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Occupational Risk Perception, Safety Training, and Injury Prevention: Testing a Model in the Italian Printing Industry

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This study examined occupational risk perception in relation to safety training and injuries. In a printing industry, 350 workers from 6 departments completed a survey. Data analysis showed significant differences in risk perceptions among departments. Differences in risk perception reflected the type of work and the injury incidents in the departments. A structural equation analysis confirmed a model of risk perception on the basis of employees' evaluation of the prevalence and lethalness of hazards as well as the control over hazards they gain from training. The number of injuries sustained was positively related to the perception of risk exposure and negatively related to evaluations about the safety training. The results highlight the importance of training interventions in increasing workers' adoption of safety procedures and prevention of injuries.

Keywords: risk perception, safety training, occupational injuries, printing industry, and prevention

In the industrialized world, the promotion of safety in the workplace strives to improve the quality of work life and prevent occupational injuries. Despite constant improvements in working conditions over recent decades, the number of accidents at work continues to be a major problem (Barling & Frone, 2004). Potential sources of noncompliance with safe working practices are employees' cognitive schemas for making sense of their work environment. Their judgments of potential risk may derive from an inaccurate evaluation of the prevalence and harmfulness of hazards in their environment. Factors that influence their judgment include the quality of safety training and the experience of an injury at work. This study considers an approach to assessing how employees' evaluations of workplace hazards combine in judgments of their inherent risks.

Review of psychological literature shows a progressive shift of perspective on occupational safety away from an individualistic conception, for which the injury causality resides in the individual (Greenwood & Woods, 1919; Tiffin & McCormick, 1980; Wallace & Vodanovich, 2003), to a psycho-social perspective, which integrates individual characteristics with influences associated with an employee's membership in one or more groups (A. Ho & Leung, 1998; Roethlisberger & Dickson, 1939; Watson, Scott, Bishop, & Turnbeaugh, 2005; Zohar, 2000). From the latter perspective, the safety problem is not only an individual human factor, but also a matter of organizational context (Mearns, Flin, Gordon, & Fleming, 2001; Mearns, et al., 2004). These studies described how an industrial injury can reflect a wide set of individual, social, professional, and organizational variables (Zohar, 1980; Zohar & Luria, 2005).

Historically, beginning with early studies of occupational safety psychology, one of the interests of researchers has always been the study of "injury risk perception." Risk appraisal was first described by Slovic, Fischoff, and Lichtenstein (1984) in terms of control, knowledge, and aversive outcomes. Later, S. Cox and Tait (1991) defined risk perception as acknowledgment of a hazard's capacity to harm and as estimation of the probability of incurring harm. Their model emphasized individual assessments of a hazard's importance and employees' acceptance of that danger. This perspective is critically important in the work setting because of the potential of risk perception to influence accident rates (Mearns & Flin, 1996; Rundmo, 1996). Risk perception assumes importance

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also in the design and development of safety training (Morillejo & Munoz, 2002; Strobel, 1991).

A key challenge for research in risk perception is identifying a brief list of qualities that influence risk perception at work. Leiter and Cox (1992) proposed a model for occupational risk assessment that comprises three major components: lethalness, prevalence, and control. *Lethalness*, the first component in their model of risk assessment, is the amount of harm or injury that a particular hazard may inflict. Hazards can range from those that can kill to those that may cause only minor bruises or scratches. *Prevalence*, the second component, is how frequently one expects to encounter a specific hazard. Lichtenstein, Slovic, Fischoff, Layman, and Coombs (1978) showed that estimates of prevalence may be biased toward underestimating high-frequency hazards and the overestimating of low-frequency hazards. These two components, lethalness and prevalence, are essentially independent factors, each contributing to a sense of vulnerability.

Control is the third component in the Leiter and Cox (1992) model. The more control workers have when they interact with hazards in the workplace, the less vulnerable they feel. The primary and secondary appraisal processes of the transactional model of stress (T. Cox, 1978; Lazarus & Folkman, 1984) provide a means of viewing the relationship of control to the other two components, lethalness and prevalence. Whereas lethalness and prevalence are judgments about the capacity of employees' environment to inflict injury or harm, control is employees' perception of their own ability to cope.

The Theory of Reasoned Action (TRA) predicts a strong association of behavior with behavioral beliefs concerning the efficacy of procedures to assure safety (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Laschinger, Goldenberg, & Bello, 1995). A definitive element of the model is control: People who doubt their control over a situation are less likely to translate intentions into action. The model notes that past experience combines with attitudes to shape estimates of control in hazardous situations.

Tversky and Kahneman (1973) posited that reliance on inaccurate information and faulty processing of that information can lead to errors in workers' assessment of risk. The cognitive effects of stress experienced by a worker (T. Cox, 1987), the context or setting in which a worker can exert greater or lesser control (E. Ferguson, Cox, Farnsworth, Irving, & Leiter, 1994), and the social environments of work groups (Cox & Leiter, 1992) may also bias the processing of information.

Sense of Control in Occupational Risk Perception

Knowledge of risk factors has a preventive function (E. Ferguson, 2001; Hoyos, 1995). However, the knowledge is not necessarily transformed into effective safe behaviors. To improve safety, one must integrate knowledge through the practical application of information. In ambiguous work settings, it is more difficult for employees to develop effective control.

Many injuries occur because workers do not adhere to safety procedures (Bennett, 2003). One reason workers do not follow safety procedures is a belief that they reflect an ideal type of safety rather than real-life experience. Without workers' confidence, procedures fail to provide workers with a sense of control.

Levine and Gorman (1994) proposed that in potentially risky activities (e.g., skiing) the awareness of previous "fatal" incidents modifies risk perception as well as the individuals' sense of control. Participants possessing injury information tend to overestimate the severity of the risk. In a successive work study, based on interviews of 200 injured workers, Kirscenbaum, Oigenblick, and Goldberg (2000) demonstrated that experiencing accidents sensitizes workers: They show relatively more severe perceptions of occupational risks combined with a lower sense of control over those risks. This tendency is particularly evident among workers involved in dangerous tasks.

> *Hypothesis 1.* The experience of injury will be associated with more severe estimates of risk.

> *Hypothesis 2.* The experience of injury will be associated with stricter adherence to safety regulations.

Recent studies (Griffin & Neal, 2000; M. C. C. Ho, 2005; Huang, Ho, Smith, & Chen, 2006) focused on plausible mechanisms through which a safety climate influences injury occurrence and have demonstrated that employees' perceived control over safety mediates the relationship between a safety climate and self-reported occupational injury. In other words, a positive safety climate leads to greater control over risks and more accurate self-reporting of occupational injury. A strong safety climate encourages staff to become more responsible for their own safety performance. In contrast, a poor safety climate

encourages workers to attribute responsibility for safety to the company (Zackowitz, 2001).

The studies presented in this section agreed that the sense of control of occupational risk factors is multiply determined. The two most important variables are shown to be the level of familiarity and experience with the duties or tasks performed and the level of knowledge of the safety behavior to be adopted in potentially dangerous activities. This research also determined that a greater sense of control over hazards increases workers' confidence in managing their interactions with workplace hazards.

Injury Risk Perception and Safety Training

The probability of employees performing safe behavior is influenced by three main factors: first, the presence of perception of risk; second, beliefs about the gravity of the consequences; and third, perceived control over the hazard (Rundmo, 1994; van der Pligt, 1996; Vaughan, 1993). Other studies (Mearns et al., 2001; Rundmo, 1996) attributed the probability of injuries occurring to working conditions, occupational safety training programs, organizational culture, and organizational attitudes toward safety.

Rundmo (1992, 1994) observed that risk perception was affected by satisfaction with company safety procedures, safety training, control, and social support. Rundmo (1994, 1995) found that a poor safety culture discouraged strict implementation of safety procedures. A similar study conducted in the United Kingdom obtained parallel results (Flin, Mearns, Fleming, & Gordon, 1996). A subsequent longitudinal study (Rundmo, Hestad, & Ulleberg, 1998) demonstrated adequate safety training positively modifies the perception of work stress, physical condition of the workplace, safety commitment, attitudes toward safety, and prevention of the injuries.

A study comparing two groups of workers (Norwegian, $N = 622$, and U.K., $N = 1138$) considered psychological and organizational factors in offshore safety (Mearns et al., 2004). The study identified two distinct safety cultures. Although the two companies provided equivalent safety training, qualities of the workplace cultures resulted in clear differences in how workers applied safety knowledge to their work.

In conclusion, it seems that a good safety climate in the workplace positively affects the workers' adherence to the safety procedures of the company and the assumption of safe behaviors versus taking occupational risks (Neal, Griffin, & Hart, 2000; Zohar, 2000). In this sense, an adequate safety climate seems predictive of a low number of occupational injuries (Barling, Loughlin, & Kelloway, 2002; Barling, Zacharatos, & Iverson, 2005).

> *Hypothesis 3.* The data will support a model in which lethalness, prevalence, and control predict employees' estimates of riskiness. Additionally, positive perceptions of training will enhance employees' experience of control over hazards.

In light of the previously cited research, the objectives of the study are to examine the following: (a) relationships between the injury risk perceptions and the number of accidents incurred by workers; (b) relationships between the perceived dimensions of injury risk; and (c) relationships between the perceived dimensions of injury risk and the perception of the safety training received about security procedures.

Method

Setting

The research setting was a printing press company in northern Italy that produces, for third parties, catalogues, books, and reproductions of art. The staff of the firm comprised 700 employees, 300 of whom are office workers and 400 of whom are industrial workers.

The study focused on the industrial workers, represented within six departments, each having specific industrial processes. In the Plates department, workers were employed in the setting of the plates and cylinders used in the printing operations that are then carried out in the Rotogravure and Offset departments. The Packaging department was responsible for the bookbinding and packaging operations, while the Plants department operated several systems (e.g., electrical and hydraulic) and provided services (e.g., storage and waste disposal) that support the production side of the company. Finally, workers belonging to the Maintenance department executed a series of operations oriented toward the monitoring and correct functioning of the different equipment present in the plant.

Participants

Participants in the survey were 350 of the 400 industrial workers in the printing press company (87% response rate). The sample was predominantly male (311) with a few female (39) participants. With respect to age, 31.1% were 30 years old or younger,

29.6% were aged 31–40, 36.4% were aged 41–50, and 2.9% were older than 50. In terms of job tenure, the workers had an average of 17.1 total years of work, 12.5 years of work within the company, and 6.5 years of work in a specific job. Regarding job title, 80.5% were operators, 13.4% were head machinists, and 6.1% were technologists. Workers belonged to six departments within the industry and were distributed in the following way: 5.7% Plants, 22.6% Packaging, 12.9% Plates, 15.1% Rotogravure, 38.0% Offset, and 5.7% Maintenance. This distribution across departments is very similar to that of the total population of employees in the company: 5.0% Plants, 20.0% Packaging, 12.5% Plates, 17.3% Rotogravure, 37.0% Offset, and 8.3% Maintenance.

Measure: Workplace Safety Questionnaire

A structured questionnaire titled Workplace Safety Questionnaire (WSQ) was used to assess injury risk perception among the workers of the company. The design of this instrument followed the general structure of a questionnaire developed for a study of aircraft maintenance technicians (Leiter & Robichaud, 1997), which had been developed from an earlier study referring to microbiological hazards in health care (Leiter & Smiley, 1995).

The questionnaire asked the participants to express their opinions on a series of risk factors present in their workplace, six factors common to all areas of work, and four factors specific to particular departments. These risk factors were determined from a previous qualitative pilot survey carried out in collaboration with the company's prevention and protection service and representatives of the workers' safety organization.

The WSQ produced five subscales. The first subscale, *lethalness*, asked about the potential for harm associated with each risk factor (typically, How great an injury would an accident involving one of the following hazards usually produce?) on a 7-point scale: 1 (a lesion that does not require nursing or medical care) to 7 (a serious or potentially fatal lesion). The second subscale assessed prevalence, rating the frequency of encountering hazards (How often do you think accidents at work occur at [the company] involving the following hazards?) on a 7-point scale: 1 (never) to 7 (daily frequency). The third subscale assessed risk, rating the level of personal exposure (To what extent do you feel at risk of injury to these potential hazards?) on a 7-point scale: 1 (no danger) to 7 (extremely dangerous). The fourth subscale assessed control, rating the possibility of controlling or avoiding each risk (To what extent do you feel your skills and experience give you control over experiencing a work-related accident with the following potential work hazards?) on a 7-point scale: 1 (no control) to 7 (total control). The fifth subscale assessed training, rating workers' opinions with respect to the training they had received (Indicate how much safety procedures training you have received for the following potential work hazards) from 1 (insufficient training) to 7 (highly adequate training).

The WSQ included three single-item measures. The first assessed injury with the question, Have you experienced an injury at work requiring medical attention during the past 3 years? Respondents answered *yes* or *no*. Given the low frequency of injuries, a long time span was necessary to obtain a meaningful number. The survey also asked if employees had experienced more than one injury, but only 9% reported more than one injury.

Self-compliance with safety regulations was assessed with the question: To what extent do you strictly follow safe working procedures? Coworker compliance with safety regulations was assessed with the question, To what extent do you feel your coworkers strictly follow safe working procedures? Responses to both questions were on a 5-point scale: always (5), nearly always (4), sometimes (3), rarely (2), and never (1).

Procedure

The company informed the workers involved in the survey, in advance, of the purposes of the research. The administration of the questionnaire was implemented through a series of programmed small group meetings. The researchers explained to the workers the content of the questionnaire and the method through which they identified specific hazards in their work. The researchers assured employees that their participation in the survey was voluntary and that their responses would remain anonymous.

Results

Relationships Among the Constructs

Table 1 displays the means, standard deviations, alpha levels, and correlations for the variables in the study. Consistent with Hypothesis 1, experiencing an injury was positively associated with employees' estimates of the lethalness, prevalence, and risk to

Table 1
Correlation Coefficients Among Perceived Dimensions of Injury Risk, Injuries Occurred, and Compliance by Self or Others

Variable	*M*	*SD*	α	2	3	4	5	6	7	8
1. Injuries (1 = no; 2 = yes)	0.47	0.66	n/a	.09*	.10*	.16**	.03	−.07	−.08	−.14**
2. Lethalness	4.17	1.24	.84		.57**	.64**	.04	.01	−.03	−.09*
3. Prevalence	3.50	1.18	.85			.65**	.06	−.11	−.08	−.18**
4. Risk	3.58	1.18	.85				−.03	−.13*	−.04	−.15**
5. Control	4.28	1.16	.84					.44**	.04	.08
6. Safety training	3.60	1.55	.94						.08	.18**
7. Compliance by self	3.02	0.70	n/a							.52**
8. Compliance by coworkers	2.59	0.85	n/a							

Note. $N = 323$. *M* = mean; *SD* = standard deviation; n/a = not applicable.
* $p < .05$; ** $p < .01$.

workplace hazards. It was negatively related to employees' estimates of coworkers' compliance with safety regulations. Contrary to Hypothesis 2, it was unrelated to employees' compliance with safety regulations. It was also unrelated to their estimates of control over hazards or the quality of training they have received.

Table 1 indicates a high level of consistency among the three risk estimates, lethalness, prevalence, and risk; these qualities are not correlated with control. Risk and prevalence are negatively related to employees' evaluation of training. Control is strongly and positively related to training quality.

Self-compliance is significantly correlated only with coworker compliance that in turn is correlated with every other measure except for control. Overall, coworker compliance with safety regulations is associated with higher quality safety training, infrequent injuries, and low levels of harm, frequency, and risk.

A within-subjects *t* test confirmed that employees rated their own compliance with regulations significantly more positively than they did coworker compliance, $t(336) = 10.50$, $p < .001$.

Injury: Departmental and Individual Relationships

Table 2 describes the six departments in reference to the percentage of departmental employees who indicated that they had experienced an injury requiring medical attention in the past 3 years. These responses have a distinct pattern, $\chi^2(5) = 19.71$, $p < .001$. In three units (Plants, Maintenance, and Rotogravure), approximately 50% of employees reported an injury; the other 50% reported zero injuries. The other three units reported a smaller proportion of injuries. These two sets of units were defined respectively as high injury units ($N = 148$), with an average of 49.3% of employees reporting injuries, or low injury units ($N = 180$), with 31.1% of employees reporting an injury.

The hypotheses regarding the relationships of employees' risk perception with their experiences with injuries was tested on the departmental and the individual level through parallel multivariate analyses of variance (MANOVAs). The departmental analysis used the designation of a high versus low injury unit as a two-level independent variable. The MANOVAs tested the dependent variables in three groups: risk perception variables, training/control variables, and compliance variables. The criterion for significance was Wilks' lambda with a .05 level of significance.

The MANOVA on risk perception was significant overall, $F(3, 344) = 8.96$, $p < .001$, $\eta 2 = .072$; observed power = .996. As is indicated in Table 3, each of the three dependent variables displayed dis-

Table 2
Number of Respondents Experiencing Injuries in Past 3 Years by Department

	Injury in past 3 years		
Department	No	Yes	Total
Plants	41	36	77
Packaging	17	1	18
Plates	32	10	42
Maintenance	10	10	20
Offset	75	45	120
Rotogravure	24	27	51
Total	199	129	328

Table 3
Univariate Analyses of Variance for Risk Perception: Departmental Analysis

Dependent variable	*F*	Significance	Partial η2	Observed power
Lethalness	9.03	.003	.03	.850
Prevalence	25.53	.001	.07	.999
Risk	16.20	.001	.04	.980

Table 5
Univariate Analyses of Variance for Risk Perception: Individual Analysis

Dependent variable	*F*	Significance	Partial η2	Observed power
Lethalness	4.01	.111	.008	.357
Prevalence	7.42	.024	.016	.620
Risk	13.08	.002	.029	.871

tinct differences when using a Bonferroni-corrected significance level of .016 to adjust for repeated tests. The high injury units reported greater harm (high = 4.39; low = 3.99), greater frequency (high = 3.84; low = 3.21), and greater risk (high = 3.86; low = 3.35). This pattern provided a more detailed confirmation of Hypothesis 1.

The MANOVA on training and control was not significant overall, $F(3, 344) = 2.25$, $p = .107$, $\eta 2 = .013$; observed power = .456. The MANOVA on compliance was significant overall, $F(3, 344) = 14.41$. $p < .001$, $\eta 2 = .079$; observed power = .999. As is indicated in Table 4, the univariate analyses of variance (ANOVAs) were significant for both self-compliance and other compliance. The low injury units reported greater self-compliance (high = 3.83; low = 4.17) and greater coworker compliance (high = 3.34; low = 3.78). This finding supported Hypothesis 2 on the level of units.

The MANOVAs on the individual level followed the same strategy. Instead of the injury unit variable, participants were differentiated according to whether they had personally experienced an injury. The MANOVA on risk perception was significant overall, $F(3, 322) = 3.94$, $p = .018$, $\eta 2 = .031$; observed power = .764. As is indicated in Table 5, only risk of the three dependent variables displayed a unique difference when using a Bonferroni-corrected significance level of .016 to adjust for repeated tests. The overall trend was for the injured employees to report greater harm (injured = 4.31; not injured = 4.08), greater frequency (injured = 3.68; not injured = 3.37), and greater risk (injured = 3.82; not injured = 3.42).

The MANOVA on training and control was not significant overall, $F(3, 344) = 1.17$, $p = .312$, $\eta 2 = .007$; observed power = .256. The MANOVA on compliance was not significant overall, $F(3, 344) = 2.58$, $p = .077$, $\eta 2 = .016$; observed power = .513.

Table 4
Univariate Analyses of Variance for Compliance: Departmental Analysis

Dependent variable	*F*	Significance	Partial η2	Observed power
Self-compliance	20.00	.001	.056	.994
Coworker compliance	23.72	.001	.066	.998

Prediction of Risk: Direct and Mediated Relationships

The WSQ has a matrix structure with issues (risk, frequency, lethalness, control, and training) on one dimension and hazards on the second dimension. A confirmatory factor analysis (CFA) tested a model that defined five factors for the issues plus one factor for each of the six hazards that were common for all respondents. The single-item indicators of safety compliance were not included in this analysis because of problems of identification and interpretation they present in CFAs (Byrne, 1994). The CFA freed correlations among the five issue factors and among the six hazard factors, but permitted no correlations between these two groups of factors. No correlations among error terms were freed. The first item coefficient for each of the 11 factors was set to 1.00 to establish the scale. Because of the kurtosis found in the responses, the analysis used the robust analysis option of EQuationS (EQS), a structural equation computer application (Byrne, 1994) that calculates the Satorra-Bentler chi-square (Satorra & Bentler, 1988). The criterion for a good fit was a CFA greater than .90 and a Root Mean Square Error of Application (RMSEA) less than .06; the criterion for an excellent fit was a CFA greater than .95 and a RMSEA less than .05.

The CFA found a good fit for the matrix model, $\chi^2(362) = 627.24$, CFI = .931, RMSEA = .049. The four largest modification indices were associated with correlated errors between pairs of sequential

items. Freeing those four error correlations improved the fit for the modified matrix model, $\chi^2(358) = 545.65$, CFI = .951, RMSEA = .042. In contrast, a five-factor issues model including only the five issue-based factors produced a poor fit, $\chi^2(395) = 1263.32$, CFI = .774, RMSEA = .085. This model had large modification indices associated with four error correlations for specific items across the issues that were addressed in the matrix model.

A structural equation analysis tested the Leiter and Robichaud (1997) model of risk perception on the basis of employees' evaluations of lethalness, prevalence, control, and training. The model that built upon the modified matrix model with correlated hazard factors but with no correlated errors, included direct paths from control, lethalness, and prevalence to risk. As in Leiter and Robichaud (1997), control was predicted by training. In addition, prevalence was predicted by lethalness, following the availability heuristic in which striking qualities of an event influence estimates of its frequency (Tversky & Kahneman, 1973). The Leiter and Robichaud (1997) model (see Figure 1) produced a good fit, $\chi^2(366) = 634.97$, CFI = .930, RMSEA = .049, supporting Hypothesis 3.

Discussion

The analyses confirm that employees have a coherent perspective on their perception of occupational risks. Employees' overall risk appraisal is consistent with their estimates of the prevalence and potential harm of hazards. The CFA provides support for a matrix model of the WSQ that produces distinct scores for each of the five issues (risk, prevalence, lethalness, control, and training) while accommodating respondents' consistency in their consideration of identical hazards across these five issues. The structural equation model (SEM) confirm core elements of the Leiter and Robichaud (1997) model, including a mediating role for control and a partial mediating role for prevalence. The analyses also confirm a consistent relationship of risk perception with the experience of workplace injuries. Employees who had experienced an injury perceived the workplace as more hazardous than did their noninjured coworkers from the individual or departmental perspective. These results are considered from the perspective of a cognitive model of risk perception.

The printing business encompasses complex operations organized into distinct departments. Some operations involve large machinery, moving parts, volatile chemicals, and heavy containers. Specific work roles and departmental assignments bring employees into contact with distinct hazards with varying frequencies. This structure of work permits differentiating units according to their overall history of injury: Half of the units had injury rates of 50%; the other half reported fewer injuries. Examining the differences between these units suggests that employees develop distinct perspectives on workplace hazards and that these perspectives reflect the departments' histories of injury. Although employees in the high injury units perceived their work settings to be more hazardous, they did not report that training was more prevalent in these units. They did note a more thorough attention to safety regulations in the high injury units.

The SEM confirmed distinct contributions from each of the three dimensions of harm, frequency, and control. This pattern supports the model's central tenet that people determine riskiness on the basis of a hazard's prevalence, its capacity to inflict harm, and

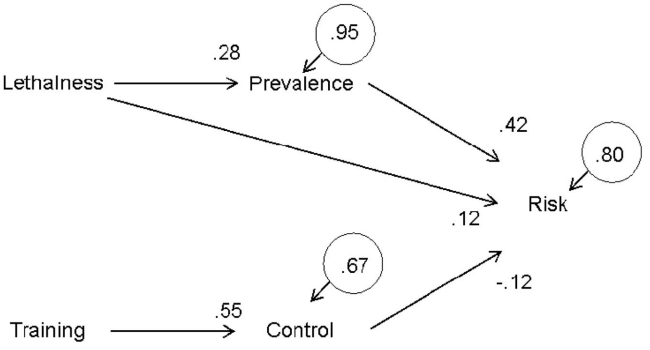

Figure 1. M. P. Leiter and L. Robichaud's (1997) model.

confidence in their capacity to control their interactions with the hazard. Employees combine their judgments on these three dimensions to derive an overall estimate of risk within their subjective perspective on their work environment. Prevalence's mediating role in the relationship of lethalness with risk captures a role for the availability heuristic in estimates of its frequency (Tversky & Kahneman, 1973). These shorthand judgment schemas assist employees in making sense of complex work environments, although they lead to overestimated frequencies for highly salient hazards. Finally, control's role in mediating the relationship of training with risk suggests that the primary impact of training is increasing employees' efficacy in managing risks.

Consistent with Leiter and Robichaud (1997), the WSQ provides a way to assess employees' evaluations of the danger, frequency, and riskiness of various hazards. Also, it provides a measure of the extent to which participants experience control over each of the identified workplace hazards. The scale's format allows researchers to adapt it to specific situations by identifying specific hazards of concern for each work setting. The scale allows for distinct assessments of the strictness with which participants and their coworkers adhere to safety requirements in their work. The structure of the scale gives clear feedback to workers and management through its focus on specific aspects of the work environment that pertain to safety.

The CFA confirms that the scale clusters into five issue-based factors. Inclusion of hazard-based factors acknowledges a secondary pattern of relationships for items across the five issues referring to a specific hazard. An SEM approach has the capacity to include these relationships in the overall model. In doing so, the analysis identifies a structural element to the relationships. The matrix structure is appropriate to the construct being measured—employees' evaluation of a finite list of hazards in relation to distinct issues—that fully integrates two dimensions. In the usual scoring of the WSQ, the five issue scores provide distinct indicators that accommodate a variety of workplace hazards.

This study demonstrates that employees who sustain industrial injuries perceive a more risky workplace, confirming other studies that have investigated changes in the perception of risk in the presence of traumatic events (Cree & Kelloway, 1997; Halpern-Felsher et al., 2001; Mearns & Flin, 1995; Rundmo, 1996; Weinstein, 1989; Weinstein & Nicolich, 1993). Furthermore, our findings emphasize the importance of workers' perceptions of the organization's level of commitment to their job concerns, specifically those related to safety and occurrence of injury, as highlighted also by Rundmo (1994) and Zohar (2000).

This study is limited by its cross-sectional design within a single organization. As was suggested by Leiter and Robichaud (1997), further progress in this area would benefit from longitudinal studies with safety interventions. A key intervention is implementing safety programs in which employees express confidence. Our findings are similar to those of other researchers (Becker & Morawetz, 2004; Duffy, 2003), who have demonstrated that workers who receive adequate training on safety procedures feel more empowered to address the hazards that they encounter. Developing multiple-item indicators for the evaluations of self-compliance and others' compliance with safety procedures would strengthen the measure. Single-item indicators encounter reliability challenges and are not amenable to SEM analyses. The CFA also notes evidence of method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) beyond the hazard factors in the large error correlations for four sequential items; these correlations indicate a response set across similar items within a questionnaire. Variations in the ordering of items may help to reduce the impact of method variance.

An interesting finding from a study by Leiter and Robichaud (1997) is that training is the construct linking employees' experience of burnout and perception of risk at work. In particular, these authors demonstrated how workers' physical and psychological states can condition the extent to which workers manifest effective safety behavior. On the basis of this finding, a possible area of future research could be to identify the mechanisms through which phenomena such as burnout and work engagement influence the learning processes with respect to safe behavior at work. In conclusion, consistent with most previous literature (Barling, Loughlin, & Kelloway, 2002; Barling et al., 2005), this research indicates that a company's commitment to adequate safety training is an important quality of its organizational culture.

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