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THE PSYCHOMETRIC PROPERTIES OF A SAFETY CLIMATE SCALE

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ABSTRACT

Taking into consideration the gaps in the safety climate measurement literature, a new scale was developed and its psychometric properties were examined in a Ghanaian industrial context. In a cross sectional survey, 273 technical mine workers, representing a response rate of 90.7%, returned their fully filled questionnaires. Principal component analysis revealed four underlying safety climate dimensions; each of which had an acceptable Cronbach's alpha reliability. Further, all the identified dimensions effectively discriminated among workers on the basis of their work unit and position. Together the findings suggest that the scale possesses a satisfactory degree of reliability and it is discriminantly valid. The scale can thus be used for periodic safety climate monitoring within the mining industry.

Key Words: Safety Climate; Psychometric property; Mining Industry

1. INTRODUCTION

Safety management is a core business function especially in organizations considered as high-risk like the aviation, chemical, electrical, mining, and oil industries. Concerning this organizational function, the literature suggests that maintaining a positive safety climate is currently at the forefront of efforts to manage safety proactively (Wills, Biggs & Watson, 2005, Zohar, 2008). A key to maintaining a positive safety climate is however having a tool that is able to indicate the state of the prevailing safety climate at any point in time, identify aspects of the safety management system that need improvement and can be used to monitor the effectiveness of interventions applied. A number of such safety climate scales have been developed and tested in other industries (Cooper & Philips, 2004). But in spite of the crucial nature of safety in their operations, mining industries have not been a common place for such studies. Also, almost all the previous studies have been conducted in the Western and Eastern countries (Vinodkumar & Bhasi, 2009). There is a paucity of similar investigations in Africa and for that matter Ghana.

For Ghanaian mining industries to benefit from the use of safety climate assessment as a proactive means to manage safety, there is therefore the need to develop and explore the psychometric properties of safety climate scales in that context. This is essential since scales from different industrial contexts cannot be assumed to apply equally valid in the Ghanaian industrial setting. Coyle et al. (1995), Dedobbeleer and Beland (1991), and Vinodkumar and Bhasi (2009) reported that the factor structure of the same safety climate scale varies according to the industrial setting where it is used. This suggests that workers in different industries differ in the meaning and degree of importance assigned to the various items on any specific safety climate scale. This paper reports a study conducted to examine the psychometric properties of a safety climate measure in the Ghanaian context. In the process, the climate for safety within the study industry was assessed.

2. SAFETY CLIMATE AND ITS MEASUREMENT

The term "climate" as used in the organizational behavior literature refers to workers' shared perceptions of the psychologically important aspects of their work environment (Parker et al, 2003). It pertains to workers' descriptions of what they see happening at the workplace. Safety climate, a type of organizational climate, thus refers to workers' perceptions of the enacted safety policies, procedures and practices at their workplace which inform them about the overall value for safety and hence provide the context for their safety behaviors (Neals & Griffin, 2002; Zohar, 1980). Based on this conceptualization, the core task in assessing safety climate is to gather the perceptions of workers regarding the importance accorded safety at the workplace. In doing this, workers are considered as observers of what happen within their workplace and are expected to report their observations rather than their personal behaviors or attitudes or judgment about the state of safety.

The above conceptualization is popular among researchers (Zohar, 2003). However, it is yet to fully inform the development of safety climate scales. In the safety climate measurement literature, conceptual ambiguity constitutes a significant gap. Many researchers have failed to distinguish between safety climate and other closely related constructs, leading led to the operationalization of safety climate with items that do not belong to it (Neal & Griffin, 2002; Zohar, 2003). For instance, items pertaining to the outcome of safety climate such as safety satisfaction and behaviors can be found as part of scales designed to measure safety climate. Also, safety climate has usually been treated as synonymous to safety culture even though existing reviews (see Guldenmund, 2000 and Neal & Griffin, 2004) suggest otherwise.

According to Clarke (2006b), many of the existing safety climate scales actually assess safety attitudes or a mixture of attitudes and perception instead of assessing perceptions alone. Theoretically, this compromises the validity and reliability of such scales as tools for proactive safety management. It has also been observed that data obtained by using such scales usually have lower criterion validity with safety outcome variables (Clarke, 2006b). To safeguard the psychometric integrity of safety climate scales, it is essential that they are not confounded with items pertaining to other constructs.

In another respect, organizational theorists have advocated for a multilevel approach to the assessment of safety climate (For details refer to Griffin & Neal, 2000; Zohar & Luria, 2005). However, this call is yet to be completely heeded. In the few cases where the distinction between climate levels (company level versus unit level) was made, unit level safety climate was conceptualized as workers' perceptions of their supervisors' commitment to safety (Zohar 2000; 2003; 2008). By virtue of their proximity to and authority over workers, supervisors would in no doubt be an important social referent at the unit level regarding the value for safety within the unit. Nonetheless, they may not be the only referent; individuals may as well determine the extent to which safety is valued within the work unit by observing the behavioral patterns of their co-workers. This is a group which they consider as similar, desirable and majority. Based on the principle of social influence (Lisa, 2007) such a group would be an important referent for their safety climate perceptions. In relational cultures such as what exist in most African countries the influence of co-worker safety actions may even be greater. Consequently, to be a true reflection of a unit-level safety climate, theoretical models and their associated scales need to take into consideration aspects of co-worker safety attitudes, values and practices.

In this study, a new unit-level safety climate scale was developed for use in the Ghanaian mining context. In developing the scale, the above identified gaps in the literature were considered in order to safeguard the integrity of safety climate as a situational factor that influences safety behavior was.

3. METHODOLOGY

3.1. Scale Development, setting and sample

The study scale was developed by adopting items from Zohar's (2000) group-level safety climate scale and Burt et al's (2008) CARE scale. These items were either used verbatim or rephrased to clarify the meaning. The initial version of the resulting scale was reviewed by two safety officers, and then piloted on 20 workers before .a 21-item final scale was produced. This scale employed a 5-point Likert response format ranging from 1 (strongly disagree) to 5 (strongly agree) and together with some demographic items formed the study questionnaire. To maintain anonymity, the demographic section excluded any identifying data like names.

The questionnaire was used in a cross sectional survey involving 15 work units within a Ghanaian mining industry. The units were purposely selected to allow for the possibility of sampling workers performing each of the popular technical jobs within the mine like drilling, refilling, processing and electrical works. The technical mine workers present in the selected units at the time of data collection formed the population for the study.

3.2. Procedure

After ethical clearance from the appropriate committees, units were visited on an agreed upon day. Potential respondents were met at the unit's safety meeting where they were briefed about the study and their questions were answered before being given the questionnaires. Each questionnaire had a cover sheet that reiterated the ethical conditions under which the survey was conducted. Workers who were proficient in English language completed the questionnaire by themselves while those with poor literacy skills responded to a questionnaire interview in the local dialect – Twi. 10-15minutes was allowed for the completion of the questionnaire and researcher stayed with respondents throughout this period to clarify issues as well as collect completed questionnaires.

3.3. Data Analyses

Of the questionnaires retrieved, 273 (representing a response rate of 90.7%) were deemed as appropriate for further analysis. Those completed by non technical workers were excluded. Data was analyzed using SPSS 16.0. The means, SDs and ranges were examined to ensure that all the data were appropriately entered. Missing data analysis revealed that none of the items had more than 5% missing values and also the pattern of missing data was completely at random. Missing data were thus excluded list wise throughout the analyses as recommended by Peng and Nichols (2003).

4. RESULTS

4.1. Demographics

The maximally and minimally represented work units had 38 and 7 respondents respectively. Males dominated the sample, forming 96.7%. Thirty two respondents held supervisory roles while the rest were frontline operators. Regarding age, 26.7% respondents were between 18-29 years, 33% (30-39 years), 31.9% (40-49years) and 8.4% were 50 years and above. Majority of respondents had some form of basic education only (28.9%) while others had high school (25.3%), technical (24.2%) and tertiary education (2.6%). Pertaining to the number of years at current workplace, respondents working for less than 1 year were 15.8%, 1-5years (19.4%), 6-10years (24.5%), 11-20years (27.8%) and 21+ years (12.5%).

4.2. Factor Structure

To determine the underlying dimensions of the safety climate questionnaire, principal component analysis (PCA) was performed on the 21 items for the 273 cases. The case to variable ratio (13: 1) exceeded that recommended by Field (2008). The data was considered appropriate for analysis as evident by KMO measure of sampling adequacy of 0.74. The population correlation matrix obtained was not an identity matrix [Bartlett's Test of Sphericity = 1120, df= 153, p = .000]. The extracted communalities were between 0.40 – 0.81, hence all 21 items were kept for factor rotation. Safety climate dimensions are theoretically expected to be related. Due to this, direct oblimin (delta = 0), which is a type of oblique rotation was selected during the PCA.

Initial rotation based on Kaiser's criterion of eigenvalues > 1 yielded five factors accounting for 52.49% of the total variance. However, it was noticed that most of the items loaded above 0.4 on the first four factors with only one item loading on the fifth factor. Upon inspection, a break was also found on the fourth component of the scree plot. As recommended by Field (2008) a four factor solution was thus deemed appropriate. Consequently, a forced four factor solution was tested; which cumulatively accounted for 51.09% of the explained variance. The resulting factor loadings are shown in Table 1, which lists only the items that loaded on a single factor and had a loading greater than 0.4.

The identified factors were labeled based on the theme conveyed by most of the items that loaded on them. The labels given to the four factors in the order they occurred during PCA were: Safety communication, Co-worker value for safety, Supervisory monitoring and recognition, and Production pressure.

The first factor consisted of six items, three of which concerned the extent to which workers were informed about the safety events. The other two concerned whether workers were consulted for safety suggestions and what the consequence of voicing out safety concerns. This factor alone accounted for 16.89% of the total variance explained. The second factor concerned the extent to which respondents perceived their colleagues as actively caring for each other's safety; hence its name co-worker care for safety. Respondents' perception of how their supervisor monitors safety behaviors as well as acknowledges workers who adopt safe practices was reflected in the four items that loaded onto the third factor. On the other hand, items on the last factor which together explain 9.99% of the total variance convey a sense of how others in the work unit expect respondents to act when safety seems to be in conflict with production.

Table 1: Rotated Factor Structure of Unit Safety Climate Scale

Items	F1	F2	F3	F4
	Factor Loadings			
1. My supervisor often reminds workers of the potential risks and hazards in our workplace	**.89**	.07	.01	.12
2. Workers in this unit are usually consulted for suggestions about how to improve safety	**.83**	.07	.00	.12
3. In this unit workers are given sufficient feedback about their safety complaints	**.62**	.03	.27	.05
4. In this unit workers receive regular updates on technical aspects of their job that will help them to work safely	**.59**	.07	.19	-.02
5. Workers in this unit are given sufficient information about safety incidents that occur throughout the mine	**.52**	.16	-.08	.13
6. Reporting a safety problem in this unit will not result in negative repercussions for the person reporting it	**.51**	.20	-.18	.13
7. My co-workers take immediate actions to correct safety hazards/risks they notice in this units	.06	**.74**	-.07	.05
8. Workers in this unit openly discuss near misses and share experiences of past injuries with each other	.16	**.71**	.06	.06
9. Workers in this unit strictly warn any colleague who acts unsafely	.03	**.65**	.02	.10
10. Workers in this unit almost always wear their safety protective equipment when they are supposed to	.10	**.52**	.19	-.02
11. Workers in this unit usually discuss about changes that could improve safety	.15	**.51**	.28	-.03
12. My supervisor frequently checks to see if workers are all following safety rules	-.12	.18	**.72**	.13
13. My supervisor often praises or says a good word to workers who pay attention to safety when working	.37	-.07	**.64**	.06
14. My supervisor insists on wearing of personal protective equipments (PPE) even if it is uncomfortable	.15	.21	**.61**	-.32
15. My supervisor usually gets annoyed with any worker who ignores safety rules and regulations, even minor rules	.16	.04	**.60**	.16
16. As long as daily targets are achieved, my supervisor does not care whether we worked by the safety rules or not (R)	.10	.07	.11	**.75**
17. Taking short cut to get a work done quickly is accepted among members of my work crew as long as everything goes well and nothing happens (R)	.11	.07	.03	**.72**
18. Whenever we fall behind schedule and we are not achieving daily targets, my supervisor wants us to work faster rather than by the rules (R)	.03	.10	.05	**.71**
% Variance explained	*16.89*	*13.81*	*10.40*	*9.99*
Cronbach's Alpha	*0.78*	*0.65*	*0.60*	*0.58*

Note: Extraction method: PCA; Rotation Method: oblimin (delta = 0) with Kaiser Normalization; Rotation conveyed in 7 iterations. (R): Indicates reversed worded items

4.3. Reliability

The internal consistency reliability of the scale was assessed using estimates of Cronbach's alpha. Since safety climate is considered a higher order construct (Griffin & Neal, 2000), all the 18 items obtained from PCA were used in calculating the reliability of the safety climate scale as a whole. The Cronbach's alpha value obtained was 0.76; signifying a satisfactorily internal consistency reliability. As evident from Table 1, each of the four identified factors also had acceptable internal consistency reliability with values ranging from 0.58 to 0.78. Together, these results suggest that the scale may be reliable when used to assess the safety climate within the Ghanaian mine.

4.4. **Validity**

As evident for discriminant validity, it was expected that respondents' safety climate perceptions would differ according to their work location and position. To avoid confounding the comparison, MANOVA was performed to analyze the groups on their demographic characteristics to determine whether they differ significantly in terms of age, gender, education and years of experience. The independent variables were the work area and position of respondents.

From the results, no main effect was found for position, Wilk's Lambda = 0.97 [F (4, 241) = 1.90, p = ns], implying that workers in different positions did not differ significantly in terms of gender, age, education and years of experience. On the other hand, a significant main effect was observed for work location, Wilk's Lambda = 0.47 [F (56, 241) = 3.56, p < 0.01]. ANOVA analysis indicated that workers in the various work areas differed significantly (p < 0.05) in terms of their gender. As such, gender was entered as covariate in a MANCOVA performed to determine the discriminant validity of the scale. The four safety climate dimensions were treated as dependent variables; with the respondents' work location and position as independent variables.

The results demonstrated a significant main effect for work unit (Wilk's Lambda = 0.59, F (56, 877) = 2.03, p < 0.01, n^2 = 0.11); implying that workers within different locations had varied safety climate perceptions. The main effect for position was also significant (Wilk's Lambda = 0.93, F (4,225) = 4.75, p < 0.01, n^2 = 0.07); suggesting that climate perceptions differed on the basis of position. The results also show that discrimination of workers was better based on location than on position (n^2=0.11 > n^2=0.07. Contrary, no significant main effect of gender was observed.

Regarding work unit, ANOVA showed that with the exception of production pressure, all the identified safety climate dimensions significantly (p < 0.05) differentiated among workers. Thus, workers from each unit perceived different levels of safety communication, co-worker care for safety and supervisory monitoring and recognition. Also, the ANOVA results in Table 2 revealed that those in supervisory roles (foremen) and frontline operators differed significantly in their perceptions of all the four climate dimensions.

Table 2: Variations in Safety Climate Dimensions by Position

	Safety Climate Dimensions	Foremen (n= 32)		Frontline (n=241)		F
		Mean	SD	Mean	SD	
I.	Communication	4.00	0.69	3.46	0.70	14.04**
II.	Co-worker safety	3.78	0.67	3.34	0.70	6.65**
III.	Supervisor Monitoring & Recognition	3.94	0.60	3.55	0.60	9.89**
IV.	Production Pressure	2.96	0.67	2.62	0.69	4.16**

**represents statistical significance at p < 0.01, *represents statistical significance at p < 0.05

For each dimension considered, the foremen had higher scores than frontline operators. For instance on the production pressure dimension, though they all felt pressured to work faster instead of safely in order to achieve production target, the mean score for the foremen was greater (2.96 > 2.62). Thus, the foremen reported experiencing less pressure.

4.5. Additional Analyses

In addition to the above analyses, MANOVA was used to examine the main effect of the various demographic variables. With this no significant effect was observed for education (F = 0.84, ns), age (F = 0.79, ns) and years of experience (1.01, ns). This implies that, safety climate perceptions did not vary according to these demographic variables.

Using the combined responses from all the work units, a composite mean score per safety climate dimension was calculated to determine the overall safety climate within the Mine as at the time of this study. Also, the percentage of respondents who agreed to each of the 18 climate items was determined. As shown in Table 3, the results of these analyses indicated that generally the safety climate within the mine was high. With the exception of the last dimension, the mean score for all the safety climate dimensions exceed 3 (with 5 being the highest possible score). Item by item consideration revealed that over 50% of workers responded favorable to most of the items. This is an indication that their supervisors and colleagues through their behaviors and attitudes demonstrate a value for safety. This notwithstanding, items pertaining to supervisor and co-workers expectations when safety conflict with production in addition to those concerned with safety feedbacks had low scores below 50%; implying that they were problem areas that required attention.

Table 3: Percentage agreement (agree or strongly agree) with items on the safety climate scale

Items		%
	Communication (Mean = 3.52, SD = 0.72)	
1.	My supervisor often reminds workers of the potential risks and hazards in our workplace	55
2.	My supervisor consults us for suggestions about how to improve safety in this unit	60
3.	In this unit workers are given sufficient feedback about their safety complaints	44
4.	In this unit workers receive regular updates on technical aspects of their job that will help them to work safely	70
5.	Workers in this unit are given sufficient information about safety incidents that occur throughout the mine	42
6.	Reporting a safety problem in this unit will not result in negative repercussions for the person reporting it	50
	Co-worker Safety Caring (Mean = 3.35, SD = 0.76)	
7.	My co-workers take immediate actions to correct safety hazards/risks they notice in this units	65
8.	Workers in this unit openly discuss near misses and share experiences of past injuries with each other	57
9.	Workers in this unit strictly warn any colleague who acts unsafely	59
10.	Workers in this unit almost always wear their safety protective equipment when they are supposed to	62
11.	Workers in this unit usually discuss about changes that could improve safety	63
	Supervisor Monitoring and Recognition (Mean = 3.69, SD = 0.60)	
12.	My supervisor frequently checks to see if workers are all following safety rules	72
13.	My supervisor often praises or says a good word to workers who pay attention to safety when working 46	46
14.	My supervisor insists on wearing of personal protective equipments (PPE) even if it is uncomfortable	60
15.	My supervisor usually gets annoyed with any worker who ignores safety rules and regulations, even minor rules 77	77
	Production Pressure (Mean = 2.79, SD = 0.75)	
16.	As long as daily targets are achieved, my supervisor does not care whether we worked according to the safety rules or not (R)	59
17.	Taking short cut to get a work done quickly is accepted among members of my work crew as long as everything goes well and nothing happens (R)	41
18.	Whenever we fall behind schedule and we are not achieving daily targets, my supervisor wants us to work faster rather than by the rules (R)	25

5. CONCLUSION

The major aim of this study was to determine the factor structure, reliability and the discriminant validity of a safety climate scale when administered to a sample of Ghanaian technical mine workers. The results reveal that the scale provides a means for assessing four dimensions or factors of safety climate. The reliabilities of the scale as a whole and of its specific dimensions were satisfactory. Also, the scale was found to be discriminantly valid, discriminating workers better on the basis of work units than based on job position. Safety climate perceptions were not significantly related to age, gender, education, or work experience. Together, these findings suggest that the scale possesses satisfactory psychometric properties and can be used for periodic mentoring of the safety climate within the industry.

6. DISCUSSION

Safety climate has hardly been explored in Ghana and in mining industries. In Ghana, the only few studies conducted (mainly by Gyekye, 2005; 2006) made use of scales developed in other contexts with no report on their factor structure. Assessing the structure and psychometric properties of a safety climate scale in a Ghanaian mining industry is one of the contributions of this study. In another regards, the findings of this study have significant theoretical and managerial implications.

Discriminant validity refers to the ability of a scale to differentiate between groups that are theoretically supposed to be distinct. In this study, the safety climate dimensions discriminated among workers based on their work units and positions. This is similar to the observations by Clarke (1999), Findley et al. (2007) and Tharaldsen, Oslen and Rundmo (2008). The discrimination according to position should be noted as an expected result because people at different hierarchy differ in the ways they present their organization, with favorable representation correlating positively with position on the organizational hierarchy (Findley et al., 2007). The significant effect of position on climate perception should thus not be considered as a support that safety climate is a dispositional variable.

On the contrary, the fact that safety climate dimensions discriminated more effectively on the basis of work unit than according to position theoretically supports the conceptualized of safety climate as a situational factor. This suggests that the construct needs to be assessed with only items pertaining to respondents' perception, a practice that may enhance the validity of the construct and consequently the reliability of the scale used as opposed to assessing it with a mixture of dispositional and perceptual items as has been the case in previous studies. Based on this, the recommendation by theorists such as Clarke (2006b) and Zohar (2008) is reemphasized that on grounds of validity, scales developed to assess safety climate should not be confounded with items pertaining to dispositional factors like workers' safety attitudes.

Practically, the fact that the safety climate dimensions effectively discriminated among workers in different units suggests that changes in workers' perceptions can be reflected in the data obtained using the study scale. Practitioners can therefore employ the scale to periodically map the safety climate within work units and to assess changes in the state of safety after an intervention strategy has been implemented.

Concerning reliability, there are many types of it in psychometrics. Of interest in this study was the internal consistency as measured by Cronbach's alpha. This type of reliability refers to the degree of interrelatedness among a set of items designed to measure a particular construct (Netemeyer, Bearden, & Sharma, 2003). Observing a high internal consistency implies that respondents answered related items in a similar way while a low value implies that the scale may be measuring more than one variable and as such unrelated items were answered differently by respondents. In this study, the reliability of the overall safety climate scale was 0.76.This is a high value according to the criteria by Coolican (1999), suggesting that the items on the scale were interrelated to each other and assessed a similar variable – the priority given to safety within the workplace.

7. LIMITATION AND DIRECTION FOR FUTURE RESEARCH

A major limitation of this study is that the predictive validity of the scale was not examined. However with evidence of good discriminant validity, the scale can be used in a study focusing purposely on its predictive validity and any other studies involving safety climate as a variable especially in the Ghanaian context with some degree of confidence. It is recommended that such studies are carried out in the future to assess how safety climate and its specific dimensions relates to various safety and non-safety outcomes like workers' safety behavior, injury frequency, and compensation claims. Paradoxically, while the multidimensionality of safety climate is widely acknowledged, most existing studies exploring the climate-behavior relationship have employed the construct in its global sense. It is therefore recommended that future studies make use of the current scale to assess how specific climate dimensions relate to various kinds of workers' safety behavior (e.g. safety compliance and safety initiative taking). Results from such investigations can give an idea of where to focus attention when safety climate driven interventions are been pursued to proactively improve safety.

REFERENCES

Burt, C., Sepie, B., & McFadden, G. (2008). The development of a considerate and responsible safety attitude in work teams. *Safety Science , 46*, 79–91.

Clarke, S. G. (1999). Perceptions of organizational safety: Implications for the development of safety culture. *Journal of Organizational Behaviour , 20*, 185-198.

Clarke, S. (2006b). The relationship between safety climate and safety performance: a meta-analytic review. *Journal of Occupational Health Psychology , 11* (4), 315–327.

Coolican, H. (1999). *Research Methods and Statistics in Psychology.* London: Hodder & Stoughton.

Cooper, M., & Phillips, R. (2004). Exploratory analysis of the safety climate and safety Behaviour relationship. *Journal of Safety Research , 35*, 497–512.

Coyle, I. R., Sleeman, S. D., & Adams, N. (1995). Safety climate. *Journal of Safety Research , 26*, 247-254.

Dedobbeleer, N., & Béland, F. (97-103). A safety climate measure for construction sites. *Journal of Safety Research , 22*, 1991.

Field, A. P. (2008). *Discovering statistics using SPSS.* London: Sage Publications Ltd.

Findley, M., Smith, S., J, G., & O'Neil, M. (2007). Safety climate differences among job positions in a nuclear decommissioning and demolition industry: Employees' self-reported safety attitudes and perceptions. *Safety Science , 45*, 875–889.

Guldenmund, F. (2000). The nature of safety culture: a review of theory and research. *Safety Science , 34*, 215–257.

Gyekye, A. (2005). Workers' perceptions of workplace safety and job satisfaction. *International Journal of Occupational Safety and Ergonomics , 11*, 291–302.

Gyekye, A. (2006). Workplace safety perceptions: miners' and non-miners' perspectives. *Professional Safety , 7*, 34-40.

Lisa, R. (2007). Social Influence. In G. Ritzer, *Blackwell Encyclopedia of Sociology* (pp. 4426-4429). Blackwell Publishing.

Vinodkumar, M., & Bhasi, M. (2009). Safety climate factors and its relationship with accidents and personal attributes in the chemical industry. *Safety Science , 47*, 659–667.

Wills, A. R., Biggs, H. C., & Watson, B. (2005). An analysis of a safety climate measure for occupational drivers and implications for safer workplaces. *Australian Journal of Rehabilitation Counselling , 11*, 8-21.

Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology , 85* (4), 587–596.

Zohar, D. (2008). Safety climate and beyond: A multi-level multi-climate framework. *Safety Science , 46*, 376–387.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology , 65* (1), 96–102.

Zohar, D. (2003). Safety climate: Conceptual and measurement issues. In J. Quick, & L. Tetrick, *Handbook of occupational health psychology* (pp. 123–142). Washington, DC: American Psychological Association.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology , 90* (4), 616–628.

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