APPLYING BEHAVIORAL THEORY TO SAFETY PROGRAM COMMUNICATION STRATEGIES

ISSUE

A Canadian National/Illinois Central Railway southbound train 533 and northbound train 243 collided near Clarkston, Michigan. The collision occurred at a switch at the south end of a siding designated as the Andersonville siding. Train 533 was traveling at 13 miles per hour when it struck train 243. The signal at the turnout for the siding displayed a stop indication, but train 533 did not stop before proceeding onto the mainline track. Train 243 was traveling about 25 miles per hour on a "proceed" signal on the single main track when the accident occurred. Both crewmembers on train 243 were fatally injured. The two crewmen on train 533 sustained serious injuries.

The National Transportation Safety Board found that both the conductor and the engineer of train 533 suffered from ***obstructive sleep apnea****. Although the engineer was taking prescription medication for high blood pressure and diabetes, his condition was not being treated at the time of the incident.*[1]

Fatigue officially was recognized as a serious problem in the railroad industry, and across transportation modes, in 1990 with the creation of the National Transportation Safety Board (NTSB) "Most Wanted List" of transportation safety improvements[1]. Over the past decades, the NTSB has issued more than 200 safety recommendations related to fatigue[2]. The NTSB cites the cost of sleep loss in the billions of dollars, not to mention the countless and underreported numbers of injuries and fatalities.

Although it is difficult to estimate the exact number of rail accidents that have fatigue as a causal or contributing factor, there is no doubt that operator fatigue is a critical issue. This statement is supported by analyses from the Collision Avoidance Working Group determining that in 19 of 65 human factors-caused mainline track train collisions, 29.3% involved impaired alertness.[3] Furthermore, in testimony before the Senate Subcommittee on Surface Transportation in 1998, the Administrator of the Federal Railroad Administration stated, "about one-third of train accidents and employee injuries and deaths are caused by human factors. We know fatigue underlies many of them."†

Locomotive engineers and conductors in the United States work largely sedentary jobs with long and unpredictable schedules that often include night and on-call work. Consequently, this population experiences both acute and chronic sleep debt, a related risk for sleep disorders such as sleep apnea, and an elevated risk of errors, which can result in injuries and incidents both on and off the job.

Recognizing the problem, the Federal Railroad Administration (FRA) Rail Safety Improvement Act of 2008 (RSIA) required railroads to develop fatigue management plans with the goal of reducing the likelihood of accidents, incidents, injuries, and fatalities caused by fatigue. The act substantially revised the previous work hour regulations, but among its provisions, each rail carrier is required to develop "a comprehensive safety risk reduction program…" Within this program, there must be a "fatigue management plan" in which the "railroad shall consider the need to include in its fatigue management plan elements addressing each of the following items, as applicable:

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[1] http://www.ntsb.gov/safety/mwl-1.html

[2] http://safetycompass.wordpress.com/2013/03/07/sleepless-america-the-deadly-cost-of-fatigue-in-transportation/

† Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue, National Transportation and Safety Board Safety Report, May 1999, NTSB/SR-99/01.

(A) Employee education and training on the physiological and human factors that affect fatigue, as well as strategies to reduce or mitigate the effects of fatigue, based on the most current scientific and medical research and literature.
(B) Opportunities for identification, diagnosis, and treatment of any medical condition that may affect alertness or fatigue, including sleep disorders."

Although individual railroads are at liberty to develop their own fatigue management educational programs, such efforts are not necessarily comprehensive or viewed by employees as containing unbiased information. Thus, there is a need to provide a source of information pertaining to sleep and circadian science, sleep disorders, fatigue/sleep deprivation mitigation strategies, self-evaluation assessment and pathways to seek treatment that is both scientifically accurate and unbiased to assist railroad employees, their families, as well as other interested parties. Because internet use is growing exponentially, and is increasingly being utilized as a source of health care information, a web site specifically targeted to the needs of railroaders may be an ideal component of an overall fatigue management plan.

One approach the FRA is using to promote railroader sleep health is through education with the multimedia website, *Railroaders' Guide to Healthy Sleep* (http://railroadersleep.org).

EXISTING PROGRAM

Sponsored by the FRA, in partnership with content and evaluation experts at the Volpe National Transportation Systems Center, the *Railroaders' Guide to Healthy Sleep* website demonstrates the collaboration of experts in sleep science and sleep health from the Harvard Medical School, Division of Sleep Medicine and educational media from WGBH Educational Foundation. The website vision, to provide science-rich information to help rail workers improve the aspects of sleep health under their control, is one way the FRA is working to address the need for strategic health and safety interventions for this worker population. The website is designed to provide information and tools to support a railroader to take action and make behavior change that is within his or her own individual control.

One key feature of the website is the Sleep Disorder Screening Tool, an anonymous self-assessment that screens an individual's risk for five common sleep disorders, including obstructive sleep apnea, which is one that railroaders are of particularly high risk. Other features of the educational website are scientifically valid information on the importance of sleep for personal health and safe performance on the job, and proven, practical strategies, tips, and downloadable tools to help address the real-world challenges railroaders face of balancing work and personal life. The information is tailored specifically to the railroader target audience, conveyed using testimonials and using various media formats, including text, graphics, interactive activities, and video.

The website has been live since June 2012 and has tracked more than 44,000 visits. However, the challenge remains to increase awareness and use of the website so that it can be the valuable resource it was intended by fostering the behavior change envisioned: More railroaders being screened, diagnosed, and treated for sleep disorders, of which they are at high-risk, in the context of fatigue risk management as an important railroad safety concern.

PROPOSED INTERVENTION

This research design posits that if safety-related behavior change strategy communications utilized Protection Motivation Theory[3] (PMT) understanding, the participants (in this case railroaders) would be more likely to engage in adaptive, rather than maladaptive, safety-related behaviors (i.e., they will participate in a request to try out the website). Invitations employing PMT should include phrasing that

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[3]http://en.wikipedia.org/wiki/Protection_Motivation_Theory, or http://www.utwente.nl/cw/theorieenoverzicht/Theory%20clusters/Health%20Communication/Protection_Motivation_Theory.doc/

provides clear evidence that the threat of sleep-related incidents is viable and salient for the railroader, and success is made to look within grasp and thoroughly probable.

A second stage to this research involves modification of the current website tools to include enhanced communication using social psychology theories to increase the likelihood of participation in the site's tools and offerings. This phase, while critical to more focused behavior change beyond using a website, would require some technological work on the current website. For instance, those who choose minimum participation in the sleep disorder tool will be encouraged, using social norming language and PMT-informed messaging, to continue with their participation to seek support and eventually change their safety-related behavior. This phase would require more investigation before a full proposal is completed.

This project is intended to address these research questions:

A. Can the application of behavioral and social psychology theories to a communication outreach strategies 1) increase the response rate to certain behavior change strategies and therefore, might 2) increase engagement in the sleep disorder website, its related screening tool, and potential follow-on diagnoses by medical professionals and subsequent regimen compliance?

B. What response rate can we expect from our target audience in future safety and website related outreach efforts?

C. An in-depth study of the activity around the website will provide an opportunity to identify ways the site can be improved after the end of the current contract period ends and inform a second phase where engagement is enhanced through adaptation of existing tools.

D. Can this application be generalized to a) other modals, b) other transportation safety-related strategies, and c) general public involvement in safety strategies?

METHOD

Protection motivation theory[4] essentially posits that perceived threats are met with a consideration framed by an appraisal of the threat (severity and one's vulnerability) and one's coping mechanism (self-efficacy and probability of success). If these elements are perceived to be great enough of a threat and the person has confidence in their success over the threat they will take measures to avoid the threat. If the assessment does not show likelihood of success then the person will most likely take maladaptive steps (i.e., avoiding taking action).

Two samples of railroaders, randomly assigned to an intervention or control group, will receive invitations to participate in the Sleep Disorder website. Participation will be clicking through a link in the email to the website, reading through the site, and coming back to another link where they will answer 4-6 questions about the website content. The linking through from the email will be tracked to identify differences between the two groups and their response to the questions will provide some measure of the depth of their participation.

The differences will be in the invitation's language choices. The intervention invitation will include language informed by PMT and the control group will receive a more generic, non-PMT invitation.

PROCEDURES

An email invitation will be sent to a specified sub-population of railroaders that will ask them to participate in a safety-related program that involves information provision through a website. They will be asked to click a link in the email that takes them to the website where they will learn about a safety concern. The invitation will also ask them to participate further in our program by spending some time on

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[4] e.g., Floyd, D. L., Prentice-Dunn, S., & Rogers, R. (2000). A Meta-Analysis of Protection Motivation Theory. *Journal of Applied Social Psychology, 3,* 2, pp. 407-429.

specific elements of the website. Finally, as a reward for participating in the study, if they answer 4-6 questions "hosted" at a survey link, they will be entered into a drawing for a $50 gift certificate to one of 4 major retail chains (e.g., Sears, Amazon, Barnes & Noble, Macy's). Two certificates for each of four groups (cost = $400) so their chance of winning = 1 in 50.

INSTRUMENT

The invitations will be written in two different patterns. One will be informed by Protection Motivation Theory (experimental) and will touch on specific elements that are intended to engage participants in more self-protection actions. The other group (control) will receive a more generic invitation absent concern for protection motivations.

Because we know that railroaders are more concerned with their lifestyle and how safety impacts their life outside their work, we will use language in the PMT-informed messages that speak to their vulnerability in their personal life as it might be impacted by work-related safety. For instance, one message might read like this:

"Studies show that 8 in 10 enginemen and conductors experience sleep issues that impact their life outside work. While this is a huge concern for the industry, no family wants to lose their loved one from an avoidable incident. This website will help you decide if your sleep patterns are impacting your and your family's happiness. It has simple steps that you can implement, confidentially, to guarantee your own wellbeing."

SAMPLE PARTICIPANTS

Four groups will be selected (2 control and 2 intervention) and will be staggered so that the website metadata can be analyzed specific to individual groups. A short window (1-2 weeks) will be described in the email invitation and each group's URL will be closed after those 2 weeks have passed. The staggered nature of these groups provides for control of any history events that might occur between the first experimental and control groups.

Obtain a list of 10,000 union members, 5,000 engineers and 5,000 conductors. From this list, randomly select (without replacement) 200 engineers and 200 conductors. From each group, select every other member for either control or experimental. Finally, every other of those will be selected for the first or second wave of the study.

OUTCOME MEASUREMENTS

1. Compare click-through rate from the survey between groups.
2. Describe and compare participant's website activity, in general and specific to the items mentioned in the email invitations.
3. Compare responses on 4-6 site-related questions by both groups of participants.

CONCLUSIONS

This project would provide evidence of which communication strategy is most effective to motivate busy and possible fearful railroaders to visit the website and use the sleep disorder screening tool as a first step to behavior change. Secondly, the study would provide the necessary evidence to begin to describe the efficacy of the website in terms of behavior change in and generalizable to the target audience. This study, even as a small first step, could generate far-reaching rewards.

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