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A systematic review of safety violations in industry

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ABSTRACT

It is widely known that intentional non-malevolent violations of safety procedures and norms occur and evidence shows that safety violations can increase the risk of accidents. However, little research about the causes of these violations in work settings exists. To help shed light on the causes, this paper systematically reviews the empirical causes of safety violations in industry. Electronic database literature searches were performed to identify relevant articles published prior to January 1, 2007. Thirteen articles met the inclusion criteria and 57 different variables were examined as predictors of safety violations. Study settings were healthcare delivery, commercial driving, aviation, mining, railroad, and construction. The predictors were categorized into individual characteristics, information/education/training, design to support worker needs, safety climate, competing goals, and problems with rules. None of the reviewed studies examined whether violations can improve system performance or safety. Methodological suggestions and a macroergonomic framework are offered for improving future studies of the epidemiology of safety violations.

1. Introduction

In his seminal work *Human Error*, Reason (1990) noted "an important lesson to be learned . . . is that the term 'error' does not capture all the ways in which human beings contribute to accidents" (p. 194). The *other* contribution mechanism to which Reason was referring was through what is commonly referred to as a violation. Violations of safety rules, procedures and norms have now been the subject of extensive research, especially among recreational drivers ("recreational drivers" in this paper refers to drivers who are not driving as part of their employment) (e.g. Aberg and Rimmo, 1998; Blockey and Hartley, 1995; Parker et al., 1995; Reason et al., 1990). However, there is a limited amount of research literature that investigates rule violations in work settings, and still less exists in work settings where the causes of violations are studied. This is an alarming gap in the literature considering that some industries estimate that about 70% of their total accidents can be attributed to violations (Mason, 1997).

Perhaps part of the reason that the causes of violations have not been studied in detail stems from the idea that violations are actions taken by 'bad' people. That the term "violation" is common and that people hold their own colloquial definition for the concept may also have contributed to the lack of systematic research to understand both the concept and causes of violations. This paper aims to provide a specific definition for the term "violation." Then, this paper seeks to systematically review what is currently known about the causes of safety violations in industry because efforts to secure or increase compliance with safety protocols and norms need an evidence base to guide intervention efforts. Armed with a specific definition and existing evidence about the causes of violations, this paper then re-frames violations as evidence of system problems rather than as actions taken by 'bad' workers.

2. Safety violations research

What is known to date about violations is that they certainly exist and that some evidence suggests they can lead to unwanted outcomes such as accidents. In studies of recreational driving, the existence of violations has been demonstrated using drivers' self-reports (e.g. Kanellaidis et al., 1995; Shinar et al., 2001), frequently using a variation of Reason et al.'s (1990) Driver Behavior Questionnaire (e.g. Aberg and Rimmo, 1998; Blockey and Hartley, 1995; Parker et al., 1995). Driving violations have further been documented during field observations (Hakkert et al., 2001; Porter and England, 2000; Retting and Williams, 1996), and uncovered through analysis of existing fatality and vehicle registration databases (Retting and Williams, 1996; Romano et al., 2006).

Safety violations have also been documented in industry. In healthcare, for example, observational (Alper et al., 2008; Kobayashi et al., 2005; Patterson et al., 2002, 2006), survey (Alper et al., 2006; McKeon et al., 2006), and violation-reporting (Horning and Smith,

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1991) methods have all been used to document the existence of violations. In addition, violations have been documented in aviation maintenance (e.g. Hobbs and Williamson, 2002; Wenner and Drury, 2000), mining (Laurence, 2005), railroad (Lawton, 1998), and other industries.

3. Violations: good or bad for safety?

Safety violations clearly exist in industry, but it remains unclear under what circumstances violations help or hurt safety. In recreational driving, it has been established that violations can lead to outcomes such as accidents (e.g. Özkan and Lajunen, 2005; Parker et al., 1995; Reason et al., 1990), though the link between safety violations and unwanted outcomes is not as firmly established in industrial settings. If violations can lead to accidents, it provides the first reason to study the causes of violations: control the causes of violations to reduce accidents.

However, violations do not necessarily lead to unwanted outcomes such as accidents and injuries. Part of the reason that a strong link between violations and unwanted outcomes has not been firmly established may be that most violations do not lead to harm. As early as 1931, Heinrich offered the idea that for every 300 accidents that do not result in an injury there are 29 minor injuries and 1 major injury (Heinrich, 1931). These accidents and injuries result from a much larger pool of errors and violations. That is, most errors and violations are not noticed because they do not result in unwanted outcomes. Despite this, there is reason to believe that safety violations may put a work system into a more vulnerable state (e.g. Reason et al., 1995, 1998). Thus, the second reason to study the causes of violations is that violations may put systems into more unsafe states, increasing their risk for an unwanted outcome.

Beyond not knowing to what extent violations contribute to unwanted outcomes is the fact that it is unclear whether or not all violations are 'wrong' behaviors. The term "violation" certainly evokes a feeling that someone did something wrong, but when safety rules are not appropriate, violations may increase system safety (Almaberti et al., 2006; Besnard and Greathead, 2003; Reason et al., 1998). In some cases then, violations can be thought of as micro-level resilience (Hollnagel et al., 2006) where resilience is "the characteristic of managing the organization's activities to anticipate and circumvent threats to its existence and primary goals" (Hale and Heijer, 2006, p. 35). A violation may occur when an individual, realizing that a system is in jeopardy, takes actions that are outside of normal operation to save the system. In such cases, the violations may not only improve safety, but may eventually be considered "best practice" in the situations that produced them. This gives rise to the third reason to study the causes of violations: to understand what system parameters lead to situations that require violations to maintain system safety.

All three reasons for studying the causes of violations make clear that simply blaming individuals for violating a safety policy or norm is an insufficient approach to improving safety. Unfortunately, the norm in industry seems to be to blame people for violations *if* a bad outcome arises, but otherwise to tacitly or explicitly approve violations (Koppel et al., 2008). But as explained, when evaluating violations, we must consider the situation the individual faced when the decision was made to violate without considering the outcomes of the action (Reason, 1998). Rather than viewing violations as a 'bad' individual's actions, they could instead be viewed as an indication that a company's rules do not meet the demands of the situations workers encounter while working. Thus, characteristics of the work system may be causes of violations. That is the question addressed by this review: what are the causes of safety violations?

4. Definitions

The first step in the review was to agree upon a definition of a safety violation. Table 1 provides a list of definitions uncovered in the literature.

The fact that there is variety among the definitions can lead to different conceptualizations of "violations." The differences between definitions used in the literature as well as the absence of definitions in much of the literature necessitate a more unified approach to the definition of violations.

The definitions uncovered in the literature share three similarities. First, each definition specifies that there must exist rules, guidelines, protocols, or norms to be violated. Second, a violation involves some action that is contrary to these rules, guidelines, protocols, or norms. Third, violations are intentional actions. However, even if an action is unintentional, if it is contrary to a rule it can be considered a violation. In this way, past definitions have overspecified the concept of violations. Therefore, a definition that could be used for the concept of "violation" is: an action that is contrary to a rule.

This is a parsimonious and general definition that serves as a blanket for all violations. However, most violation research requires a more specific focus. This has been provided in the literature by differentiating between 'types' of violations. Fig. 1 depicts graphically how violation types have been distinguished (Reason, 1990).

When an individual violates a rule unintentionally, it is known as an *erroneous violation* (Lawton, 1998; Reason, 1990) or an *unintended violation* (Reason et al., 1990). Erroneous/unintended violations can occur due to human error (e.g. Reason, 1990), but can also occur if an individual simply does not know the rule governing the actions (Lawton, 1998). In general, research about violations has focused more on intentional violations than on erroneous/unintended violations (e.g. Lawton, 1998; Parker et al., 1995;

Table 1
Definitions of violations that have been used in previous research.

Author	Definition
Beatty and Beatty (2004)	"Intentional acts contrary to advice or best practice guidelines" (p. 528)
Lawton (1998)	"Deliberate departures from rules that describe the safe or approved method of performing a particular task or job" (p. 78)
Mason (1997)	"Violations can be defined as any deliberate deviations from the rules, procedures, instructions or regulations introduced for the safe or efficient operation and maintenance of equipment" (p. 288)
Parker et al. (1995)	"Violations . . . may be defined as the deliberate infringement of some regulated or socially accepted code of behaviour" (p. 1036)
Reason (1990)	"Deliberate – but not necessarily reprehensible – deviations from those practices deemed necessary (by designers, managers and regulatory agencies) to maintain the safe operation of a potentially hazardous system" (p. 195)
Reason et al. (1990)	"Violations can be defined as deliberate (though not necessarily reprehensible) deviations from those practices deemed necessary (by designers, managers, and regulatory agencies) to maintain the safe operation of a potentially hazardous system" (p. 1316)
Reason et al. (1995)	"Violations are . . . the deliberate deviation of actions from safe operating procedures" (p.1715)
Reason et al. (1998)	"Violations are deviations from safe operating procedures, standards, or rules" (p. 292)