thankfully, injuries don't happen very often—especially the types of incidents that cause serious injuries and fatalities. While this is a blessing, it is also a hindrance when using incident investigations to make things safer for your workforce. The problem is that these analyses track low-frequency