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Development and validation of safety climate scales for mobile remote workers using utility/electrical workers as exemplar☆

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A B S T R A C T

Purpose: The objective of this study was to develop and test the reliability and validity of a new scale designed for measuring safety climate among mobile remote workers, using utility/electrical workers as exemplar. The new scale employs perceived safety priority as the metric of safety climate and a multi-level framework, separating the measurement of organization- and group-level safety climate items into two sub-scales. The question of the emergence of shared perceptions among remote workers was also examined.

Method: For the initial survey development, several items were adopted from a generic safety climate scale and new industry-specific items were generated based on an extensive literature review, expert judgment, 15-day field observations, and 38 in-depth individual interviews with subject matter experts (i.e., utility industry electrical workers, trainers and supervisors of electrical workers). The items were revised after 45 cognitive interviews and a pre-test with 139 additional utility/electrical workers. The revised scale was subsequently implemented with a total of 2421 workers at two large US electric utility companies (1560 participants for the pilot company and 861 for the second company). Both exploratory (EFA) and confirmatory factor analyses (CFA) were adopted to finalize the items and to ensure construct validity. Reliability of the scale was tested based on Cronbach's α. Homogeneity tests examined whether utility/electrical workers' safety climate perceptions were shared within the same supervisor group. This was followed by an analysis of the criterion-related validity, which linked the safety climate scores to self-reports of safety behavior and injury outcomes (i.e., recordable incidents, missing days due to work-related injuries, vehicle accidents, and near misses).

Results: Six dimensions (Safety pro-activity, General training, Trucks and equipment, Field orientation, Financial Investment, and Schedule flexibility) with 29 items were extracted from the EFA to measure the organization-level safety climate. Three dimensions (Supervisory care, Participation encouragement, and Safety straight talk) with 19 items were extracted to measure the group-level safety climate. Acceptable ranges of internal consistency statistics for the sub-scales were observed. Whether or not to aggregate these multi-dimensions of safety climate into a single higher-order construct (overall safety climate) was discussed. CFAs confirmed the construct validity of the developed safety climate scale for utility/electrical workers. Homogeneity tests showed that utility/electrical workers' safety climate perceptions were shared within the same supervisor group. Both the organization- and group-level safety climate scores showed a statistically significant relationship with workers' self-reported safety behaviors and injury outcomes.

Implications: A valid and reliable instrument to measure the essential elements of safety climate for utility/electrical workers in the remote working situation has been introduced. The scale can provide an in-depth understanding of safety climate based on its key dimensions and show where improvements can be made at both group and organization levels. As such, it may also offer a valuable starting point for future safety interventions.

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1. Introduction

1.1. Safety climate

Safety climate is defined as the shared perception among workers regarding their organization's policies, procedures, and practices with respect to the relative value and importance of safety (Griffin and Neal, 2000; Zohar, 1980, 2000, 2011, in press) and indicates a temporal state that is measured at one discrete point in time (Cheyne et al., 1998). Formal policies are explicit (i.e., written procedures, overt statements), while enforced policies or enacted practices are implicit (i.e., observing the actions of management in relation to key policy issues; Zohar, 2008). Enacted policies inform employees' about likely organizational consequences they will face if they sacrifice production for safety or vice versa (Zohar, 2008). The enforced policies and procedures communicate to employees the relative priorities (e.g., safety vs. speed or flow of production) of their organization. In essence, an organization with a strong safety climate communicates safety information formally through meetings and training and informally through on-the-job discussions (Christian et al., 2009). It is also important to note that managerial commitment is at the core of safety climate, with an important role in the theoretical and empirical development of safety climate (Zohar, 2008). Overall, safety climate is one of the best leading indicators of organizational safety outcomes, such as frequency or severity of injury incidents (Beus et al., 2010; Christian et al., 2009).

1.2. The need for studying safety climate for remote workers using utility/electrical workers as exemplar

1.2.1. Remote workers

Remote (or mobile) workers are defined as individuals who work at a distance from a supervisor, thereby reducing in-person supervision and increasing technology-mediated communication (Barsness et al., 2005; Kurland and Bailey, 1999). In general, there is no one to observe their level of effort, productivity, safety, or time spent on the job (Barsness et al., 2005). Much of the literature that refers to remote workers describes teleworkers who work from home, satellite offices, neighborhood work centers, or while traveling from one location to the next (Kurland and Bailey, 1999). This study extends the remote worker literature to the utility industry, where workers travel to different locations throughout the day to complete their work. A parallel investigation of long-haul truck drivers in the lone worker situation has previously been published (Huang et al., 2013).

1.2.2. High safety risk in the utility industry

The number of occupational injuries and illnesses requiring days away from work was 5650 in private utility companies and 4770 in the public utility companies in 2010, for a total of 10,420 workers injured and ill (NIOSH, 2012). In 2010, there were 42 fatalities in the utility industry as a whole (NIOSH, 2012), which is an increase from the 25 fatalities in 2009 (BLS, 2011a). Factors that contribute to injury risk in the utility industry include potentially hazardous and unpredictable work environments, long shifts, working in emergency situations, physically demanding maintenance and repair tasks, equipment use, customer interaction and, for certain employees, extensive travel and driving (Kelsh et al., 2004).

The utility industry includes several types of services: electric power, natural gas, water supply, steam supply, and sewage removal (BLS, 2011b). Of the 559,500 waged jobs in the utilities industry in 2008, electric power alone provided 404,700 of the jobs (72%; BLS, 2011c). The electric power industry is particularly important to study because of the numerous challenges the electrical utility companies face. These challenges include changing worker demographics, deregulation, and increased competition (Kelsh et al., 2004). The average age of employees in the US electric power industry is among the highest in the world (Ashworth, 2006). Recently, there has been downsizing in the industry as a result of deregulation and fewer hires made because of work practice redesign and technology implementation (Gross et al., 2002; Niederjohn, 2003). While energy generation has steadily increased by 30% from 1970 to 2004, employment has decreased by 23.7% (Ashworth, 2006). Greater advances in technology change the types of skills utility workers need (Borland, 2002; Chowdhury, 2000; Gross et al., 2002). The rapid advances in technology also affect safety, making it necessary to continuously monitor, reevaluate, and analyze worker injury risk (Kelsh et al., 2004). In fact, Cawley and Homce (2006) examined trends in electrical injury between 1992 and 2002 and concluded that a majority of fatalities were the result of contact with overhead power lines (47%) and contact with wiring, transformers, or other electrical components (33%).

1.2.3. Safety climate for remote workers in the utility/electric power industry

Different types of industries are likely to have unique dimensions of safety climate and herein arises the need for measurement of industry-specific safety climate (Zohar, 2010). Identifying industry-specific safety climate scales has been suggested in previous research (Zohar, 2010) as a way to recognize new, context-dependent targets of climate perceptions within a given industry. Developing new climate indicators in each industry has the potential to aid researchers in postulating and testing hypotheses which aim to study how climates emerge. Traditional studies of the utility industry have focused on equipment and worker behavior (e.g., Kromhout et al., 1995; Savitz et al., 1997). This study extends the traditional research to include the safety climate impact on safety outcomes for utility/electrical workers who constitute a unique group (remote workers), as they work away from their home base. The objective of this study was to develop and test the reliability and validity of a new scale designed for measuring safety climate among remote workers, using utility/electrical workers as exemplar.

1.3. The conceptual framework of the safety climate measure

The construction of a new safety climate measure specifically for the utility/electric power industry was based on three propositions put forth by Zohar (2008, 2010) following three decades of safety climate research. First, employees should be asked about the safety priority of their organization when examining their safety climate perceptions. Second, follow a multi-level framework in which employees are asked about the safety priorities of their company and their direct supervisors separately. Third, examine whether safety perceptions are shared (Christian et al., 2009; Zohar, 2010). In this study, it was of particular importance to test whether shared perceptions can emerge among remote workers given that they are removed from frequent face-to-face contact with their supervisors and most of their co-workers.

1.3.1. Perceived priorities and multi-level framework for safety climate

In addition to safety, organizations have a number of issues that must be addressed, such as speed or flow of production (Zohar, 2008). Since those operational issues often compete with safety, organizations enforce policies and procedures according to their priorities of safety and other production goals. Therefore, items should present situations concerning competing demands (e.g., safety vs. speed, schedules, flow, profitability). Presenting such situations allows employees to clearly identify their organization's priorities, as they perceive them. The new safety climate scale examines employees' perceptions using safety priority as the metric of safety climate.