AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN SAFETY CLIMATE AND SAFETY BEHAVIOURS IN IRISH ORGANISATIONS

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Introduction

Traditional approaches to the management of safety in the workplace have focused primarily on job redesign (Chhokar and Wallin, 1984; Komaki et al., 1978), engineering management (Heinrich, 1950; Kanki et al., 1989), and the selection of what are considered safety conscious employees (Donald and Canter, 1993, 1994). Many of these traditional approaches tend to ignore the fact that a majority of industrial/occupational accidents and injuries in Ireland are the result of the unsafe work behaviour of employees rather than unsafe mechanical or physical conditions in the workplace.

The past tewnty years has seen the emergence of a new paradigm, which focuses on the affective and behavioural characteristics of employees in a safety context (Reber and Wallin, 1983; Donald and Young, 1996). This new thinking has shifted the focus towards the study of safety attitudes, climate, and culture within organisations. Zohar (1980) was one of the first researchers to suggest a relationship between safety climate and specific measures of safety performance. This study, while useful, was primarily based on expert opinions and did not demonstrate a statistical relationship between safety climate within the organisation and specific safety behaviours. Three subsequent studies by Canter and Donald (1990), Cox and Cox (1991), and Cox et al. (1998) moved the debate along and demonstrated significant correlations between organisational safety climate and specific behaviour and safety performance measures.

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These studies illustrate a fundamental shift in thinking about how safety in organisations should be managed. Rather than focusing on the hardware and task oriented dimensions of jobs, it is clear that the safety management process is a much more complex one involving dimensions of organisations, and specific attitudinal and behavioural characteristics of individuals.

The number of studies focusing on the role of organisation-level variables has increased significantly. Many of these are of a qualitative nature. Wright (1986) studied the causes of fatal accidents involving offshore oil workers. He found that employees typically equated normal working methods (essentially what everyone else does) with safe and/or ideal working approaches. This was, however, not necessarily the case. He also found evidence of strong pressure within the organisation to complete work as quickly as possible. This performance imperative was in many cases related to a range of safety climate issues within the organisation. A particular dimension of safety climate highlighted was the existence of defective communications of safety issues both between workers and management and among workers. It is acknowledged in the literature that more human errors occurred in situations where the organisational climate was characterised by psychological stress and where pressures existed within the organisation which focused on performance rather than safety. Embrey (1992) similarly identified production/safety trade offs, time pressures, poor communication and co-ordination systems as important organisational factors that help explain safety behaviour patterns. Dawson (1991) likewise argues that safety climate is one factor that influences how employees behave in safety terms. Similar findings are reported by Hurst *et al.* (1990) and Hofmann *et al.* (1995).

What emerges from the existing research is the proposition that important variables or characteristics of an organisational-level nature can lead employees to behave in particular ways in the context of safety. Currently, there is a lack of empirical evidence to inform us of the factors that influence how individuals attach meaning to, and interpret, elements of safety climate. Furthermore, how do the various elements of safety climate influence safety behaviours, and more specifically, are demographic and human capital characteristics of the individual or their perceptions of the safety climate more significant in terms of the commission of safe and unsafe behaviours in organisations?

This paper reports the preliminary results of a major study that focused on identifying how employees perceive the safety climate of an organisation, the factors that influence the perception of safety climate, the nature of their safety behaviours and the relationship be-

tween perceptions of safety climate and safety behaviours. The paper is structured in the following way. It first of all considers the concept of safety climate and reviews the academic debate about how it differs, if at all, from safety culture. It then considers safety behaviour and in particular the factors that influence safety behaviours, including the relationship between perceptions of safety climate and specific behaviours. The paper provides a detailed discussion of the levels of analysis used to interpret the data, the methodological decisions made, and the analysis protocols adopted. It concludes with a discussion of the findings and their implications for theory, research, and safety management practices.

The Concept of Safety Climate

Safety climate and culture have received considerable attention in the safety literature. The distinction between the two, in the general organisational behaviour literature, is unclear. Rousseau (1988) found considerable overlap between them. However, she concluded that there were sufficient differences for one to be differentiated from the other. Rousseau characterises culture as a group phenomenon, manifested in the expression of strongly held norms, consisting of shared beliefs and values. She argues that it is possible to have organisations that do not have strong organisational norms, leading to the conclusion that organisations may not have an organisational culture at all. Brown and Holmes (1986) suggest that climate is best conceptualised as a descriptive term that applies to the organisation. Climate therefore refers to a situation and its links to thoughts, feelings, and behaviours of organisational members. It is generally viewed as temporal, subjective, and often subject to direct manipulation. Denison (1996) argues that this is perhaps where climate differs from culture. Culture refers to an evolving context that is rooted in history, collectively held, and of sufficient complexity to resist organisational attempts at manipulation. Denison does however acknowledge that within the organisational behaviour literature the distinctions appear to have disappeared and that the two concepts should be viewed as differences in interpretation rather than differences in phenomenon. He concludes that the two concepts address a common phenomenon, which he defines as the creation and influence of social contexts in organisations. Moran and Volkwein (1992) appear to have come to the same conclusion. They conclude that climate and culture overlap in that they are components of the expressive, communicative, socially constructed dimensions of an organisation. They point to a funda-

mental difference between the two concepts which argues that climate reflects the attitudes and behaviours of organisational members, which are directly observable, whereas culture focuses on assumptions, expectations, and perspectives that are taken for granted by organisational members, but are not easily interpreted by outsiders or, for that matter, measured.

Within the safety literature, the distinctions discussed so far have not been as clearly in evidence. Cox and Cox (1996), for example, suggest that there is a common tendency to describe safety culture in terms of values, beliefs, attitudes, social mores, norms, rules, practices, and behaviour. They argue that such definitions represent catch-alls and as a result have tended ultimately to be of limited value in a research context. However, many of the studies that propose to measure safety culture essentially only measure safety attitudes and pay little attention to norms and rules and whether an organisation has the capacity to reflect on safety practices or not. Pidgeon (1995) argues that the search for safety culture has in effect been reduced to measuring individual attitudes and behaviours in a specific work context, which more closely matches the concept of safety climate rather than safety culture.

A number of attempts have been made to measure safety climate. Zohar (1980) concluded, based on questionnaires completed by over 400 employees, that safety climate consisted of dimensions such as the importance of safety training, the effects of safe conduct on promotion, levels of risk in the workplace, and management attitudes to safety. Zohar identified eight dimensions in all. However, Brown and Holmes (1986), in an attempt to validate Zohar's safety climate model, found that his original eight factor model reduced to three factors; employee perceptions of management commitment, management actions, and the physical risk perception of employees. A more recent study by Williamson et al. (1997) proposed a 67-item measure of safety climate. Factor analysis on a reduced scale revealed five items: personal motivation and safety behaviour, positive safety practice, risk justification, fatalism, and optimism. The study did not, however, investigate how these measures related to accident rates.

Cox and Cox (1991), Guest *et al.* (1994), Alaxander *et al.* (1995), Lee (1995) and Cox and Flin (1998) have in contrast focused on safety attitudes as a measure of safety culture. Cox and Cox appear to have been the initiators of this line of research. They postulated the view that the idea of safety culture reflects the attitudes, values, beliefs and perceptions that employees share in respect of safety issues. They developed a conceptual model, which posits that the shared aspects

of employee attitude to safety provide a partial description of an organisation's safety culture. They did not however seek to link these measures with safety metrics such as accident rates. A subsequent study by Alaxander et al. (1995) also focused on safety culture and made attempts to link safety attitude with prior accident involvement. They concluded that a measure of safety culture could not be reliably demonstrated but did suggest six key factors that underpin safety attitude; personal need for safety, personal appreciation of risk, attribution of blame, conflict, control, and a supportive environment. Lee (1995) conducted similar research on a sample of 5,295 employees at a large British nuclear plant. This study highlighted three factors of importance to risk and safety: risk taking, an assessment of perceived risks, and the extent to which risks were perceived to be under personal control. The study did find major differences in attitude and perception according to job type, type of shift worked, gender, age, and experience. They also reported that differences in perception and attitude to safety were linked with prior accident involvement. Cox et al. (1998) examined the makeup of safety culture in terms of the relationship between attitudes to safety and perceived organisational commitment to safety. They found that the individual's attitudes to personal actions for safety were not related to their perception of the organisation's commitment to safety. The most significant finding of this study was that management actions for safety were most significant in influencing how employees perceived the overall level of commitment to safety in the organisation.

Guest et al. (1994), in contrast, did not rely on a questionnaire methodology, but instead used in-depth interviews using critical incident technique, repertory grid and open-ended questions. The study was conducted among British Rail employees following the Clapham Junction disaster. It concluded that a number of dimensions of safety culture could be identified. These included the following: a belief in hierarchy and management, a belief in the value of technically sound and complex safety systems, a reluctance of employees at lower levels to accept personal responsibility, and a sense of duty and commitment to running trains on time. The study in general did not succeed in linking safety culture and accident rates because there were few, if any, differences in perceptions of risk and safety performance between what were characterised 'safe' and 'unsafe' employees.

One can conclude that the dimensions identified from studies of safety climate appear to be related to employees perceptions of the organisational characteristics that impact upon safety whereas those dimensions associated with safety culture are more complex, diverse,

and personal. The findings on safety climate are in general consistent with definitions of climate constructs found in the organisational literature (Schneider, 1990) in that individuals do attach meanings to and interpret the environments within which they work. The meanings and perceptions that they attach to safety climate then influence their behaviour. Hofmann and Stetzer (1996) for example demonstrate that where employees work for a supervisor who never mentions safety, they are likely to develop perceptions that safety is not important and as a result will not place a strong emphasis on safety issues. Schneider (1990) provides support for the view that a strong safety climate has the potential to motivate employees to take greater ownership of,and responsibility for, safety within the organisation. This in turn has the potential to influence propensity to behave in a safe manner.

For the purposes of this study, safety climate was operationalised in the following way: perceptions of management's commitment to safety, employee ownership of safety related issues, stereotyping of safety conscious employees, adherence to safety rules and procedures, and the existence of proactive approaches to managing safety. It was postulated that perceptions of a strong safety climate would be associated with safe behaviour and a reduced tendency to engage in unsafe behaviour. We also selected a number of demographic and human capital dimensions of individuals as potential explanatory variables in the context of safety climate and safety behaviour.

Explaining Safety Behaviour

It has been argued that unsafe acts or behaviours are a major causal factor in workplace accidents/injuries and that improved safety behaviour reduces the frequency of work related accidents and injuries. The literature suggests that a range of factors explain safety behaviour. Accident proneness theory, for example, suggests that certain individuals possess relatively permanent idiosyncrasies, which increase their likelihood of having an accident. McKenna (1983) has challenged the accident proneness theory and argues that if one accepts such an explanation, one has to accept the underlying assumption that all employees are exposed to the same job and environmental conditions. A restrictive and far more realistic interpretation of this theory has emerged to the effect that employees are more or less prone to accidents in given situations and that this proneness is not permanent but changes over time (Porter, 1988).

The literature does, however, reveal a number of individual characteristics that explain unsafe behaviour and accidents:

- Younger employees are more unsafe and have higher accident rates than older employees (Singleton, 1982).
- Younger employees appear to have problems with attention, lack of discipline, impulsiveness, recklessness, overestimation of capacity and pride (Lampert, 1974).
- Older employees (50–60) show an increase in accident rates but at a lower rate than for younger employees (Broberg, 1984). DeGreen (1972) suggests that older employees have more accidents due to deterioration in motor skills, sensory functions, mental agility and reaction time.
- Oborne (1995) argues that safe behaviour is often negatively reinforcing in that it takes more time, may involve the use of safe clothing and may be subject of adverse comment from other employees. Unsafe behaviour is quicker, more comfortable, and more socially acceptable. Winsemsus (1965) demonstrated that experienced operators had learned to use unsafe behaviour patterns. This behaviour was viewed as easier and less time consuming, and so it was positively reinforced.
- Reason (1979) studied absent-mindedness and suggested that it is more likely a problem for the skilled or than the unskilled operator.

A number of studies have sought to categorise safety behaviours. Ray and Frey (1999) group safety behaviours into five categories: housekeeping, personal protective clothing, personal clothing, material handling, and operations. Hofmann and Stetzer (1996) suggest six broad categories of behaviour: improper tool use, improper work strategies at risk to self, failure to wear personal protective equipment, improper storage of tools, improper storage by others, and improper work strategies with risk to others. We utilised a number of these categories of safety behaviour when conducting this study.

The Methodology

Levels of Analysis

Klein et al. (1994) suggest that researchers should specify the levels of analysis at which they are assuming variables will operate and then test these assumptions. For the current research study, perceptions of safety climate were targeted for investigation at the organisational

level of analysis, whereas safety behaviour was investigated at the individual level of analysis. Even though safety climate was targeted at the organisational level of analysis, this construct does have individual counterparts. We hypothesised that individuals within any given organisation would have shared perceptions of safety climate given the organisational context. It is argued that social information processing influences could readily produce these shared perceptions. We expected that perceptions of safety climate would be relatively homogeneous within organisations. Safety behaviour was assumed to be an individual level variable.

Given that both organisational level and individual level variables were included in this study, a cross level model was investigated. Rousseau (1985) defines cross level models as those where variables at one level of analysis are hypothesised to influence variables at another level of analysis. Within the context studied, these hypotheses usually consist of variables at a higher level of analysis influencing outcome variables at a lower level, e.g. the influence of safety climate on individual safety behaviour. In the current study the effects of safety climate were investigated as contextual influences on safe and unsafe work behaviour.

Participants

The participants were 1240 employees in 25 manufacturing companies randomly selected. The data of 17 participants were eliminated due to excessive missing data. The average age of participants was 34 years (standard deviation, 10 years) and they had an average tenure of 8 years (standard deviation, 7.5 years). Of the participants 67% were male and all occupational groups were represented in the sample including operators (55%), technical/engineering (18%), management/supervision (15%), and administrative/professional (12%). The survey responses were anonymous.

Measures

Two sets of measures were utilised in the study. These were perceptions of safety climate and reported safety behaviours. We briefly describe each one:

- Safety climate was measured using a 38-item scale based on the work of Zohar (1980) and Dedobbeleer and Beland (1991). Slight modifications were made to make it situation specific to Ireland and to match common job titles found in Irish industry. For all items, a

five-point Likert-type 'strongly agree' to 'strongly disagree' scale was used. The Cronbach-alpha for the scale was 0.60.

- Safety behaviour: A review of the literature and discussions with experts provided a list of 52 behaviours that were treated as a behavioural construct. Respondents were asked to indicate the frequency (ranging from 'never' to 'always') with which they had engaged in the behaviour over the past year. The Cronbach-alpha for the scale was 0.94.

Statistical Methodology

The data was collected and prepared in an appropriate format for manipulation using SPSS. The scale items for both safety climate and safety behaviour were subjected to factor analysis. Factor analysis is a statistical technique that analyses the interrelationships among a large number of variables and enables the researcher to explain these variables in terms of their common underlying dimensions (factors). Thus, the statistical approach involves finding a way of condensing the information contained in a large number of original items into a smaller number of dimensions (factors) with a minimum loss of information quality.

Before the two relevant scales were subjected to exploratory factor analysis, they were tested for reliability. The respective Cronbach-alpha scores reported above were considered acceptable. The method of factor extraction used in this study was principal components analysis. It focuses on the total variance around the items, so the solution generated includes as many factors as there are items, although it is unlikely that they will all meet the criterion for retention. The criterion for retention selected was that a factor had an eigenvalue greater than one.

After the factor analysis was completed, the possible effects of specified predictors of safety climate and safety behaviour, i.e. three demographic variables, two human capital variables, and three safety history variables, were examined. Given that the data collected was primarily interval in nature, non-parametric techniques dominate the analysis, i.e. the Kruskal-Wallis test statistic is employed to compare the means of three groups or more and Spearman correlations are used to examine whether there is any significant relationship between safety climate and safety behaviour.

Results

Factor Analysis of Safety Climate Scale

The analysis of the safety climate scale proceeded through two stages with problematic items being removed after the first analysis. The second analysis yielded a factor solution, which accounted for 51.7% of the variance. The factor analysis identified eleven factors with eigenvalues greater than one and a fairly clear factor structure emerged: one large factor accounting for 11% of the variance, another item accounting for 8% of the variance and nine small factors accounting for 2–6% each. The factor solution is presented in Table 1.

TABLE 1: FACTOR STRUCTURE FOR SAFETY CLIMATE SCALE

Factor	% of Variance
Employee willingness to take ownership and participate in safety management	11%
Negative stereotypes of safety conscious workers	8%
Belief about employees who have accidents	5.7%
Management commitment to safety	4.2%
Riskiness of the job	3.8%
Belief in accident proneness	3.6%
Safety strategies in existence	3.5%
Proactive approaches to safety in organisations	3.2%
Management has sole ownership of safety issues	3.2%
Belief in strict adherence to rules of discipline for unsafe work behaviour	2.7%
Employees possess the capacity to be safety conscious	2.7%

The first factor represents a core concept of safety climate – employee willingness to take ownership and participate in safety management. This is expressed in terms of a willingness to participate in safety training, the importance of being briefed on the organisation's safety record, the importance of having accurate safety records, participation on safety committees, and taking on board some of the task of managing aspects of safety.

The second factor – negative stereotypes of safety conscious employees – is expressed in terms of the following stereotypes: employees who observe safety rules are softies, to carry out unsafe work practices is positive, safety rules contribute to accidents at work, non-co-operation in investigating accidents and the difficulty of training employees to be safety conscious.

The third factor is beliefs about individuals who have accidents. This factor is expressed in terms of the following beliefs: competitive people are most likely to be involved in accidents in the workplace, people who are ambitious are likely to have more accidents as are people who are either aggressive or impatient.

The fourth factor is management commitment to safety. This is expressed in the following terms: the organisation's culture places strong emphasis on safety; all accidents are reported within the organisation using the correct procedures; there is a positive commitment to safety in the organisation, and getting the work done is not more important than safety.

The fifth factor, riskiness of the job, is expressed in the following terms: the organisation is not high risk in safety terms, the chances of an accident occurring are slight, the chances of the employee's job resulting in an accident are slight and there is limited risk attached to any job within the organisation.

The sixth factor, belief in accident proneness, is expressed in terms of three elements: some employees are more accident prone than others, accident proneness is a significant factor in explaining accidents and I am not an accident-prone individual.

The seventh factor, specific strategies for safety, is expressed in the following terms: the existence of strategies to deal with employees' personal problems, providing employees with more autonomy, and a reduction of work overload.

The remaining four factors: proactive approaches to safety in the organisation, management has sole ownership for safety, strict adherence to rules and procedures, and the belief that employees possess a capacity to be safety conscious account for 11% of the variance.

Factor Analysis of Safety Behaviour Scale

The analysis of the safety behaviour scale proceeded through two stages with problematic items being removed before the second stage. The factors extracted accounted for 54% of the variance. The factor analysis identified nine factors with eigenvalues greater than one and a very clear factor structure emerged. One factor accounted

for 26% of the variance; a second factor accounted for 9% of the variance. The remaining set of factors accounted for 2–5% each. The factor solution is presented in Table 2.

TABLE 2: FACTOR STRUCTURE FOR SAFETY BEHAVIOUR SCALE

Factor	% of Variance
Correct responses to hazardous situations	26.3%
Communication of unsafe work conditions	8.9%
Proper use of equipment	4.8%
Break safety rules	3%
Engage in preventive safety behaviour	2.58%
Safety behaviour by exception	2.3%
Attention to rules/procedures	2.22%
Engage in risking behaviours	2%
Good housekeeping practised	2%

The first factor clearly represents a core element of safety behaviour – correct responses to hazardous situations – and explains 26.3% of the variance. This is expressed in terms of the following: proper storage of hazardous chemicals, proper usage of hazardous chemicals, proper disposal of hazardous equipment, use of necessary safety devices when working around harmful chemical fumes, properly label hazardous work areas, prepare materials for safe usage, and use necessary safety equipment in dangerous work situations.

The second factor – communication of unsafe work conditions – accounts for almost 9% of the variance. This is expressed in terms of eight important behaviours; warning co-workers of unsafe conditions, reporting unsafe work conditions to supervisors, reporting unsafe work practices to supervisors, encouraging co-workers to behave in a safe manner, reporting to management any unrecognised safety hazards, reporting safety issues in general to supervisors, stepping away from unsafe work situations, and communicate with co-workers regarding hazards relevant to them.

The third factor – proper use of equipment – is expressed in terms of nine specific behaviours. These are the return of all equipment to its proper storage place after use, the proper use of equipment re-

quired by practice, keeping equipment in an orderly fashion, properly storing equipment required by practice, clearing up spills left by equipment, periodically performing thorough inspections of equipment, inspecting equipment prior to use, using equipment as if there is the possibility of an accident, and following proper maintenance schedules for equipment.

The fourth factor focuses on unsafe work behaviours. This factor – breaking safety rules – is expressed in the following terms: altering equipment to save time, improperly setting up equipment before use, taking shortcuts in order to get the job done faster, modifying or altering equipment, exceeding equipment's recommended limitations, and improvising when safety equipment is not available.

The fifth factor focuses on preventive safety behaviours. This factor is expressed in terms of the following behaviours: replacing old/damaged equipment prior to use, the inspection of work areas to detect hazards, making representations to management on preventing accidents, making sure emergency equipment is on site, making sure emergency equipment is available when required, and attending all scheduled safety meetings.

The remaining four factors – safety behaviour by exception, attention to rules and procedures, engaging in risky behaviour, and good housekeeping practices – account for 8.5% of the variance.

Influence of Gender and Provision of Safety Training on Safety Climate

Table 3 presents the results of t-tests examining the statistical significance of gender and participation in safety training in relation to perceptions of safety climate.

The analysis reveals a number of statistically significant results. Gender does appear to have a significant effect on safety climate in an overall sense. Furthermore, a number of significant effects were revealed for specific climate factors. Gender appears to have a statistically significant effect on the extent to which employees are likely to perceive that safety climate promotes ownership of, and participation in, safety issues; the extent to which employees perceive that the climate promotes particular beliefs about people who have accidents; the level of management commitment to safety; the degree of riskiness in the job; and the belief that the safety climate promotes strict adherence to rules and procedures.

TABLE 3: T-TESTS INVESTIGATING THE EFFECT OF GENDER AND PARTICIPATION IN SAFETY TRAINING ON PERCEPTIONS OF SAFETY CLIMATE

	Gender		Safety Training	
Factor	*t-statistic*	*p-value*	*t-statistic*	*p-value*
Ownership and participation	–2.535	0.012*	2.540	0.011*
Negative stereotyping	–0.273	0.785	–2.316	0.021*
Beliefs about people who have accidents	4.019	<0.001***	–2.590	0.010**
Management commitment to safety	3.049	0.002**	6.016	<0.001***
Riskiness of the job	–4.438	<0.001***	–1.013	0.312
Belief in accident-proneness	4.000	<0.001***	0.737	0.462
Specific strategies for safety	1.794	0.073	0.263	0.793
Proactive approaches to safety	0.082	0.935	0.839	0.839
Management have sole ownership of safety	0.229	0.819	0.102	0.102
Strict adherence to rules	3.060	0.002**	0.452	0.452
Employees possess capacity to be safety conscious	–1.181	0.238	0.939	0.939
The overall safety climate score	–4.380	<0.001***	–0.810	0.589

Significance is indicated as follows: * at the 5% level; ** at the 1% level; and *** at the 0.1% level

Participation in safety training does not appear to have a significant effect on employees' perception of the overall safety climate in the organisation. However, the study revealed that this predictor had a significant effect on the most important safety climate factors. Participation in safety training has a significant effect on the extent to which employees perceive that the safety climate promotes ownership of, and participation in, safety issues; the extent to which the climate contains negative stereotypes about safety conscious employees; the beliefs about people who typically have accidents; and the perception of management commitment to health and safety.

Influences of Other Demographic and Accident History Variables or Perceptions of Safety Climate

Six other predictor variables were included in the study: two demographic variables, age and job title; one human capital variable, organisational tenure; and three accident history variables' accident involvement, accident reporting, and near accident involvement. Again, statistical analysis was conducted to ascertain whether these predictors had a significant effect on overall safety climate, and the various factors identified within safety climate. Table 4 presents the results of the analysis.

The analysis reveals that job title has a significant effect on perceptions of overall safety climate and specific dimensions of an organisation's safety climate. In particular, job title has a significant effect on almost three quarters of the safety climate factors including the most significant factors, as revealed by the factor analysis. It has a significant effect on the perceptions of ownership of, and participation in, safety; the beliefs that people have about accident prone individuals; perceived management commitment to safety; the perceived riskiness of the job; the perception of the existence of specific strategies for safety; the beliefs regarding the extent of proactive approaches to safety; the perception that management has sole ownership of safety; the perception of strict adherence to rules; and the perceived overall safety climate of the organisation.

Age appears to be of relatively limited significance in perceptions of safety climate. It does, however, appear to have a significant effect on the extent of negative stereotypes about safety conscious employees, perceptions of proactive approaches to safety, and the extent of perceptions of management commitment to safety.

TABLE 4: KRUSKAL-WALLIS TESTS INVESTIGATING THE EFFECT OF DEMOGRAPHIC, HUMAN CAPITAL, AND ACCIDENT HISTORY VARIABLES ON SAFETY CLIMATE

	Age		*Job Title*		*Tenure*		*Accident Involvement*		*Reported Accidents*		*Near Accidents*	
Factor	***Test Statistic***	***p-value***	***Test Statistic***	***p-value***	***Test Statistic***	***p-value***	***Test Statistic***	***p-value***	***Test Statistic***	***p-value***	***Test Statistic***	***p-value***
Ownership and participation	1.945	0.857	19.133	0.001**	0.874	0.928	3.163	0.531	4.835	0.305	9.245	0.055
Negative stereotyping of safety conscious employees	11.557	0.041*	4.705	0.319	9.596	0.048*	8.503	0.075	6.433	0.169	5.951	0.203
Beliefs about people who have accidents	5.158	0.397	16.281	0.003**	3.955	0.412	2.656	0.617	3.850	0.427	4.057	0.398
Management commitment to safety	28.593	<0.001***	11.182	0.025*	5.793	0.215	13.109	0.011*	1.116	0.892	22.948	<0.001***
Riskiness of the job	9.139	0.104	40.175	<0.001***	20.289	<0.001***	39.482	<0.001***	26.023	<0.001***	47.403	<0.001***
Beliefs about accident prone individuals	4.061	0.541	1.923	0.750	0.667	0.955	1.913	0.752	15.960	0.003**	12.759	0.013*
Specific strategies for safety	6.724	0.242	17.446	0.002**	8.736	0.068	5.050	0.282	9.346	0.053	11.118	0.025*
Proactive approaches to safety	15.031	0.010**	17.380	0.002**	2.608	0.625	5.457	0.244	8.162	0.086	4.884	0.299
Management has sole ownership	10.592	0.060	15.546	0.004**	9.126	0.058	6.091	0.192	12.546	0.014*	9.499	0.050
Strict adherence to rules	10.935	0.053	41.686	<0.001***	3.787	0.436	10.676	0.030*	14.000	0.007**	6.366	0.173
Employees possess ability to be safety conscious	9.957	0.076	6.120	0.190	5.343	0.254	4.250	0.373	1.873	0.759	10.687	0.030*
The overall safety climate score	4.28	0.509	12.482	0.014*	8.744	0.068	3.994	0.407	15.213	0.004**	6.396	0.249

Significance is indicated as follows: * at the 5% level; ** at the 1% level; and *** at the 0.1% level

Organisation tenure appears to be of little significance in perceptions of safety climate also. However, it has a significant effect on the extent of negative stereotyping about safety conscious employees and the level of riskiness in the job. There were no significant results for the remaining safety climate factors.

Of the three accident history variables, the involvement of the employee in an accident in the past three years has a significant effect on specific aspects of safety climate. In particular, it appears to be significant in relation to perceptions of management commitment to safety, the perceived riskiness of the job, and the perceived extent of strict adherence to rules for those who engage in unsafe work behaviour.

The two remaining accident history variables appear to be of more significance and have an effect on a larger number of the safety climate factors included in the study. Where the employee experienced a reported accident in the previous twelve months, the analysis reveals that this has a significant effect on the perceived riskiness of the job, beliefs about accident prone individuals, the perception that management has sole ownership of safety, the perception of strict adherence to safety rules for unsafe behaviours, and the overall perception of safety climate within the organisation.

Where the employee was involved in a near accident (something that could have caused an injury but did not) in the previous twelve months, the analysis reveals that this significantly affects a number of dimensions of safety climate. It appears to have an effect on the following dimensions: the perception of management commitment to safety, the perceived riskiness of the job, beliefs about accident proneness, individual perceptions that specific strategies exist for safety, the perception that management has sole ownership of safety, and the belief that employees possess the capacity to be safety conscious. Many of the statistically significant results identified are logical, rational ones and there is significant support for many of them in the current body of literature (Donald and Canter, 1994; Cox and Cox, 1996; Cox and Flin, 1998; Mearns and Flin, 1999).

Influences of Gender and Provision of Safety Training on Safety Behaviour

Table 5 presents the results of the statistical investigation into the effects of gender and participation in safety training on the reported safety behaviour of respondents.

TABLE 5: T-TESTS INVESTIGATING THE EFFECT OF GENDER AND PARTICIPATION IN SAFETY TRAINING ON REPORTED SAFETY BEHAVIOUR

	Gender		Safety Training	
Factor	*t-statistic*	*p-value*	*t-statistic*	*p-value*
Correct responses to hazardous situations	0.878	0.380	1.941	0.053
Communication of unsafe work conditions	–1.241	0.215	4.083	<0.001***
Proper use of equipment	1.325	0.186	1.613	0.108
Break safety rules	–4.598	<0.001***	–2.550	0.011*
Engage in preventive safety behaviour	3.008	0.003**	5.229	<0.001***
Safety behaviour by exception	0.643	0.521	–1.892	0.059
Attention to rules and procedures	4.511	<0.001***	3.095	0.002**
Engage in risky behaviours	0.189	0.850	0.351	0.351
Good housekeeping practice	–5.210	<0.001***	0.775	0.775
The overall safety behaviour score	0.279	0.780	4.500	<0.001***

Significance is indicated as follows: * at the 5% level; ** at the 1% level; and *** at the 0.1% level

The analysis reveals that gender does not appear to significantly influence overall reported safety behaviour by employees. However, it has a significant effect on the likelihood of breaking safety rules, the extent to which the employees engage in preventive safety behaviour, the extent of attention to safety rules, and the demonstration of

good housekeeping practices. Further analysis reveals that participation in safety training has a significant effect on overall safety behaviour and on three other positive behaviours and one negative behaviour. Participation in safety training has a significant effect on the following positive behaviours: the extent to which an employee is likely to communicate unsafe work conditions, the extent to which an employee engages in preventive safety behaviours, and the extent of attention to safety rules and procedures; and on the negative behaviour breaking safety rules.

Influence of Other Demographic and Accident History Variables on Reported Safety Behaviours

Statistical analysis was conducted to investigate whether two other demographic variables (age and job title), one human capital variable (organisational tenure), and three dimensions of accident history (involvement in accidents, experiencing a reported accident, and involvement in a near accident) had a significant effect on reported safety behaviour. Table 6 presents the results of the analysis.

The analysis reveals that none of the accident history variables have a significant effect on overall safety behaviour. However, they have a significant effect on specific behaviours. Accident involvement, for example, has a significant effect on the unsafe behaviour of employees and safety behaviour by exception, both of which are negative behaviour categories.

The experience of a reported accident in the previous twelve months has a significant effect on safety behaviour by exception and the extent of good housekeeping. Involvement in near accidents is significant in relation to unsafe behaviours, safety behaviour by exception, and the extent of good housekeeping. All three of the accident history variables appear to have a significant effect on the commission of unsafe acts in the workplace or safety behaviour by exception.

As is the case with perceptions of safety climate, job title has a significant effect on overall safety behaviour and on many of the important safety behaviour factors. Job title has a significant effect on the following categories of positive safety behaviour: positive responses to hazardous situations, the communication of unsafe work conditions, the proper use of equipment, engagement in preventive safety behaviour, good housekeeping practices, and attention to rules and procedures. It also has a significant effect on one negative safety behaviour: breaking safety rules.

TABLE 6: KRUSKAL-WALLIS TESTS INVESTIGATING THE EFFECT OF DEMOGRAPHIC, HUMAN CAPITAL, AND ACCIDENT HISTORY VARIABLES ON REPORTED SAFETY BEHAVIOUR

	Age		Job Title		Tenure		Accident Involvement		Reported Accidents		Near Accidents	
Factor	*Test Statistic*	*p-value*	*Test Statistic*	*p-value*	*Test Statistic*	*p-value*	*Test Statistic*	*p-value*	*Test Statistic*	*p-value*	*Test Statistic*	*p-value*
Correct responses to hazardous situations	4.515	0.341	33.311	<0.001***	5.342	0.254	5.122	0.275	3.066	0.547	8.644	0.071
Communication of unsafe work conditions	20.267	<0.001***	15.527	0.004**	13.564	0.009**	2.861	0.581	4.706	0.319	7.171	0.127
Proper use of equipment	8.282	0.082	32.058	<0.001***	2.175	0.704	4.311	0.366	2.179	0.703	2.175	0.704
Break safety rules	12.672	0.013*	23.619	<0.001***	2.128	0.712	9.844	0.043*	7.202	0.126	24.026	<0.001 ***
Engage in preventive safety behaviour	25.771	<0.001***	40.185	<0.001***	4.785	0.310	4.033	0.402	6.932	0.140	4.504	0.342
Safety behaviour by exception	8.389	0.078	5.780	0.216	3.947	0.413	17.238	0.002**	11.491	0.022*	9.953	0.041*
Attention to rules and procedures	6.036	0.196	19.276	0.001**	8.217	0.084	3.555	0.470	8.573	0.073	3.720	0.445
Engage in risky behaviours	1.368	0.850	4.715	0.318	10.022	0.040*	.526	0.971	5.149	0.272	3.129	0.573
Good housekeeping practice	7.072	0.123	26.383	<0.001***	15.228	0.004**	7.453	0.114	11.333	0.023*	10.508	0.033*
The overall safety behaviour score	12.301	0.015*	21.116	<0.001***	5.345	0.254	1.364	0.851	2.588	0.630	2.583	0.630

Significance is indicated as follows: * at the 5% level; ** at the 1% level; and *** at the 0.1% level

The potential predictor age seems to have an overall significant effect on reported safety behaviour. In particular, it has a significant effect on two positive safety behaviours and one negative one. It appears to have a significant effect on the communication of unsafe work conditions, the extent of engagement in preventive safety behaviour, and the negative safety behaviour of breaking safety rules. Organisational tenure also has a significant effect on two positive and one negative safety behaviour: the extent of communication of unsafe work conditions, the extent of good housekeeping practices and the extent to which employees engage in risky behaviour. Overall the demographic and human capital variables of job title, age, and organisational tenure have a statistically significant effect on a considerable number of safety behaviours in organisations.

Relationships between Perceptions of Climate and Reported Safety Behaviours

The study also examines the relationship between safety climate within the organisation and specific safety behaviours. Table 7 shows the Spearman non-parametric correlation between the safety climate factors and the safety behaviour factors included in the study. The analysis reveals that there are a number of significant correlation between safety climate factors and safety behaviour factors.

- The 'management commitment to safety' safety climate factor is significantly correlated with five safety behaviour factors. More interestingly, it is significantly negatively correlated with unsafe behaviour factors and significantly positively correlated with safe behaviour factors.

- The safety climate factor labelled 'specific strategies for safety' is significantly positively correlated with three positive safety behaviour factors: 'correct responses to hazardous situations', 'communication of unsafe working conditions', and 'engaging in preventive safety behaviour'. A similar relationship exists for the safety climate factor labelled 'proactive approaches to safety in organisations'.

- The positive safety behaviour factors of 'communicating unsafe working conditions' and 'attention to rules/procedures' are significantly positively correlated to the safety climate factor labelled 'employee willingness to take ownership of and participate in safety management', whereas the negative behaviour factor of "engaging in risky behaviours" shows a significant negative correlation.

TABLE 7: SPEARMAN NON–PARAMETRIC CORRELATIONS BETWEEN SAFETY CLIMATE FACTORS AND SAFETY BEHAVIOUR FACTORS

Safety Climate Factors		Correct Responses to Hazardous Situations	Communication of Unsafe Working Conditions	Proper Use of Equipment	Break Safety Rules	Engage in Preventive Safety Behaviour	Safety Behaviour by Exception	Attention to Rules/ Procedures	Engage in Risky Behaviours	Good House-keeping Practice
Employee willingness to take ownership and participate in safety management	*Corr. Coeff*		0.127					0.063	–0.067	
	p-value		<0.001***					0.042*	0.031*	
Negative stereotypes of safety conscious workers	*Corr. Coeff*		–0.109	–0.102	0.118	–0.156	0.228	–0.087	0.061	–0.061
	p-value		<0.001***	0.001**	<0.001***	<0.001***	<0.001***	0.005**	0.048*	0.048*
Beliefs about employees who have accidents	*Corr. Coeff*				0.070		0.083			–0.086
	p-value				0.025*		0.008**			0.006**
Management commitment to safety	*Corr. Coeff*		0.129	0.088	–0.170	0.205	–0.144	0.157		
	p-value		<0.001***	0.005**	<0.001***	<0.001***	<0.001***	<0.001***		
Riskiness of the job	*Corr. Coeff*	–0.074					–0.079	–0.084	0.066	0.091
	p-value	0.016*					0.011*	0.007**	0.033*	0.003**
Belief in accident proneness	*Corr. Coeff*			–0.100	0.113	0.074	0.110			
	p-value			0.001**	<0.001***	0.017*	<0.001***			

Table 7 Cont'd

Safety Climate Factors		Correct Responses to Hazardous Situations	Communication of Unsafe Working Conditions	Proper Use of Equipment	Break Safety Rules	Engage in Preventive Safety Behaviour	Safety Behaviour by Exception	Attention to Rules/ Procedures	Engage in Risky behaviours	Good House-keeping Practice
Specific strategies for safety	*Corr. Coeff*	0.080	0.107			0.062				
	p-value	0.010*	0.001**			0.046*				
Proactive approaches to safety in organisations	*Corr. Coeff*		0.077			0.063				0.078
	p-value		0.013*			0.041*				0.012*
Management has sole ownership of safety issues	*Corr. Coeff*			0.069	0.093		0.156		0.084	
	p-value			0.025*	0.003**		<0.001***		0.006**	
Belief in strict adherence to rules of discipline for unsafe work behaviour	*Corr. Coeff*	–0.080	0.118			0.129				
	p-value	0.010*	<0.001***			<0.001***				
Employees possess the capacity to be safety conscious	*Corr. Coeff*									
	p-value									

Significance is indicated as follows: * at the 5% level; ** at the 1% level; and *** at the 0.1% level

- The safety climate factor labelled 'negative stereotypes of safety conscious workers' is significantly correlated to eight of the nine safety behaviour factors. There seems to be significant negative correlation between this factor and a range of positive safety behaviour factors.
- The safety climate factor labelled 'specific strategies for safety' reveals a significant positive correlation with the safety behaviour factors labelled 'correct responses to hazardous situations', 'communication of unsafe working conditions', and 'engaging in preventive safety behaviour'.
- The safety climate factor labelled "proactive approaches to safety in organisations" is significantly positively correlated with five "positive" safety behaviour factors.

There are many other correlations within the table presented above most of which make intuitive sense and point towards safety climate having an important influence on safety behaviour. In general the results show significant relationships between dimensions of safety climate, as perceived by employees, and a range of reported safety behaviours.

Discussion, Conclusions, and Future Research

A number of quantitative and qualitative studies of safety in the workplace have identified safety climate as a key organisational factor that influences individual employee safety behaviour and performance. The current study operationalised these constructs as employees' perceptions of safety climate and employee reported safe and unsafe work behaviours. A number of potential predictors of both safety climate and safety behaviour were also investigated. These were categorised as demographic, human capital, and accident history variables.

The analysis reveals that the three accident history variables did not seem to have a significant effect on a very wide range of safety climate factors or reported safety behaviours. In relation to safety climate, however, accident history variables were mostly found to have a significant effect on perceptions of management commitment to safety, perceived riskiness of job, and perceptions of how strictly rules are adhered to. Accident history variables are generally insignificant in relation to the most important categories of safety behaviour, i.e. correct response to hazardous situations, the communication of unsafe working conditions, and the proper use of equipment. A

number of demographic variables do appear to have a significant effect on both perceptions of safety climate and safety behaviour. Gender has a significant effect on a number of safety climate factors, including two of the most important factors that make up safety climate, the extent of ownership of and participation in safety and the extent of beliefs about people who have accidents in the workplace. Age in general has a significant effect on a small number of safety climate factors and is insignificant in relation to perceptions of overall safety climate within an organisation. Organisational tenure likewise is relatively insignificant in relation to the safety climate factors with the exception of negative stereotyping about safety conscious employees and the perceptions of riskiness in the job.

Participation in safety training does appear to have a significant effect on four important dimensions of safety climate: stereotyping, ownership of and participation in safety, beliefs about people who typically have accidents, and the perception of management commitment to safety.

Job title is revealed to be significant in relation to perceptions of safety climate. It has a significant effect on overall perceptions of safety climate and almost all of the important factors within the safety climate construct.

The demographic and human capital variables have a significant effect on a range of safety behaviours. Age, gender, and job title are significant in relation to unsafe behaviours in the workplace. They are significant with regard to the breaking of safety rules, but also in explaining a wide range of safe work behaviours. Job title reveals the most significant results and has an effect on many safety behaviours. Age is significant in relation to engagement in preventive safety behaviours and the communication of unsafe work conditions. Gender is significant in relation to attention to rules and procedures, good housekeeping practice, and engaging in preventive safety behaviour.

Participation in safety training is, as expected, a significant factor in a number of safety behaviours. It has a significant effect on three important positive safety behaviours: the communication of unsafe work conditions, engaging in preventive safety behaviour and attention to rules and procedures. Organisational tenure has a significant effect on a small number of safety behaviours, including the extent of communication of unsafe conditions, good housekeeping practice, and one negative behaviour, engaging in risky behaviour.

The analysis reveals that perceptions of safety climate are significantly associated with a range of safety behaviours. It suggests that where employees perceive a strong safety climate, on average they

engage in fewer unsafe behaviours. The analysis leaves open the question of the causal direction of the climate–behaviour relationship. However, these findings do suggest that if employees perceive a strong safety climate in the form of ownership and of participation in safety and management commitment to safety, for example, then they are more likely to take personal ownership of safety activities, be more proactive, and demonstrate a stronger capacity to perform tasks in a safe manner. They are therefore likely to engage in fewer unsafe behaviours, such as breaking safety rules, being safe by exception, and engaging in risky behaviour in the workplace. Such an interpretation is in general consistent with the general body of safety research which highlights the influence that management actions can have on the behaviour of employees within organisations.

The findings of the study have a number of implications for effective safety management within organisations. The literature presents evidence of a wide range of strategies being utilised by organisations to manage safety activities. These include training (Donald and Young, 1996), goal setting (Marsh *et al.*, 1995), feedback and financial incentives (McAfee and Winn, 1989; Sulzer-Azaroff *et al.* 1994; Hofmann *et al.* 1995). Many of these interventions are directed at the individual level whereas very few interventions or strategies focus on either the team or organisational level. Such a trend is in general a reflection of the implicit assumption made by many organisations that safety problems reside at an individual level. House et al. (1995) argues that while it is reasonable to make such an assumption, it is quite limited as a management approach because it ignores the importance of contextual influences on safety behaviour in organisations. The results of this study suggest that safety specialists should begin to focus on broader safety strategies and consider safety communication issues, perceptions of safety climate, the existence of role models, and the identification of more general trends in accident data and other unsafe behaviours. Such an approach may provide more fruitful answers about the root causes of unsafe work behaviour. This is not to suggest that individual level analysis is not also worthwhile, however it may be necessary to link organisational and individual level data to get a more focused picture.

The current study is far from conclusive, but it posits that perceptions of safety climate do influence the extent of safe and unsafe behaviours within organisations. The study is not without limitations. Firstly, it is based on self-reports of perceptions of safety climate and safe/unsafe behaviours. Individuals were being asked to self-report negative (unsafe) behaviours so that they were likely to provide more

socially desirable responses. If such were the case then the socially desirable responses would yield no variance on the measures of unsafe behaviour. However, the study findings show that there meaningful variance was reported

The findings reported in this paper represent an exploratory analysis of the data collected. Therefore, a number of research avenues remain open for investigation. The study so far has not investigated the differential impact of a range of independent demographic, human capital, and safety history factors on perceptions of safety climate and reported safety behaviours. We can for example subject the data to further statistical analysis in order to ascertain the specific impact of a number of variables found to be significant in this study. These include the level of the employee in the organisation, gender of employee, whether the employee participated in safety training, and whether the employee was involved in a reported accident.

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