Safety Culture

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Introduction

Transport is fundamental to our society, but it unfortunately has several negative side effects. The annual number of road traffic fatalities is now 1.35 million people, while between 20 and 50 million people sustain nonfatal injuries (WHO, 2018). Thanks to safety strategies targeting general road user safety behaviors, as well as improvements in technology and infrastructure, the number of road fatalities has steadily decreased. For example, in the United States, fatality numbers in roadway traffic peaked in 1972 with 54,589 people killed and was reduced to 37,133 in 2017 while the population grew from 209.9 million to 325.7 million, bringing the fatality rate from 260.1 to 114.0 fatalities per million inhabitants, a reduction in the rate of 56%. Even more impressive, in Sweden, the total number of people killed in roadway crashes has gone from a high of 1313 in 1965 (and stayed the same in 1966) to 253 in 2017 in spite of the population growing from 7.77 to 9.95 million; it means that the fatality rate per million people has decreased from 168.9 to 25.4 in this period, a rate decrease of 84.9%. To reduce road crash risks for all road users further, it has been argued that new perspectives are required, and international research has pointed to safety culture as a promising new perspective (AAA, 2007; Ward et al., 2010, 2019). Safety culture generally refers to shared and safety relevant ways of thinking or acting that are (re)created through the joint negotiation of people in social settings.

Since its first use in the wake of the Chernobyl nuclear power accident in 1986, the organizational safety culture concept has become an established part of safety research. Although it has especially been applied in what is considered high-risk settings like the nuclear industry and in aviation, the relationship between organizational safety culture/climate and safety outcomes is robustly documented in studies reporting experiences across organizations, industries, and countries (Christian et al., 2009; Zohar, 2010). The crucial importance of safety culture is also documented in a range of accident investigations. Additionally, high-quality studies of safety culture interventions, with pre- and post-measurements, test, and control groups, have indicated up to 60% decrease in crash risk in the road sector (Nævestad et al., 2018a).

In spite of this, the organizational safety culture perspective has been applied to a limited extent among drivers at work in general and professional drivers in specific. Potential reason for this is the lack of rules requiring safety management systems (SMSs) in the sector. SMS typically includes formal routines and measures enabling the organization to work systematically with safety, by identifying and correcting risks, for example, appointment of key safety personnel, risk assessments, safety training, safety procedures, and safety performance monitoring. SMSs aiming to foster positive safety culture are legally required in aviation, rail, and the maritime sector. In contrast to the other transport sectors, formal SMSs for companies in the road sector are so far voluntary (e.g., ISO:39001). While SMS denotes the formal aspects of safety management in organizations ("what the organization is supposed to do"), safety culture denotes the informal aspects ("what the organization actually does") (Antonsen, 2009). Other factors that may explain the presumably lower focus on organizational safety culture in the road sector are the prevalence of small road transport companies that often have few resources and lower competence on organizational safety management, and that drivers at work often are treated in the same ways as private car drivers, by their companies and authorities. The latter means that drivers at work are given the primary responsibility for the safety of their driving, often neglecting the organizational influence on, and responsibility for their safety performance. This contrasts with Vision Zero, which fits well with a safety culture perspective (refer to Article The Swedish Vision Zero – A Policy Innovation).

When employing the safety culture concept to road transport, it is important to note that the organizational safety culture concept only applies to drivers who are part of work organizations. Given the potential importance of the safety culture perspective for road safety, and the fact that the majority of drivers on the road are not at work, several scholars have also argued that the safety culture perspective should be employed to private road users, linking it to other social units than organizations, for example, nations, communities, peer groups, and families (Edwards et al., 2014; Luria et al., 2014; Nævestad and Bjørnskau 2012; Rakauskas et al., 2009). We will return to this issue later.

What is Organizational Safety Culture?

The concept of (safety) culture lends itself to a wide range of different definitions and operationalizations, as it is abstract and general. A 1963 study conducted by Kroeber and Kluckhohm referred to more than 160 definitions of culture. As a consequence, safety culture is often criticized for being a fuzzy concept that refers to everything and nothing. Researchers have pointed to a fragmented literature and terminological confusion within safety culture research (Antonsen, 2009; Glendon, 2008; Guldenmund, 2000). Nevertheless, most researchers agree that safety culture is a sub-concept of the more general concept of organizational culture, and thus that safety culture can be described and understood by referring to definitions and conceptualizations of organizational culture (Edwards et al., 2014). The highly influential organizational culture scholar and social psychologist Edgar Schein defines organizational safety culture as:

> "(. . .) a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems." (Schein, 2004, p. 17)

Drawing on a sociological/social anthropological understanding of culture, Stian Antonsen refers to culture as:

> "(. . .) frames of reference through which information, symbols and behavior are interpreted, and the conventions for behavior, interaction and communication are generated." (Antonsen, 2009, p. 4).

Bearing these definitions in mind, organizational safety culture can be defined as "safety relevant aspects of culture in organizations." The important thing to remember about these definitions is that safety culture provides frames of reference that guide individuals' interpretations of actions, hazards, and their identities, and which motivate and legitimize behaviors that have an impact on safety, and that such shared frames of reference are created through interaction within groups.

It should also be mentioned that several scholars on culture in organizations discern between different levels of culture. Schein discerns between three different levels. Culture at the deepest level refers to underlying assumptions (beliefs, perceptions, thoughts, and feelings) influencing what we pay attention to, what things mean, how we react emotionally, and how we act. Organizational culture at the middle level refers to espoused beliefs and values, for example, explicit strategies, goals, and philosophies, while organizational culture at the most superficial level refers to artifacts, for example, visible organizational structure and processes. Accident investigations often find discrepancies between cultural levels, for example, between espoused values (e.g., safety first) and underlying assumptions (e.g., timetables must be met).

Due to the safety performance and acknowledged good safety culture of aviation, James Reason's description of five key aspects of safety culture (based on aviation) is often used as a point of departure for describing the most important aspects of good safety culture (Reason, 1997). First, Reason refers to a good safety culture as an informed culture, which means that the organization collects information about both accidents and incidents and carries out proactive countermeasures. The second aspect is a reporting culture, which means that all employees report their errors or near misses, and take part in initiatives to improve safety. The third aspect of safety culture is a just culture, which means that there is an atmosphere of trust within an organization that encourages and rewards its employees for providing information on errors and incidents, with the confidence of knowing that they will receive fair and just treatment for any mistake they make. A just culture is a key premise of a reporting culture. The fourth aspect is a flexible culture, which involves that the organization and its members are capable of adapting effectively to changing demands. The final aspect of safety culture is a learning culture, which means that the organization learns from incident reports, safety audits, and so forth, resulting in improved safety. These aspects of good safety culture are by and large taken for granted as the key aspects of good safety culture in all sectors, including transport, for example, in rail, in maritime sector, and in road.

How Can Safety Culture Be Measured?

Safety culture, exemplified by Reason's key aspects, can be studied using a qualitative or a quantitative approach, or ideally through a combination of the two. These methods facilitate examinations of different aspects and layers of safety culture. Quantitative studies are often referred to as studies of safety climate, which can be conceived of as "snapshots," or manifestations of safety culture (Flin et al., 2000). Safety climate is also defined as perceptions of the value and importance of safety in a given context. The concepts of culture and climate are, however, often used interchangeably. Based on Schein's depiction of different layers of culture, we may state that safety climate only gives access to the most superficial levels of safety culture: perceptions of managers' and colleagues' commitment to safety, perceptions of incident reporting, perceptions of procedures, safety training, etc (Guldenmund, 2007). Quantitative measurements of safety culture can provide leading indicators of safety and consequently offer predictive assessments that enable safety improvements without having to wait for crashes or incidents to happen. Quantitative measurements of safety culture are necessary to compare scores over time between organizations and to quantify the relationship between safety culture and safety outcomes.

The most commonly measured aspect in safety climate studies, independent of sector, is senior management commitment to safety. This is the most studied and best-documented characteristic of a good safety climate. It tends to influence all other safety-related

aspects of organizations (Flin et al., 2000). The other most commonly measured aspects of safety climate, independent of sector, are employee perceptions of SMSs (e.g., work permit systems and safety philosophies) and perceptions of, and attitudes to, risk.

Risking oversimplification, we may suggest that while safety climate often is studied quantitatively by social psychologists, safety culture is often studied qualitatively by social anthropologists and sociologists. The qualitative studies involve research interviews and/or time-consuming fieldworks, where researchers interact with people over long periods of time to learn how they see the world, how they think, how they (inter)act, etc. Qualitative studies of safety culture focus on how it guides individuals' interpretations of actions, hazards, and their identities, and motivates and legitimizes behaviors that have an impact on safety. These studies may give us access to the "deeper" levels of safety culture: the more implicit and taken-for-granted basic assumptions and "tacit knowledge." Qualitative studies focus on how safety culture provides a frame of reference that guides individuals' interpretations of actions, hazards, and their identities, and which motivates and legitimizes behaviors that have an impact on safety.

Organizational Safety Climate among Drivers at Work

There are few studies focusing explicitly on organizational safety climate among professional drivers, or drivers at work in road transport. The studies that do exist often combine organizational safety climate questionnaires with questionnaires measuring safety outcomes such as self-reported driving behaviors (e.g., the Driving Behavior Questionnaire [DBQ]) (Reason et al., 1990) and self-reported crashes (Davey et al., 2006; Öz et al., 2014).

Apart from also focusing on management commitment to safety, like most of the studies of safety climate independent of sector do, the studies of safety climate in road transport organizations also measure safety climate aspects such as, for example, the supervisor's role (adequacy of), fleet safety rules, support from managers and supervisors during the trips, communication and support, work pressure, driver training, colleagues' influence, competence, etc (Davey et al., 2006; Huang et al., 2013; Wills et al., 2005). The studies also often include questions on perceived time and work pressure, and other work-related factors related to efficiency, for example, commission pay, bonus, and reward systems. The studies also include questions measuring attitudes to various traffic safety interventions targeting risky behaviors, perceptions of risky behaviors, and so forth. Although management commitment, perceptions of SMS aspects, and work pressure are recurring safety climate aspects measured in the studies, this indicates the abundance of possible safety climate aspects. As in studies of safety climate in other sectors, it may be difficult to replicate factor structures in different organizational settings.

The existing studies generally find that positive organizational safety culture/climate scores are related to lower incidences of aberrant driving behaviors, measured by means of the DBQ. The DBQ originally distinguishes between three types of aberrant behaviors, based on Reason et al. (1990): lapses, errors, and violations. Lapses typically involve problems with attention and memory. Errors typically involve observation failures and misjudgments. Violations involve deliberate deviations from safe driving practices. The aberrant driving behaviors that have been found to be related to organizational safety culture/climate are violations and errors.

Studies of safety climate/culture in road transport also find a relationship between organizational safety culture/climate scores and crash involvement among professional drivers and drivers at work. As noted, high-quality studies of safety culture interventions, with pre- and post-measurements, test, and control groups, have indicated up to 60% decrease in crash risk (property damage accidents) in the road sector. Retrospective data indicate that an annual average of about 1.500 people in Norway are injured in accidents involving drivers at work annually, and most (81%) of the people injured in these accidents are other road users. At the same time, Norwegian and international research indicates that companies employing drivers at work often focus (too) little on organizational factors such as safety culture and SMS. Estimates including only road goods transport companies in Norway indicate that between 7 and 56 fatalities/severely injured potentially could have be avoided annually, if those companies had focused systematically on safety culture and SMS (Nævestad et al., 2018b). The estimates take into account prevalence, expected effects, etc. These estimates are conservative, and they only apply to about 40% of the accidents involving drivers at work in Norway. Thus, there is a large and largely untapped safety potential in focusing on safety culture and SMS in transport.

The relationship between safety climate/culture and crashes often seems to be mediated by driving behaviors, for example, measured by means of the DBQ. Studying the relationship between organizational safety culture and crashes is, however, not a straightforward issue, as it may be difficult to determine the causal relationship between safety culture and crashes. First, reporting of errors, injuries, crashes, etc., is one of the key characteristics of good safety culture. Thus, organizations with a good safety culture will also have a higher probability of reporting a high number of crashes, injuries, and incidents. (Still, police reported injury crashes would be relatively unbiased.) In organizations with poorer safety culture, on the contrary, we may expect a certain level of underreporting of incidents. Second, cross-sectional studies of safety culture and crashes may also find a negative relationship, e.g. if organizations have learned from crashes and developed a positive safety culture. Nevertheless, high-quality studies of organizational safety culture in road transport also indicate that good safety culture/climate is related to fewer crashes.

Safety Culture among Nonprofessional Road Users

It seems even more important to employ the safety culture perspective to nonprofessional road users, as these include high-risk groups, like those who are too young or too old to be employed by work organizations, and which also include drivers who drive in

high-risk contexts, for example, in weekend, at evening/nights, and with friends (Luria et al., 2014). Few studies have, however, so far been devoted to this issue. Employing the safety culture concept to these groups involves, however, shifting the focus to other social units than organizations, for example, nations, communities, peer groups, and families (Edwards et al., 2014; Luria et al., 2014; Nævestad and Bjørnskau, 2012; Rakauskas et al., 2009). There are several challenges related to this, as some sociocultural units may be less well defined than, for example, work organizations (Nævestad and Bjørnskau, 2012).

Although scholars seem to agree that safety culture is also important for nonprofessional road users, there are still no definitions of traffic safety culture that are commonly accepted by road safety researchers (Edwards et al., 2014; Girasek 2012). Previous studies of traffic safety culture among private drivers define it as, for example, the "beliefs, norms and values and things people use that guide their social interactions in everyday life," "implicit shared values and beliefs," and "common practices, expectations and informal rules that drivers learn by observation from others in their communities (Edwards et al., 2014)."

There seems to be agreement that traffic safety culture among nonprofessional road users can be viewed as a different application of the same foundational concept as organizational safety culture (Edwards et al., 2014). Thus, we may, for example, define safety culture among nonprofessional road users as, for example, shared norms, beliefs, and assumptions that provide frames of reference that guide individuals' interpretations of actions, hazards, and their identities, and which motivate and legitimize behaviors that have an impact on safety, and which are created through interaction within groups. We may hypothesize that this definition also can be applied to the national level, the community level, peer groups, and families.

Safety culture is generally (re)created through interaction processes in groups, and, to explain the existence of traffic safety culture at different levels (e.g., national, communities, peer group, and family), we may hypothesize that this interaction is influenced by factors located at different analytical levels. At the more general level, we may hypothesize that national road safety culture is created through processes involving drivers in the same country. Several factors that could influence a traffic safety culture are national (e.g., traffic rules, the police enforcing the rules, and infrastructure). Based on these factors, we may expect the existence of different national traffic safety cultures. Studies comparing road safety in countries find considerable variations between national road safety records (the fatality risk varies with a factor of up to 10 between EU countries), and between self-reported road safety behaviors, measured by means of the DBQ. In accordance with this, studies find national differences between national traffic safety cultures. A recent study comparing national traffic safety culture among Norwegian and Greek private and professional drivers found a relationship between national traffic safety culture and driver behaviors, which in turn were related to self-reported accident involvement (Nævestad et al., 2019). The authors found that the differences were in accordance with the national road safety records in the two countries. This study defines road safety culture as shared patterns of behavior, shared norms prescribing certain road safety behaviors, and shared expectations regarding the behaviors of others. The study measures national traffic safety culture as descriptive norms, hypothesizing that the mechanisms between national traffic safety culture and road safety behavior are drivers' perception of what is "normal" and expected from drivers within their country, generating a subtle social pressure to behave in certain ways. This hypothesized mechanism may explain the influence of road safety culture in several different groups (national, community, peer groups, and family) on behaviors, and we may hypothesize that the perceived social pressure is stronger, contingent on the importance of the group (e.g., that family and peers are most important).

It also seems well founded to hypothesize the existence of traffic safety culture at the community level, as road user interaction to a large extent occurs between a given number of actors within relatively geographical limited areas (Luria et al., 2014). This especially applies to islands, which to some extent are closed communities. The mentioned study of traffic safety culture in Norway and Greece found such an "island effect", and a previous study has also found differences between traffic safety culture in rural and urban areas.

Some studies also apply the traffic safety culture perspective to peer groups, which can be defined as a group of people sharing some key characteristics, often a combination of age, sex, and/or crucial interests. This type of sociocultural group membership is hypothesized to be especially important, as its members are assumed to view each other as equal, significant others, who share identities and who often exercise a considerable level of normative pressure to comply with certain norms for behavior. In accordance with this, studies have found descriptive norms at the peer level to influence road user behavior.

Finally, it should be noted that the application of the safety culture concept to nonprofessional road users is less developed than the organizational safety culture concept. The successful application of the safety culture concept to private drivers seems to be contingent on developing more research-based knowledge on: (1) the mechanisms generating traffic safety culture in different sociocultural units (nations, communities, peer groups, and families), (2) a theoretical explanation of the influence of traffic safety culture on traffic safety behaviors in these sociocultural units, and (3) how this knowledge can be utilized to develop successful interventions to improve road safety (Nævestad et al., 2019). We will return to these issues later.

How Can Safety Culture Inform Preventive Measures in the Road Sector?

Approaches to Influencing Safety Culture among Drivers at Work

Although there are few studies of explicit safety culture interventions in the road sector, the research on organizational safety culture stands on the shoulders of the more well-developed organizational culture research. It is therefore easier to describe how this perspective can inform measures to prevent road crashes, than it is to describe how the research on nonprofessional road users can inform preventive measures (as this scarcely has been studied).

Based on existing research, we may conceive of at least three ways of influencing organizational safety culture in organizations employing drivers at work. First, managers may influence safety culture through their daily management of safety culture. Schein (2004) refers to "six primary embedding mechanisms" that managers can use to shape culture:

1 What managers pay attention to, measure, and control on a regular basis
2 How managers react to critical incidents and organizational crises
3 How managers allocate resources
4 Deliberate role modeling, teaching, and coaching
5 How managers allocate rewards and status
6 How managers recruit, select, promote, and excommunicate

Although this probably is the most important way of influencing safety culture, due to its regularity and comprehensiveness (ideally applying to all aspects of organizational life), these mechanisms have, to a little extent, been subjected to robust evaluations in transport. The reason is probably that this mode of influence is constant, indefinite, and hard to delineate and define. It must, however, be noted that the importance of these mechanisms is indicated by the fact that management commitment to safety is the most important aspects in studies of organizational safety climate. The mechanisms specify and operationalize how management may indicate commitment to safety. Several scholars criticize, however, the assertion that leaders initiate and shape integrated organizational cultures in organizations. They hold that culture emerges bottom-up, as cultures are created and recreated through group members' interaction and negotiation over meaning (Nævestad et al., 2018a). This means that organizations comprise several subcultures that may respond negatively to managerial efforts to manage culture, and that changing and managing safety culture is a very demanding task.

Second, safety culture in organizations may also be influenced by means of interventions. A systematic literature review of safety culture interventions in transport organizations, published in 2018, identifies eight relevant studies of interventions that may be defined as safety culture interventions in road transport organizations (Nævestad et al., 2018a). Generally, the interventions have a broad safety focus, which means that safety culture is not the primary target of the interventions. Effects on safety culture are only measured (or assumed to happen) as an additional effect of a broader set of organizational safety measures. The interventions also vary widely in resource intensiveness. Nevertheless, the author concludes that safety culture interventions seem to be effective, as the most robust of the reviewed studies (with pre- and post-measurements, test, and control groups) indicates that safety culture interventions improve safety culture and safety behaviors, and reduce crashes. However, as the studied interventions often are very different, the author identifies four key elements that seem to be common in all the reviewed safety culture interventions:

1 Appointing a key person (generally a manager) to be responsible for implementing the intervention.
2 Institutionalizing joint discussions and risk assessments of workplace hazards, involving managers and employees.
3 Implementing and monitoring measures based on these discussions and joint risk assessments, for example, reporting systems and training.
4 Maintaining effective communication about safety issues in the organization, in line with Reason's depiction of an informed safety culture.

The authors concludes that the basic requirements of safety culture change seem to institutionalize joint discussions of workplace hazards facilitated by manager commitment and employee involvement.

A third possible approach to influencing organizational safety culture is by implementing SMS. As noted, this is a common strategy in other transport sectors, in which SMS fostering positive safety cultures are required. The 2018 review referenced earlier mentions at least one high-quality study describing how voluntary SMS implementation (ISO:39001) in road transport organization fosters positive safety culture.

Approaches to Influencing Safety Culture among Nonprofessional Road Users

Describing how the safety culture perspective can be used to inform preventive measures among nonprofessional road users is, as noted, a relatively unresearched issue compared to the research on organizational safety culture interventions among drivers at work. One possible approach is to take the knowledge about the factors influencing traffic safety culture in the different sociocultural groups as the point of departure, and to identify how to effectively influence these. In a recent study comparing national traffic safety culture in Norway and Greece, the authors hypothesizes that national traffic safety culture is (re)created through road user interaction, which is influenced by infrastructure, enforcement, training, the composition of road users, and economic conditions (Nævestad et al., 2019). The authors also suggest that national traffic safety culture could be influenced by targeting the five factors influencing the interaction among road users. They argue that relevant questions in this respect are, for example, which factors are possible to influence? (How) do the factors interact? What are the expected outcomes? Which is the most important factor? They also state that a crucial question is the extent to which traffic safety culture is an independent social force, and the extent to which it merely reflects other influencing factors (e.g., infrastructure and enforcement). An important question related to this is the extent to which collectively shared norms for behavior remain unchanged, although the factors through which they originally were influenced by change, or whether shared norms "follow" from infrastructure, police enforcement, and education. We may hypothesize that the interaction between road users creates an independent dynamic where new norms are developed, which not necessarily reflect the infrastructure. Certain social groups may develop norms prescribing unsafe road behaviors, despite good training, infrastructure,

and police enforcement. This discussion and several of the discussed factors (e.g., interaction, enforcement, and infrastructure) are also relevant in the discussion of how to influence traffic safety culture at the community level.

A second and relatively widespread approach that is discussed by the mentioned study, and which already is applied in several countries, is to change traffic safety culture through campaigns aiming to change road users' attitudes, norms, and thus to motivate safe(r) road transport behaviors (Nævestad et al., 2019). Relevant questions in this respect are, for example, how do social norms for road safety behavior come about? To what extent is it possible to change such norms through other ways than the interaction processes in which (we assume) that they are created? How should it be done? Research on road safety campaigns often shows that they are more efficient when they are combined with police enforcement. Thus, future research should also shed more light on such relationships and the combinations of mechanisms generating changes in traffic safety cultures.

A third approach to influencing traffic safety culture among nonprofessional road users, that also is discussed in the aforementioned study of Norway and Greece, is to employ a social norms approach, targeting descriptive norms, that is, perceptions of what other people in a given group do (Nævestad et al., 2019). As noted, the study of national traffic safety culture in Norway and Greece hypothesized that the observed relationship between national traffic safety culture and road safety behaviors could be explained by pointing to descriptive norms, creating a subtle social pressure to behave in certain ways. The underlying idea behind the social norms approach to interventions is that people who behave in undesirable ways (e.g. driving under the influence of alcohol, failing to use seat-belt) tend to overestimate the prevalence of risky behavior among other people (e.g., in their country and in peer groups) to justify their own undesirable behavior (e.g. "everybody drink and drive"). This effect is referred to as false consensus. Thus, the social norms approach hypothesizes that by informing people about the actual prevalence of risky behavior in given groups, the false consensus effect will be reduced or removed, and mild social pressure (i.e., the descriptive norms mechanism) will make people behave in safer ways. This approach has successfully been employed in traffic safety interventions. The social norms approach may, however, not work if road users at risk have fairly correct perceptions of their peers' (un)safe behavior. This could be the case in high-risk subcultures, which may be based on, and defined by, risky behaviors.

See Also

The Swedish vision zero – a policy innovation

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