Safety Climate Dimensions as Predictors for Risk Behavior

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Abstract

This study examines the interactive relationship between three dimensions of safety climate (management commitment to safety, priority of safety, and pressure for production), and their impact on risk behavior reported by employees. The sample consisted of 623 employees from a chemical manufacturing organization in South Africa. Hierarchical regression analyses were carried out to test the direct effects and the interaction effect of the three safety climate dimensions on risk behavior. The results showed that, as expected, employees' risk behavior was negatively related to management commitment to safety and priority of safety and positively related to pressure for production. Moreover, as expected, the three-way interaction between management commitment to safety, priority of safety and pressure for production was significant. When pressure for production was high, management commitment to safety was positively related to risk behavior, regardless of level of priority of safety on plant. When pressure for production was low, the effect of management commitment to safety on risk behavior was nullified under conditions of high, as compared to low priority of safety on plant. These findings highlight the importance of managerial commitment to safety in contexts where employees experience tensions between production deadlines and safety procedures.

Keywords: Safety Climate; Risk behavior; Safety Performance; Chemical Manufacturer

1.0 Introduction

The importance of safety climate and its relationship with occupational safety has been established across a range of industry settings (Flin et al., 2000; Clarke, 2006; Nahrgang et al., 2008; Christian et al., 2009). Safety climate relates to individuals' perceptions of safety policies, procedures, practices and behaviors in the work environment that indicate the true priority given to safety relative to other organizational goals (e.g. Naveh et al., 2005; Neal and Griffin, 2006; Nahrgang et al., 2008; Morrow et al., 2010). Safety climate is associated with safety practices (Zohar, 1980), compliance with safety standards (Goldenhar et al., 2003), lower occurrence of workplace accidents (Griffin and Neal, 2000; Zohar, 2003; Clarke, 2006) and has also been found to predict safety behavior (Hofmann and Stetzer, 1996; Cooper and Phillips, 2004). Safety climate can therefore be considered as an important variable for understanding safety performance and is used as a leading indicator of unsafe work conditions (Zohar, 1980; Flin et al., 2000; Cooper and Philips, 2004; Hoffmann and Mark, 2006). However, despite its predictive validity many authors emphasize the need for further research which explains how specific features of safety climate are associated with one another and consequently with safety behavior (e.g. Prussia et al., 2003; Pousette et al., 2008; Wirth and Sigurdsson, 2008). In line with this, Zohar (2010) argues that safety climate perceptions should move beyond an isolated focus on safety, toward an evaluation which incorporates the relative priorities among the various safety policies, procedures and practices and their competing domains (e.g. productivity or efficiency).

This paper, using an adapted version of the Offshore Safety Questionnaire (OSQ) (Mearns et al., 1997; Fleming, 2001), examines three dimensions of safety climate, that is 1) management commitment to safety, 2) priority of safety in the workplace and 3) pressure for production, and the relationship among them as predictors of risk behavior reported by employees working in a chemical manufacturing organization situated in South Africa. Risk behavior, which refers to the extent to which employees ignore safety regulations to get the job done, carry out forbidden activities, and perform their duties incorrectly (Rundmo and Hale, 2003), has been related to accident involvement in previous research and is therefore an appropriate measurement of employee's safety behavior (e.g. Rundmo, 1995; Mearns et al., 1997;

Flemming, 1999). Regular non-compliance with policies, procedures and safety rules are considered a major cause of accidents as it can make the entire system more vulnerable to failure (Reason, 1997; Neal and Griffin, 2006; Baysari et al.,2008). In line with recent research (e.g. Katz-Navon et al., 2005; Naveh et al., 2005), this study examines the interplay of safety climate dimensions and therefore extends the existing literature by 1) testing whether the observed relationship between management commitment to safety and priority of safety is also dependent on pressure for production and 2) examines the complex pattern of relationships among these three safety climate dimensions in their influence on risk behavior. Understanding how specific dimensions of safety climate may influence risk behavior will enable organizations to balance competing organizational priorities (productivity and safety compliance) and thereby minimize unsafe behavior in the workplace.

2.0 Psychological Safety Climate

The level of conceptualization and analysis of safety climate is a continuing debate among climate researchers; climate can be investigated at different levels of the organization (Rousseau, 1985). Psychological safety climate, which is the focus of the present study, reflects individual perceptions of safety policies, procedures, and practices in the workplace (Christian et al., 2009). These non-aggregated perceptions of the work environment (Clarke, 2009) differ from safety climate at the group or organizational level, which represent collective perceptions of workplace safety. Although safety climate has traditionally been conceptualized and operationalized at the organizational level (e.g. Zohar, 1980), there is growing evidence for the informative and predictive nature of safety climate at both workgroup and individual level (Zohar, 2003; Neal and Griffin, 2006; Zohar and Luria, 2005). For example, a recent meta-analysis which examines the moderating effect of level of analysis in the safety climate-safety behavior relationship found that safety climate at both the individual and group level had similar magnitudes in the prediction of safety behavior, which were both slightly stronger than organizational level safety climate (Christian et al., 2009). Evidence for the prediction of safety behavior across various industries has also been found for psychological safety climate (Larsson et al., 2008; Morrow et al., 2010). In the present study we focus on psychological safety climate in order to examine the impact of varying employee interpretations regarding safety in

their workplace, possibly caused by idiosyncratic worldviews, perceptual biases, and experiences (Ostroff and Bowen, 2000), on individual behavior (i.e., risk behavior).

Despite the importance of safety climate in the prediction of accidents in the workplace the dimensionality of safety climate (Zohar and Luria, 2005) and its factor structure (Zohar, 1980; Dedobbeleer and Beland, 1991) remains disputed. With regard to dimensionality, some researchers argue that safety climate can be regarded as a uni-dimensional latent variable (Neal et al., 2000) while others claim it is multidimensional in nature (Cooper and Phillips, 2004; Zohar and Luria, 2005). With regard to factor structure, research demonstrates the inability to reproduce factor structures across industries (Zohar, 1980; Dedobbeleer and Beland, 1991; Brown and Holmes, 1996), indicative of the problematic nature of measuring and operationalizing safety climate. In addition, a number of different measures of safety climate have been developed (e.g. Zohar 1980; Brown and Holmes, 1996; Hayes et al., 1998; Mearns et al., 1998; Dedobbeleer and Beland, 1991; Cox and Cheyne 2000; Shannon et al., 2001; Mearns et al., 2003). Therefore, to date no universal model specifying the definition and conceptualization of safety climate and its underlying key dimensions exists (Christian et al., 2009), although common themes have emerged (e.g. Flin et al., 2000). Zohar (2010) recently encouraged researchers to consider safety climate perceptions as targeted at system-level attributes which include the priority of competing demands (e.g. safety and efficiency), discrepancies between espoused and enacted safety practices, and consistencies among policies and procedures. It is therefore necessary to address safety climate from a multi-dimensional perspective, which permits examination of potential interactions between its components in their impact on safety performance.

3.0 Safety Climate Dimensions and Risk Behavior: Direct Effects

Three safety climate dimensions in particular capture both competing organizational domains and consistency between policy and practice and have been regularly included in safety climate studies, namely, management commitment to safety, perceptions of the priority of safety in the workplace, and pressure for production (Mearns et al., 1998; Zohar, 2002; Cooper and Phillips, 2004). Although a number of

additional aspects of safety climate have been identified in the literature (e.g. safety knowledge, safety training), these three specific dimensions were chosen based on their frequent inclusion in safety climate studies in addition to evidence demonstrating their importance in predicting safe behavior beyond alternative safety dimensions. For example a number of review, field and meta-analytic studies examining a range of safety climate dimensions have demonstrated management commitment to safety as the strongest predictor of safety performance (e.g. Cox and Flin, 1998; Flin et al., 2000; Christian et al., 2009; Beus et al., 2010). Priority of safety and pressure for production, despite having received less attention than management commitment to safety, are commonly used dimensions of safety climate which have been consistently found to predict safety outcomes such as unsafe behavior (e.g. Morrow et al., 2010). Furthermore Cox and Cheyne (2000), in developing a safety climate assessment tool, found that management commitment to safety, safety priority and the work environment (i.e. conflict between operational targets and safety) were deemed as some of the most highly ranked dimensions of safety climate for offshore workers.

The impact of perceived managerial practices on safety performance has been widely demonstrated in previous research (e.g. Thompson et al., 1998; Zohar, 2002), and there is consensus that management actions are an important determinant in creating a safe work environment (see Shannon et al., 2001 for an overview). McLain and Jarrell (2007) have explained this effect by proposing that management commitment leads to trust in management which in turn leads to a) a reduction in the need for employees to divert attention to safety hazards while performing tasks, and b) greater information sharing about safety and safe actions. Managerial behavior provides cues regarding workplace norms and the kinds of behavior likely to be supported, valued or rewarded, which informs employees' perceptions of safety climate (Zohar, 2003; Morrow et al., 2010). On a practical level it means that managers at all levels in the organization must visibly demonstrate their commitment towards safety as well as their support for safety in visible behaviors i.e. talk about safety, invest resources in creating a safe work environment, involve employees in safety matters, consideration of safety matters in job design and congruence between managerial safety talk and managerial actions (Zohar, 1980; Hoffmann and Stetzer, 1996; Geller, 2001; Clarke and Ward, 2006). It is important to note that safety climate, as a socially construed

indication of desired employee behavior, originates simultaneously from both policy and procedural actions of senior management and supervisory actions demonstrated by frontline or shop-floor supervisors (Zohar and Luria, 2005). The managerial level at which commitment is examined (i.e. senior manager, supervisor) is however ambiguous in some studies despite the large differences in their roles and perceived influence by employees (Clarke, 1999; Flin et al., 2000). In the present study we focus on employees' perceptions of senior management commitment to safety as senior managers "undoubtedly set the tone and tempo for organizational atmosphere, establish priorities and allocate resources" (Flin et al., 2000, p. 186) and as their safety policies, procedures, and actions are critical in limiting supervisor discretion in policy implementation (Zohar and Luria, 2005).

Priority of safety as the second safety climate dimension refers to the degree to which safety is perceived as a top priority for employees (Naveh et al., 2005). A high safety priority within an organization means that safety is considered an important issue that must be given precedence regardless of other competing demands, such as work speed and productivity (Flemming, 1999). A high priority of safety can potentially motivate employees to take greater ownership of, and responsibility for, safety. This in turn, is likely to influence employee's tendency to behave safely. A low safety priority denotes that safety-related policies and procedures are perceived only as rhetoric or as pretence and then they can be inadequately followed or even ignored without consequences (Falbruch and Wilpert, 1999). Fleming (1999) in a study of off-shore personnel, found that 19% of the variance in subordinate self-report safety behavior was explained by the priority of safety in the work environment and supervisory behavior. Dedobbeleer and Beland (1991) similarly found that workforce attitudes towards safety practices (i.e. propensity to take risks) were predicted by perceptions of management concern for employee well-being.

Finally, the present study focuses on pressure for production as the third safety climate dimension. As managers generally place a high demand on workplace productivity it can often cause employees to compromise on safety (Wright, 1986; Langford et al., 2000). Although employee perceptions of work pressure (e.g.

excessive workload, high work pace, time pressures, etc.) are known to be a causal factor for both accidents and unsafe work behavior (Wright, 1986; Hoffmann and Stetzer, 1996; Brown et al., 2002; Goldenhar et al., 2003; Seo, 2005), work pressure has been found to have a small effect in predicting safety performance, accident and injuries relative to other safety climate dimensions according to meta-analytic research (Christian et al., 2009). The small effect observed for work pressure could suggest that it is not work pressure per se that causes accidents, but the perceived pressure to ignore safety rules. For example, although looking at employees' attitudes rather than perceptions, Rundmo (1998a, b) found that an attitude amongst employees to accept rule violation is the strongest predictor of risk behavior. In the present study we therefore define and conceptualize pressure for production as an employee's perception that the organization encourages him or her to work around safety procedures in order to meet production quotas, keep up with the flow of incoming work, or meet important deadlines (Brown et al., 2000). This definition is similar to previously examined constructs such as work-safety tension, i.e., workers perceive that working safely is at odds with effectively doing their jobs (Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Morrow et al., 2010), and work pressure and safety rules (Wills et al., 2006) which were influential in predicting safety behaviors amongst drivers, production and construction workers. These findings are consistent with Mearns et al. (2001) who found that unsafe behavior, in a sample of off-shore oil workers, was primarily predicted by perceived pressure for production.

To conclude, management commitment to safety, priority of safety, and pressure for production by employees have been deemed important dimensions of safety, which are predictive of unsafe behaviors. Based on our above review of the literature we expect these three dimensions to have a direct effect on risk behavior. Specifically, our Hypothesis 1 reads as follows:

Hypothesis 1: (a) Management commitment to safety and (b) Priority of safety are negatively related to risk behavior as reported by employees. (c) Pressure for production is positively related to risk behavior as reported by employees.

4.0 Safety Climate Dimensions and Risk Behavior: Interactive Effects

Although there is strong evidence to support the direct relationship between each of the above dimensions of safety climate and safety behavior, research to date has largely ignored the possible relationships that exist between these safety climate dimensions in their impact on safety performance (Naveh et al., 2005; Beus et al., 2010). Few researchers (Katz-Navon et al., 2005; Naveh et al., 2005) have recently demonstrated the intricate relationships between safety climate dimensions in their prediction of safety performance. For example, in their study of hospitals, Katz-Navon and colleagues (2005) found that, when safety priority was high as opposed to low, the influence of managerial safety practices on the number of treatment errors was nullified. In other words, high priority of safety provided employees with sufficient cues regarding the importance of safety within their unit to the extent that managerial emphasis on safety had no additional influence. However in addition to employees' evaluation of commitment to and priority of safety by management, climate perceptions are also guided by discrepancies between espoused and enacted priorities of managers (Zohar, 2010). Therefore the present study proposes that in addition to the direct relationship between the above outlined safety climate dimensions and risk behavior, the two-way interaction between management commitment to safety and priority of safety as found by Katz-Navon and colleagues (2005) will only hold when employees perceive low levels of pressure for production. In this particular context, employees receive enough cues regarding the importance of safety within their unit and the low work pressure is not at conflict with these cues; employees' understanding that senior management is committed to and values safety will have no additional influence on their safety behavior (i.e. risk behavior). In contrast, when employees perceive high levels of pressure for production, their safety behavior will be influenced by management commitment to safety, regardless of the level of priority of safety on plant. Specifically, our Hypothesis 2 reads as follows:

Hypothesis 2: Management commitment to safety will be less strongly associated with risk behavior under conditions of high, as compared to low priority of safety on plant, but only when pressure for production is low rather than high.

The added value of this study above and beyond previous research (e.g. Katz-Navon et al., 2005; Naveh et al., 2005) is twofold: First, we focus on employee perceptions of senior management rather than supervisor commitment to safety in testing the proposed safety climate-safety behavior relationships as senior managers play a critical role in shaping both employee and lower management behaviors (Simard and Marchand, 1995; Cooper, 2006). Second, rather than focusing on one moderator of the management commitment to safety-outcome relationship only, we propose the impact of management commitment to safety on outcomes (i.e. risk behavior) to be contingent not only on priority of safety but also pressure for production, thereby enabling us to provide a more complex picture of the interplay between different safety climate dimensions. This is important from a theoretical and practical perspective as our findings ascertain the boundary conditions under which the impact of managerial commitment to safety on employee risk behavior is enhanced or attenuated (for the relevance of moderating effects in climate research, see González-Romá, et al., 2009), which in turn can inform managers about the situations in which their actions and behaviors are particularly influential for reducing employee risk behavior and accidents on site. To our knowledge this is the first study in the safety climate literature to test and find a higher-order interaction between safety climate dimensions, which deserves attention given the difficulty of finding higher-order interactions due to lower statistical power in field research (McClelland and Judd, 1993). We also would like the reader to note that the proposed effects of safety climate dimensions were tested in a South African chemical manufacturing organization, a context very different from medical units in hospitals. The present study therefore clearly addresses Katz-Navon et al.'s (2005) and Naveh et al.'s (2005) call for future research to test the validity of their findings in other industries and to study additional dimensions (e.g. pressure for production) which may affect the nature of the relationships found among the dimensions.

4.0 Method

4.1 Participants and Procedure

The data used in this study were collected as part of a larger research project to examine the effectiveness of safety management practices and procedures in organizations. Questionnaires in English were distributed to a random sample of 1300

employees working at a chemical manufacturing organization in South Africa. This resulted in a sample of 856 non-management employees, a response rate of 65.8%. Among these employees, 623 (72.8%) operated in high-risk environments in the chemical manufacturing organization, i.e., maintenance and production, and were predominantly blue collar workers (for the importance of safety climate for blue collar construction and maintenance workers, see Larsson et al., 2008, Morrow et al., 2010). These employees who experience high-risk in their daily work environment and who are thus eligible to answer questions pertaining to safety (e.g. pressure for production) and risk behavior are the focus of the present study. A covering letter accompanied all questionnaires explaining the purpose of the survey and was distributed by the research team and personnel from SHE Department to the employees of the organization. In addition, prior to completing the questionnaires, employees were informed about the objectives of the investigation. Where employees were unable to understand English, translators were used to explain concepts. Respondents completed the questionnaires in hard copy and returned the completed questionnaires to the research team. In terms of age, 12.2% of the respondents in maintenance and production were between 18 and 24; 16.9% were between 25 and 29; 14.4% were between 30 and 34; 13.8% were between 35 and 39; 14.8% were between 40 and 44; 13% between 45 and 49 and 14% were older than 50 years. 7 respondents (1.1%) did not indicate their age. As far as length of service is concerned, 45.9% of the respondents had less than five years' service with the organization, 19.4% had between five and ten years of service, 12.7% had between eleven and fifteen years of service and 18.5% of the respondents had indicated that they had more than 16 years of service with the organization. Twenty-two respondents (3.5%) did not indicate their length of service with the organization.

4.2 Measures

The research questionnaire consisted of three sections and the different sections elicited the following information of participants: Section 1: Background information (e.g. age, length of service, etc.), Section 2: Psychological safety climate questions and Section 3: Risk behavior. As mentioned earlier, all dimensions of safety climate and risk behavior were measured and analysed at the individual level as the present

study focuses on individual perceptions of safety climate and their role in predicting variation in employee risk behavior.

4.2.1. Safety Climate

Employees' perceptions of safety climate in the organization were assessed using 26 items from the Offshore Safety Questionnaire (OSQ), developed from previous research into safety climate in offshore environments (Mearns et al., 1997; Fleming, 2001; Mearns et al., 2003). The questionnaire was chosen due to its use in previous studies and range of measures available (Fleming, 2001). The questionnaire was adapted for use in the manufacturing industry by omitting items that relate to the offshore oil context. Specifically, we measured the following safety dimensions: Management commitment to safety, status of safety on the plant, and pressure for production. Employees responded to all items using a 5-point Likert-type scale ranging from *fully disagree* (1) to *fully agree* (5). All three dimensions relate to perceptions of plant-level safety whereby respondents were instructed to consider senior management on site when questions referred to 'managers'.

(a) *Management commitment to safety.* Twelve items assessed employees' perceptions of management commitment to safety[i]. Example items are "Some safety rules/procedures are only there to protect management" and "Management listen to safety concerns, but nothing ever gets done". The internal consistency reliability was .88.

(b) *Priority of safety on plant.* Eight items assessed employees' perceptions of the priority of safety on plant. Example items are "The standard of safety is very high at my work place" and "I am allowed to stop work if I feel the job is unsafe". The internal consistency reliability was .87.

(c) *Pressure for production.* Six items assessed employees' perceptions of pressure for production. Example items are "Sometimes it is necessary to ignore safety rules/procedures to keep production going" and "People in this plant are sometimes under pressure to put production before safety". The internal consistency reliability was .75.

4.2.2. Risk behavior.

As the dependent measure, the survey included five items from the Offshore Safety Questionnaire (OSQ) to assess the extent to which employees perceived that they engaged in risk behavior in their work setting. These items from the OSQ were originally adapted from Rundmo (1997, 2000). Example items are "I sometimes ignore safety rules/procedures to get the job done" and "I use work methods that are not allowed". Employees responded to all items using a 5-point Likert-type scale ranging from *never* (1) to *very often* (5). The internal consistency reliability was .80.

4.3 Measure Validation.

Confirmatory factor analyses (CFA) were carried out to investigate the discriminant validity of our self-reported measures. The items for risk behavior, management commitment to safety, priority of safety, and pressure for production were specified to load on four separate latent factors, while the latent factors were allowed to co-vary. The chi-square was statistically significant (χ^2/df = 1129.97/426 = 2.65, p <.001) but the other fit indices indicate levels of fit which are commonly used as indicating acceptable model fit (Lance et al., 2006); comparative fit index [CFI] = .90, Tucker-Lewis Index [TLI] = .89, and root-mean-square error of approximation [RMSEA] = .05). Factor loadings ranged from .48-.76 (risk behavior), .53-.69 (management commitment to safety), .56-.81 (priority of safety), and .48-.67 (pressure for production) and were all statistically significant, $p < .05$. Interfactor correlations ranged from -.43 to -.76. In addition to affirming the fit of our proposed four-factor model, we also tested alternative models by combining original factors to test discriminant validity (see Campbell and Fiske, 1959). Specifically, we tested a three-factor model in which risk behavior, priority of safety, and management commitment to safety combined with pressure for production were specified to load on three separate latent factors, a two-factor model in which the safety climate dimensions and risk behavior were specified to load on two separate latent factors, and a single latent factor model in which all self-reported measures were specified to load on one single latent factor. Chi-square difference tests were used to compare the alternative models. The three-factor, two-factor and single latent factor models all demonstrated significantly worse fit (CFIs $\leq$ .85, TLIs $\leq$ .83, RMSEAs $\geq$ .06) than the four-factor model of our self-reported measures. Comparisons of the four-factor model with all the alternative models using chi-square difference tests showed that the

proposed four-factor model of self-reported measures fitted the data best[ii], supporting the discriminant validity of our measures.

5.0 Results

In Table 1 the means, standard deviations, internal consistencies and zero-order correlations of all variables are displayed. We carried out hierarchical regression analyses to test our hypotheses. The included predictor variables were centered around their grand mean to facilitate the interpretation of main effects in models containing interaction terms (see Aiken and West, 1991).

Insert Table 1

We entered the predictors into the regression in the following four steps: (1) Age, function, contract type and length of service as control variables, (2) Management commitment to safety (MCS), priority of safety on plant (SP), and pressure for production (PP) as predictor variables, (3) the two-way interactions, and (4) the three-way interaction.

Insert Table 2

Table 2 displays the results of the regression analysis. The results demonstrated that the direct effects of management commitment to safety, priority of safety on plant, and pressure for production on employees' self-reported risk behavior were significant (see Model 2). Consistent with Hypothesis 1, management commitment to safety and priority of safety were negatively related to risk behavior whereas pressure for production was positively related to risk behavior. In addition, the results demonstrated that the three-way interaction of management commitment to safety, priority of safety, and pressure for production was significant (see Model 4), beta = -3.17, p = .002, explaining an additional 1.2% of the variance. The interaction pattern will be presented in Figure 1.

In order to carry out a more specific test of our interaction hypothesis (see Hypothesis 2), we conducted simple slope analyses as suggested by Aiken and West (1991) as

well as slope difference tests as suggested by Dawson and Richter (2006). When pressure for production was low (see Figure 1), management commitment to safety was not related to risk behavior under conditions of high priority of safety on plant (beta = .02, p = .74) but negatively related to risk behavior under conditions of low priority of safety on plant (beta = -.25, p < .001). Further, these two slopes differed significantly from each other (t = 3.18, p = .002).

Insert Figure 1

When pressure for production was high (see Figure 2), management commitment to safety was negatively related to risk behavior under conditions of high priority of safety on plant (beta = -.25, p < .001) as well as under conditions of low priority of safety on plant (beta = -.18, p = .008). The difference between the slopes was not significant (t = -0.75, p = .46). These results are consistent with our Hypothesis 2.

Insert Figure 2

6.0 Discussion

Although there is a large body of research on the safety climate-safety outcome relationship (for an overview, see Beus et al., 2010), the interrelationships among specific safety climate dimensions and their impact on safety performance are regarded as contradictory and unclear and therefore require additional research (Naveh et al., 2005; Beus et al., 2010). The present study adopts a multi-dimensional approach to safety climate (Cooper and Philips, 2004; Zohar and Luria, 2005) and demonstrates (1) the differential direct impact of these safety climate dimensions (management commitment to safety, priority of safety, pressure for production) on risk behavior and (2) a complex relationship between these three safety climate dimensions in influencing unsafe behavior at work. In support of our hypothesis, and in line with previous research examining their impact on safety performance, we found that employee risk behavior was negatively related to management commitment and priority of safety, and positively related to pressure for production (see Hypothesis 1). The more employees perceive that an organization considers safety to be an important issue which must be given priority (Naveh et al., 2005) and

that (senior) management engages in communication and actions that support safety (Christian et al., 2009), the less they will engage in risk behavior. Managerial behavior provides cues regarding workplace norms (Morrow et al., 2010) as well as which kind of behavior is likely to be supported, valued or rewarded (Zohar, 2003). Similarly when employees perceive that aspects such as safety policies, procedures and management systems are relevant, effective and given priority over competing demands, they are less inclined to engage in risk behavior (Fleming, 1999; Cooper, 2000). In contrast perceived tensions between meeting production deadlines and adhering to safety procedure (i.e. pressure for production) may cause employees to sacrifice safety and engage in risk behavior. This tension can have a direct effect on accident risk as employees who perceive that they are under pressure to increase production may deviate from safety rules that impede their progress or perform tasks with less care, thereby increasing the likelihood of accidents (Clarke and Cooper, 2004).

Finally, we demonstrated that these three safety climate dimensions interacted, supporting our assumption that the moderating effect of safety priority on the relationship between management commitment to safety and safety outcomes as found by Katz-Navon and colleagues (2005) depends upon the level of pressure for production within the organization (see Hypothesis 2). In other words, similar to Katz-Navon et al (2005) we found that when priority given to safety was high the impact of managerial commitment to safety on employees' risk behavior was nullified; however, in contrast to these researchers we expected and found this effect only for conditions where employees experienced low levels of pressure for production. In this particular context, employees received enough cues regarding the importance of safety within their unit and the low work pressure was not at conflict with these cues; the understanding that management also emphasized and valued safety had no additional influence on employees' behavior. In contrast, under conditions where employees experienced high levels of pressure for production, management commitment to safety was still influential regardless of high versus low priority of safety on plant. Therefore when conflict exists between pressure for production and priority of safety, employees look to their managers for cues to guide their own safety behavior. As managers have a direct bearing on the jobs and

allocated rewards of employees (Morrow et al., 2010), an employees' likelihood to engage in risk behavior is reduced when their manager is highly committed to safety despite a high demand for workplace productivity. Overall, the results of the three-way interaction between the three safety climate dimensions suggest that senior management commitment to safety was influential in reducing risk behavior in "unideal" situations (e.g. ambiguity, not enough cues regarding importance of safety, role conflict) but not "ideal" situations.

7.0 Limitations and Future Research

There are a number of issues with the current research that deserve attention. Foremost among them is the small effect of the three-way interaction. Although this effect accounted for only 1.2% of the variance in employees' risk behavior, we feel that it is meaningful for the following reasons. Relative to experimentalists, field researchers have lower statistical power and thus considerable difficulty detecting theorized moderator effects due to a number of factors including nonoptimal distributions of the component variables associated with lower residual variances of the product term and thus lesser efficiency of the moderator parameter estimate (McClelland and Judd, 1993). This is particularly true for higher order interactions. Thus even though the effect size of the interaction observed in the present research is small by conventional standards, the effect is important as the odds of detecting it were against us. Similarly, Evans (1985) concluded even those effects explaining as little as 1% of the total variance should be considered important. From a practical perspective this effect deserves attention for two reasons. First, the impact of supervisors and plant managers' behaviors on worker safety is believed to operate in a more direct fashion than that of the less visible and more remote senior managers (Thompson et al., 1998), suggesting that the correlation between perceived managerial commitment to safety and employee risk behavior is more distal for the latter than the former group of managers. Therefore even the small effect of our three-way interaction might indicate that (senior) management commitment to safety has an important impact on employee risk behavior, contingent on priority of safety and pressure for production. Second, following Cortina and Landis's (2009) logic, such effects may appear small if observed in a snapshot but might have significant cumulative consequences for (un) safe employee behavior and accidents if considered

across a large number of situations, organizations and/or over time. Another issue that needs to be addressed is the collection of data from the same respondents using self-report measures, as the mono-method approach is believed to distort (typically inflate) correlations among the key variables (e.g. Lance and Vandenberg, 2009; Lance et al., 2010). Although it could be argued that any inflated correlations due to common method variance are counterbalanced by the attenuating effect of measurement error as demonstrated by Lance and colleagues (2010), it is advisable that future studies testing the observed relationships in the present study also employ a hetero-method approach and procedural methods of control, believed to reduce common method variance (see Podsakoff et al., 2012). For example, archival data on accidents could be used as a proxy for risk behavior instead of self-reported measures. Ratings of risk behavior by co-workers and supervisors could also be used in addition to observation of safety behavior on site. Other research, however, has shown that self-reported unsafe behaviors and accidents are related to independent observations of the same variables (Lusk et al., 1995). In addition, any social desirability concerns on the part of employees are believed to suppress variance on these measures such that employees would tend to underestimate rather than overestimate unsafe behaviors and accidents (Hofmann and Stelzer, 1996; Probst and Estrada, 2010). Thus, social desirability concerns among employees presumably counterbalance any possible inflated correlations between our safety climate predictors and outcome variable, i.e., risk behavior, due to common method bias.

Our study is also restricted to three dimensions of safety climate (Mearns et al., 1997; Fleming, 2001) and one measure of unsafe behavior (i.e. risk behavior). Future research should identify and investigate other safety climate dimensions such as safety training (Zohar, 2002), safety motivation (Griffin and Neal, 2000) and safety-specific leadership (Conchie and Donald, 2009) and examine their impact on different forms of safe (e.g. pro-active safety behavior), and unsafe behaviors (e.g. non-compliance), using not only a cross-sectional but also longitudinal design. A longitudinal assessment would provide further validation of the found relationships and also test for causation. In addition, we advise researchers to investigate if the results of this study hold for all types of industries (Coyle et al., 1995; Cooper and Philips, 2004;). Finally, in contrast to Naveh et al. (2005) the present study focused on

employees' perceptions of senior management rather than direct supervisor commitment to safety. As previously mentioned, these groups have different roles, with senior management focusing on safety policy-making and the establishment of safety procedures to facilitate policy implementation, and supervisors executing these procedures (Zohar and Luria, 2005). To date research that considers perceptions of both senior managers and direct supervisors simultaneously is sparse and yields contradictory findings regarding the impact of different management levels on employee safety behavior (e.g. Andriessen, 1978; Simard and Marchand, 1995; Zohar and Luria, 2005; Cooper, 2006). Building on our findings, future research could address commitment to safety at both management levels in order to see if the found interaction among the safety climate dimensions holds for senior and front line managers, and investigate whether either takes precedence when pressure for production is high or low. In other words, when employees experience work-safety tension or role conflict, which group is the most influential safety referent to guide employee safety behavior? In line with O'Dea and Flin (2001) we therefore encourage researchers to disentangle the differential effects of senior management and direct supervisors and their relative impact on safety, possibly employing a multilevel model of climate (see Zohar and Luria, 2005) and collecting data also from supervisors and top management.

8.0 Implications for Management

According to our findings, the three dimensions of safety climate have a direct influence on employee risk behavior. Therefore activities which promote managerial commitment and priority of safety, and minimise pressure for production should be enacted and encouraged within organizations to reduce the occurrence of risk behavior by employees. More specifically for organizations the three-way interaction found between the three safety dimensions demonstrate that when employees experience tension between their production deadlines and safety procedures, they are less likely to engage in risk behavior when managerial commitment to safety is perceived to be high. In other words, senior management commitment to safety is particularly critical for minimizing employee risk behavior when there is perceived pressure to ignore or even break safety rules. Therefore from a practical perspective senior management may need to re-evaluate their role in the safety process and move

beyond safety policy formulation to that of a safety change agent (Buchanan & Storey, 1997). This may be especially relevant when trying to reduce risk behavior amongst blue collar workers who are subject to highly pressurised production quotas. Managers' discourse may appear insincere if employees perceive that the job duties do not allow for safe working (Morrow et al., 2010). Given the perceived differences in status, power and prestige between management and employees, employees scrutinise the behavior of senior management for evidence that management are not committed towards safety, that safety is not a priority or that production targets should be met at all costs. This may impact on their levels of motivation to work safely or their willingness to engage in pro-active safety behavior. Zohar (2010) describes this as a social learning process whereby employees interpret the organizational environment by repeatedly observing (and exchanging information with) their leader (Dragoni, 2005). The extent to which employees' scrutinize managerial actions with regard to safety can be emphasised using managerial safety training, which emphasize the manager's role as a safety referent (Beus et al., 2010). As employees look to managerial behavior in situations of productivity-safety tensions, managers should demonstrate their commitment to safety through both communications and actions (i.e. regularly talk about safety, investment of resources in creating safe work environment, consideration in job design decisions, rewarding safe behavior etc.). In addition, the findings of our research suggest that managers who intend to design safety interventions should target all three safety climate dimensions in order to ensure safety. As mentioned by Katz-Navon and colleagues (2005) interventions that aim to improve only part of the three dimensions are unlikely to be as effective, since the dimensions are interrelated and together they influence employees' risk behavior and should be managed as such.

In sum our findings demonstrate the direct and interactive effects of safety climate dimensions on risk behavior which (a) broaden our understanding of safety climate as a multi-dimensional construct and (b) highlight the importance of examining higher-order interactions between dimensions of safety climate in predicting (un)safe employee behavior. Specifically, our study has identified boundary conditions under which the impact of managerial commitment to safety on employee risk behavior is enhanced or attenuated which in turn can inform managers about the situations in

which their actions and behaviors are particularly influential for reducing employee risk behavior and accidents on site.

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Table 1: Descriptive Statistics and Correlations Among the Study Variables

Variables	M	SD	1	2	3	4	5	6	7	8
1. Risk Behavior	1.68	.85	(.80)							
2. Age	5.04	2.08	-.09*	-						
3. Function [a]	.74	.44	.12**	-.02	-					
4. Contact Type [b]	.31	.46	.05	-.33**	.09*	-				
5. Service Length	2.04	1.17	.05	.54**	.04	-.39**	-			
6. MCS	-.07	1.01	-.48**	.11**	-.14**	-.05	.07	(.88)		
7. SP	-.02	.95	-.45**	.06	-.07	.02	.01	.36**	(.87)	
8. PP	.11	1.10	.52**	-.18**	.09*	.03	-.06	-.58**	-.34**	(.75)

Note. N = 623. Cronbach's Alphas are indicated in parentheses. MCS = Management Commitment to Safety, SP = Safety Priority on Plant, PP = Pressure for Production

[a] 0 = Maintenance, 1 = Production

[b] 0 = Permanent, 1 = Temporary

*** $p < .001$, ** $p < .01$, * $p < .05$

Table 2: Results of Hierarchical/Moderated Regression Analyses (Standardized beta coefficients)

	Model 1	Model 2	Model 3	Model 4
Control Variables				
1. Age	-.16**	-.05	-.06	-.07
2. Function [a]	.10*	.03	.02	.03
3. Contact Type [b]	.05	.08*	.07	.07
4. Service Length	.15**	.13**	.13**	.13**
Predictor variables				
1. MCS		-.20***	-.18***	-.19***
2. SP		-.25***	-.23***	-.27***
3. PP		.32***	.33***	.36***
4. MCS x SP			.05	.07
5. MCS x PP			-.07	-.06
6. SP x PP			-.07	-.10*
7. MCS x SP x PP				-.14**
ΔR^2	.04	.35	.02	.01
ΔF	5.41***	110.38***	6.23***	10.05**
Dfs				

Notes. [a] 0 = Maintenance, 1 = Production [b] 0 = Permanent, 1 = Temporary MCS = Management Commitment to Safety, SP = Safety Priority on Plant, PP = Pressure for Production

*** $p < .001$, ** $p < .01$, * $p < .05$

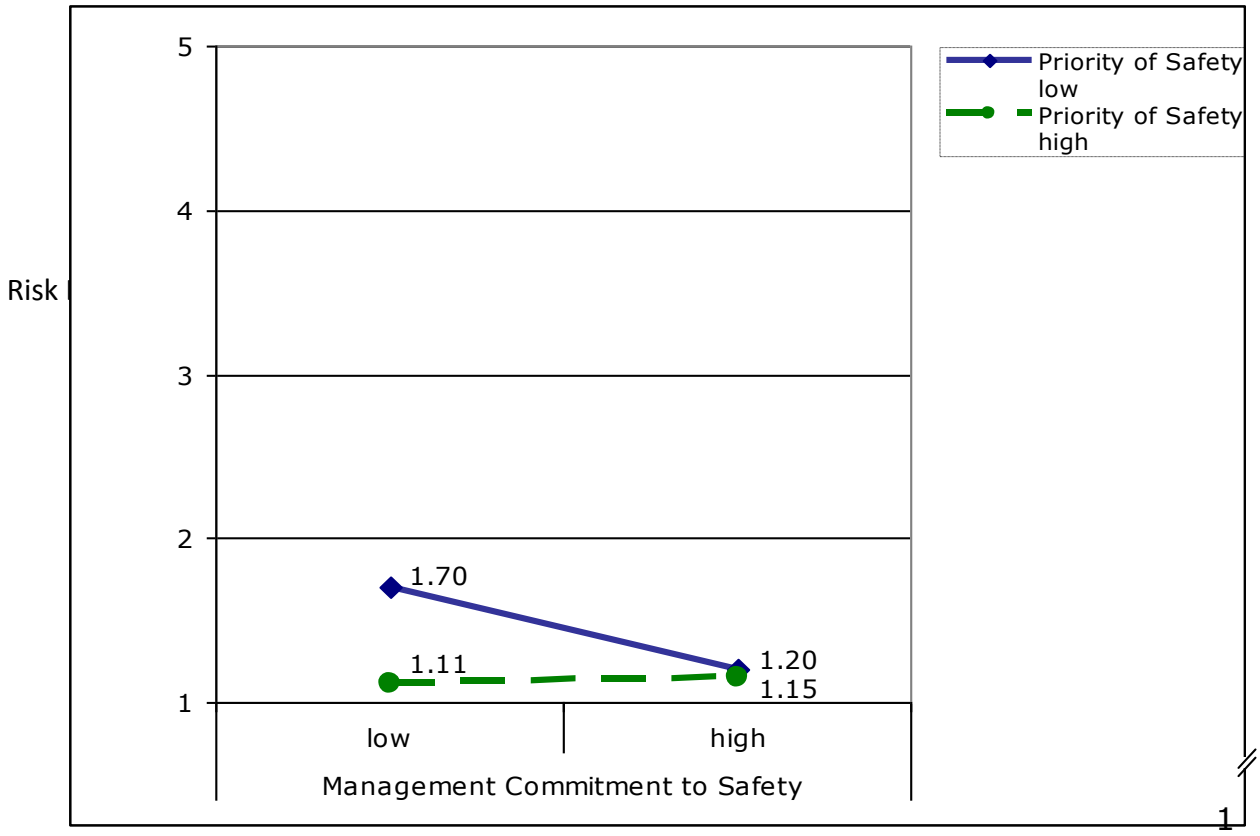

Figure 1: Employee risk behavior as a function of priority of safety, given low pressure for production (-1SD)

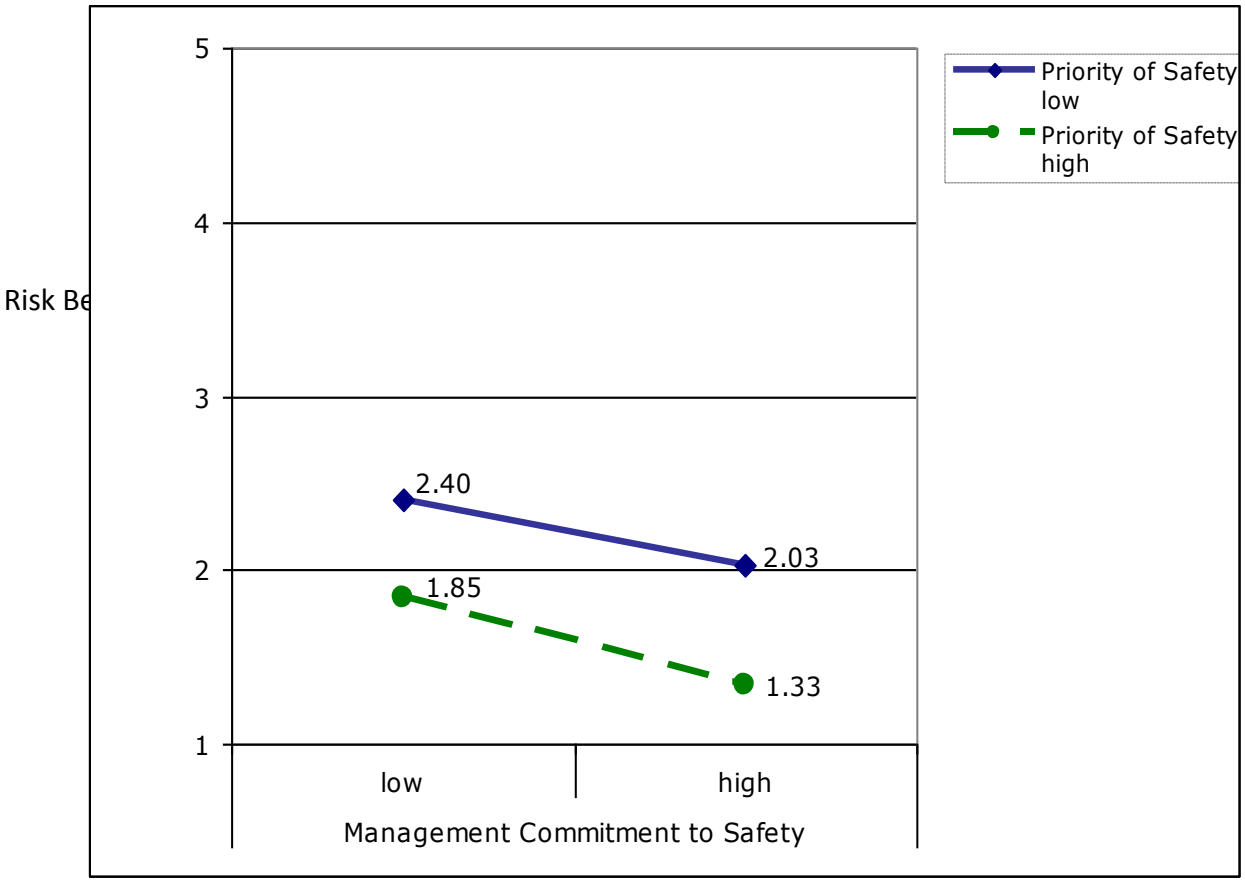

Figure 2: Employee risk behavior as a function of priority of safety, given high pressure for production (+1SD)

[i] One of the twelve items indicative of management commitment to safety scale in our study used the referent "supervisor" instead of "management". In Mearns et al. (2003)'s study, which employed the OSQ in order to investigate safety climate, safety practice, and safety performance in offshore environments, the factor solution revealed this item to load onto the factor (senior) management commitment and therefore we also decided to keep this item.

[ii] Results of the alternative model comparisons are available upon request from the first author.