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EXPLAINING SAFE BEHAVIOUR ACROSS DIFFERENT WORK GROUPS

J.M. TOMÁS
Department of Methodology for Behavioural Sciences, Faculty of Psychology,
University of Valencia, Spain. E-mail: tomasjm@uv.es

A.OLIVER
Department of Methodology for Behavioural Sciences, Faculty of Psychology,
University of Valencia, Spain.

A.CHEYNE
Business School, Loughborough University, UK

ABSTRACT

This study examines the relationships between employee attitudes to organisational safety issues; perceptions of the physical working environment, and evaluations of worker involvement; and relates these to self-reported levels of safety behaviour. It explores the relationships between these variables in three work groups in a large transportation organisation, examining the similarities and differences in the architecture of safety attitudes in those groups. Over 1100 workers from a large transportation company based in UK were assessed using self report questionnaire measures. These workers were involved in three types of tasks: delivery, warehousing and administration.

Multisample structural equation modelling was used to estimate different nested models, in order to explore the moderation effects of membership of different work groups on the promotion of safe behaviours. These data showed the same basic structure of attitudes to safety issues, and their relationships to safety behaviour, across the three occupational groups. This suggests that climate and attitudes to safety play an important role in the explanation of employee safe behaviours. However the differences between groups suggest that occupational role can act as a moderator in several of these relationships. Comparisons are made between the three groups, and mean scores on each of the model components show that there are differences in the relative assessments of the dimensions. The results are discussed in terms of generating general models of attitudes to safety, which in turn may facilitate climate change and result in the promotion of safe behaviours.

1. INTRODUCTION

The concepts of safety culture and climate have become central to contemporary thinking on health and safety management (Cox & Flin, 1998; Clarke, 2000). A fundamental element of these approaches has involved an investigation of the relationships between safety attitudes and climate and some aspect of safety performance (for example, Zohar, 1980; Cox & Cox, 1991; Clarke, 2000). The majority of research into the assessment of culture and climate for safety has centred on the use of employee attitude surveys. It has been suggested (Williamson, Feyer, Cairns & Biancotti, 1997) that the perceptions and attitudes of workers are important factors in understanding safety climate and that survey instruments provide an effective means of assessing organisational safety issues (Bailey & Petersen, 1989).

Early research, concerned with nature and intensity of safety climate, was based around the use of large-scale questionnaire surveys. Zohar (1980) developed one of the first questionnaires in this area, which involved

asking around 400 factory workers for their views. The results from 20 factories were compared to independent ratings of safety performance and correlations were found between climate ratings and these evaluations, with the highest importance accorded to management attitudes and the relevance of safety in the production process. A number of studies, based on Zohar's work, have since been carried out in various industries around the world (Brown & Holmes, 1986; Dedobbeleer & Béland, 1991; Cooper & Phillips, 1994; Isla Díaz & Díaz Cabrera, 1997).

Williamson et al. (1997) developed a similar questionnaire for a study of Australian workers. The five factors derived from this study were similar to those uncovered in earlier research, suggesting that it may be possible to identify 'core' dimensions relating employee attitudes to safety (see Flin, Mearns, O'Connor & Bryden, 2000; and Clarke, 2000). The Williamson et al. (1997) study found that there was little variation in intensity of views between respondents on a large proportion of the items, suggesting that the consensus shown across these items might reflect workers' views about safety in general and that safety climate may be composed of these views as well as more specific perceptions of individual work environments. Mearns and Flin (1999) propose that this may be explained by the fact that shared attitudes and beliefs are indicative of a shared safety culture across Australian workers. The differences in views of day-to-day safety issues, however, might reflect salient climates in different organisations. Similar findings have been shown in terms of the structure of attitudes and climate in UK companies, with broad similarities in the structure of attitudes to safety in two organisations (Cheyne, Oliver, Tomás & Cox, 2002).

Research has also focused on specific groups within organisations when examining attitudes and varying climate structures. Cox, Tomás, Cheyne and Oliver (1998) found differences between the views of workers, supervisors and managers in their study of attitudes to safety in a large manufacturing organisation. In this study permanent workers tended to have had more positive views than the other employment groups. This has lead to the examination of the importance of such employment groups in achieving a safe working environment. For example, Simard and Marchand's (1994) study of first-line supervisor behaviour suggested that participatory supervisor behaviour was related to safety performance, albeit not as an independent determining factor.

Comparisons of the structure of attitudes and climate have highlighted similar results. A survey carried out in one nuclear organisation (Harvey, Bolam & Gregory, 1999) has suggested that basic conceptualisations of safety differed between management and staff at two locations. Different factor structures emerged for managerial and industrial staff. The two work groups shared the majority of factors, with the exception of the final factor, with responsibility for safety appearing only for industrial staff and good versus poor management appearing only for managerial staff. Harvey et al (1999) suggest that these differences may be a function of how the individual views the organisation from their position in it and their experience of it, and that this may be the case within a wide range of organisations.

Hierarchical differences consistent with those found by Harvey et al. (1999) have been discovered in other sectors. Niskanen's (1994) study found differences between supervisors and workers relating to factors dealing with supervision, individual responsibility, changes in work demands and the value placed on work, in a study in the construction industry. Similarly, Cheyne, Tomás, Cox and Oliver (2003) compared data on employee attitudes to safety across three levels (managers, supervisors and general employees). This study highlighted that, while managers, supervisors and employees shared the same definition of safety factors, their perceptions of these factors and how they inter-related proved to be quite different.

The above studies provide two broad types of evidence relating to the pervasiveness of organisational climates for safety. Some research suggests scope for potential common views to exist across several organisations (Williamson et al., 1997; Mearns et al., 1998). At the same time, differences have been uncovered between occupational levels (that is, management and workforce) within some organisations Cox et al., 1998; Harvey et al.,1999; Cheyne et al., 2003). Such differences have been found both in terms of the interpretations (intensity of attitudes) (Cox et al., 1998) and in terms of the structure (Niskanen, 1994; Harvey et al., 1999; Cheyne et al., 2003) of attitudes and climate.

One possible explanation of these results is that, while there may be general levels of agreement across organisations, differences between organisational sub-groups might also be consistent, showing a similar pattern for each organisation, with hierarchies giving rise to similar subcultures, in line with Trice and Beyer's (1993) more general suggestion that organisational hierarchy may give rise to subcultures. This possibility would explain the broad agreement found by Williamson et al. (1997) for example, but also allows for differing sub-group structures found by Harvey et al. (1999). Furthermore, the similarities between sub-groups might reflect shared organisational culture, while the differences could reflect more group specific climates for safety. The potential

structure of sub-groups attitudes and perceptions, and how these might compare to each other, is the focus of the study discussed here.

1.1 Current Study

Previous research described above (Niskanen, 1994; Cox et al., 1998; Harvey et al., 1999; Cheyne et al., 2003) suggests that there may be variations in both structure and intensity of attitudes between different employee groups within an organisation. This possibility is explored in the testing of the hypothesis that different employee groups within the same organisation will exhibit different attitude/climate structures, reflecting the particular view from their working environment. Whereas much previous research has focussed on employment level, this research will seek to differentiate between job functions.

The structure of attitudes and perception to safety will be examined not only through the use of factor analytical techniques, but also in terms of the structural inter-relationships between attitude dimensions. The aim of this research is two-fold: First to test for mean differences in key safety variables among three job roles within a distribution company. Second, to test for a structural model to predict active safe behaviour and risk taking (safety compliance) simultaneously in the three job types (deliverers, warehouse workers and administrative workers), in order to explore moderator effects.

2. METHOD

2.1 Research strategy and sample

The study was based on a survey of the total population of workers in a UK based Distribution Company. A total of 1189 workers, across 33 depots, completed the survey, representing a response rate of 38%. 10.2% of the workers were less than 25 years old; 26.5% were between 26 to 35 years old; in the range 36-45 years there were 33.7% of the workers; 22.7% were 46 to 55 years old, and finally 6.8% of the workers were over 56 years old. With respect to job tenure 5.8% had been in their position for less than one year; 34.1% had been working for the company for between one and five years; 21.6% between six and ten years; and 38.6% for more than ten years.

2.2 Survey instrument

The survey instrument comprised three sections. Section 1 gathered demographic and job position information. Section 2 focussed on assessing individual safe behaviours. Ten items with a 4 point Likert response scale, as used in previous research, were included here. These items were based on safe behaviour questionnaires utilised by García, Boix and Canosa (2004); and Mearns, Whitaker and Flin (2003). A confirmatory factor analysis found a two factor orthogonal solution: Active Safety behaviour (AS) and Risk Taking (RT)

Section 3 of the survey instrument included 45 attitude and perception items (each with a 5 point Likert response scale). These items were designed to capture views on safety climate, the working environment and the workers' own role in safety issues. The Safety Climate (SC) section included a total of 24 items derived from previous work by Cox and Cheyne (2000), Zohar (2000) and Zohar and Luria (2005). A confirmatory factor analysis found four oblique factors: Management Commitment (MC), Team Leader Actions (TLA), Priority of Safety (PS) and Communication (COM). The Work Environment (WE) section included 14 items used previously by Cooper Phillips, Sutherland and Makin (1994) and Cox and Cheyne (2000). A confirmatory factor analysis found three correlated factors: Work Resources (WR), Workers Risk Perception (WRP) and Safety Rules (SR). Finally Individual Role (IR) included 9 items, selected from previous work by Cheyne et al. (1998) and Cox and Cheyne (2000). A confirmatory factor analysis found a two-factor oblique solution: Involvement (INV) and Personal Responsibility (PR).

2.3 Analyses

MANOVAs were applied to test whether the mean differences among groups on a combination of safety dimensions were likely to have occurred by chance. MANOVA is recommended for use in situations in which there is more than one dependent variable and these are correlated (Weinfurt, 1995), such as the present research with several oblique factors.

Structural equation models with latent variables were employed to test the hypothesized pattern of relationships among the variables in the study and their proposed latent factors. A multisample structural modelling procedure was set up in order to test moderator effects of work group on the hypothesized relationships.

The multisample procedure place a sequence of nested models, with varying degrees of relationships constrained to equality. Once these nested models have been specified and estimated, chi-square differences tests can be used to test for the statistical adequacy of these equality constraints. If the difference between the chi-squares is not statistically significant, then the statistical evidence points out no cross-group differences between the constrained parameters. If the chi-square difference is statistically significant then evidence of cross-groups inequalities exists. However, this statistical testing approach to model comparison may be overly sensitive (Marsh et al., 1996) and should be combined with a practical approach based on the comparison of a number of fit-indices used in structural equation modelling. Therefore, as recommended by Little (1997), the parsimonious (with more constraints) model may be retained when: 1) it has an acceptable model fit; and 2) there are minimal differences between the more parsimonious model and the model with less constraints. Structural models were estimated within the EQS 6.1 program.

3. RESULTS

3.1 Mean differences

A multivariate analysis of variance (MANOVA) was performed to test for group differences on measures of safety climate (management commitment, team leader actions, priority of safety and communication). With the use of Wilk's criterion, the combined dependent variables were affected by worker's group ($\Lambda = 0.902$, $F_{6, 2232} = 14.678$, $p < 0.001$, $\eta^2 = 0.05$). Separate ANOVA's on each dependent variable were performed and statistically significant differences were found in all cases ($p < 0.001$). *Post hoc* tests found consistent higher means in all safety climate dimensions for administrative workers.

A second MANOVA found significant group differences on the combined indicators of work environment ($\Lambda = 0.744$, $F_{6, 2232} = 59.178$, $p < 0.001$, $\eta^2 = 0.137$). All individual ANOVA's on safety rules, workers risk perception and work resources were also statistically significant. *Post hoc* procedures showed that administration workers reported greater means followed by warehouse workers. Lowest means of work environment were always associated with those involved in delivery activities.

The third MANOVA that was performed focussed on worker's involvement and personal responsibility as combined dependent variables. This MANOVA was also statistically significant ($\Lambda = 0.744$, $F_{6, 2232} = 59.178$, $p < 0.001$, $\eta^2 = 0.137$). Separate ANOVA's found significant mean differences on personal responsibility ($p < 0.001$), but not on involvement ($p = 0.054$). *Post hoc* comparisons found that warehouse and delivery workers had greater levels of personal responsibility than administrative workers.

Finally, a MANOVA was estimated to test for group differences on safety behaviour and risk taking (compliance) simultaneously. Statistically significant differences were found on the combined dependent variables ($\Lambda = 0.845$, $F_{8, 2238} = 59.178$, $p < 0.001$, $\eta^2 = 0.137$). Separate ANOVAs were also statistically significant ($p < 0.001$), while *post hoc* comparisons found again a consistent pattern of mean differences: warehouse and delivery workers had greater levels for both active safety behaviour and risk taking than administrative workers.

3.2 Multisample structural equation models

A structural equation model relating latent variables was theoretically proposed: Safety Climate (based on four indicators, Management Commitment, Team Leader Actions, Priority of Safety and Communication) and Work Environment (made up of three indicators: Work Resources, Workers' Risk Perception and Safety Rules) were considered exogenous factors explaining Active Safety behaviour (with two indicators formed from random grouping of the items in the scale) and Risk Taking (again with two indicators formed from random grouping of the items in the scale), while the Individual's Role in safety was considered a latent mediator (made up of Involvement and Personal Responsibility). This theoretically driven model was slightly modified in order to achieve a good model fit. Two changes were made: the relationship between Work Environment and Individual Role was dropped as non significant; and a direct relationship between Safety Rules and Risk Taking was introduced, as proposed by a large modification index.

This modified model was tested in a multisample framework, comparing three groups (administration workers, deliverers, and warehouse workers). A sequence of multisample nested models was estimated. Goodnesss-of-fit indices for the sequence of models are shown in Table 1. Model 1 posited no constraints across groups. In other words, model 1 was freely and simultaneously estimated in all groups, and was used as a baseline comparison model. Model 2 constrained all factor loadings to equality, therefore testing if indicators were equally reliable in measuring the latent factors. Although there were statistically significant differences between model 1 and 2 chi-squares, in terms of practical fit, these differences were minimal. Model 3 imposed constraints on all

factor loadings and structural relations. Again, there were statistically significant chi-square differences between models and slightly larger differences in terms of practical fit. Therefore, LM tests to modify constraints were estimated and some constraints were released (those that were statistically significant) in model 4. Practical differences in model fit between models 4 and 1 were minimum considering its level of parsimony, and more importantly no other suggested modifications would made a large statistical contribution to model fit. Thus, model 4 was retained as the best-fitting model.

Table 1: Multisample nested models and chi-square differences.

									Model 1	
Model	Description	χ^2	df	p	CFI	GFI	SRMR	RMSEA	$\Delta\chi^2$	p
1	Multisample (MS) no constraints	830.6	174	<0.001	0.914	0.894	0.067	0.058	--	--
2	MS factor loadings constrained	877.01	190	<0.001	0.910	0.888	0.083	0.057	46.41	<0.01
3	MS factor loadings and structural relations constrained	938.34	201	<0.001	0.904	0.879	0.111	0.057	107.74	<0.01
4	MS Model 3 with LM test exceptions	876.11	197	<0.001	0.911	0.888	0.083	0.056	45.51	<0.01

Note: df= degrees of freedon; CFI= comparative fit index; GFI= Goodness-of-fit index; SRMR= Standardised Root Mean-Square Residual; RMSEA= Root Mean Square Error of Approximation; $\Delta\chi^2$= chi-square difference.

Parameter estimates for model 4 are shown in Figure 1. All estimates shown are significant ($p<0.001$) unless marked as ns (non significant). Estimates were constrained to equality except those between brackets that correspond to the free estimation in group three (administration workers). Therefore, only four relations were moderated by group, and these differences always were between groups one and two (deliverers and warehouse workers) and group three (administration workers). The most important results in the model relate to structural relations among latent variables. Safety Climate had a strong relationship with Individual Role and Work Environment, and these results are also positive, but larger, for administration workers. Overall 60% of the variance of Individual Role was explained by Safety Climate (91.3% in group three); while variance explained in Work Environment was 49.2% in groups one and two and 57.4% in group three. The effects of latent variables on Active Safety behaviour were modest: 6.8% of the variance explained in groups one and two and 17.7% in group three. Finally, the amount of Risk Taking variance explained by the predictors was relatively large: 48.1% for groups one and two and 34.3% for group three. It must be noted that the indicator Safety Rules had a unique and large effect on Risk Taking, but only for groups one and two (see Figure 1).

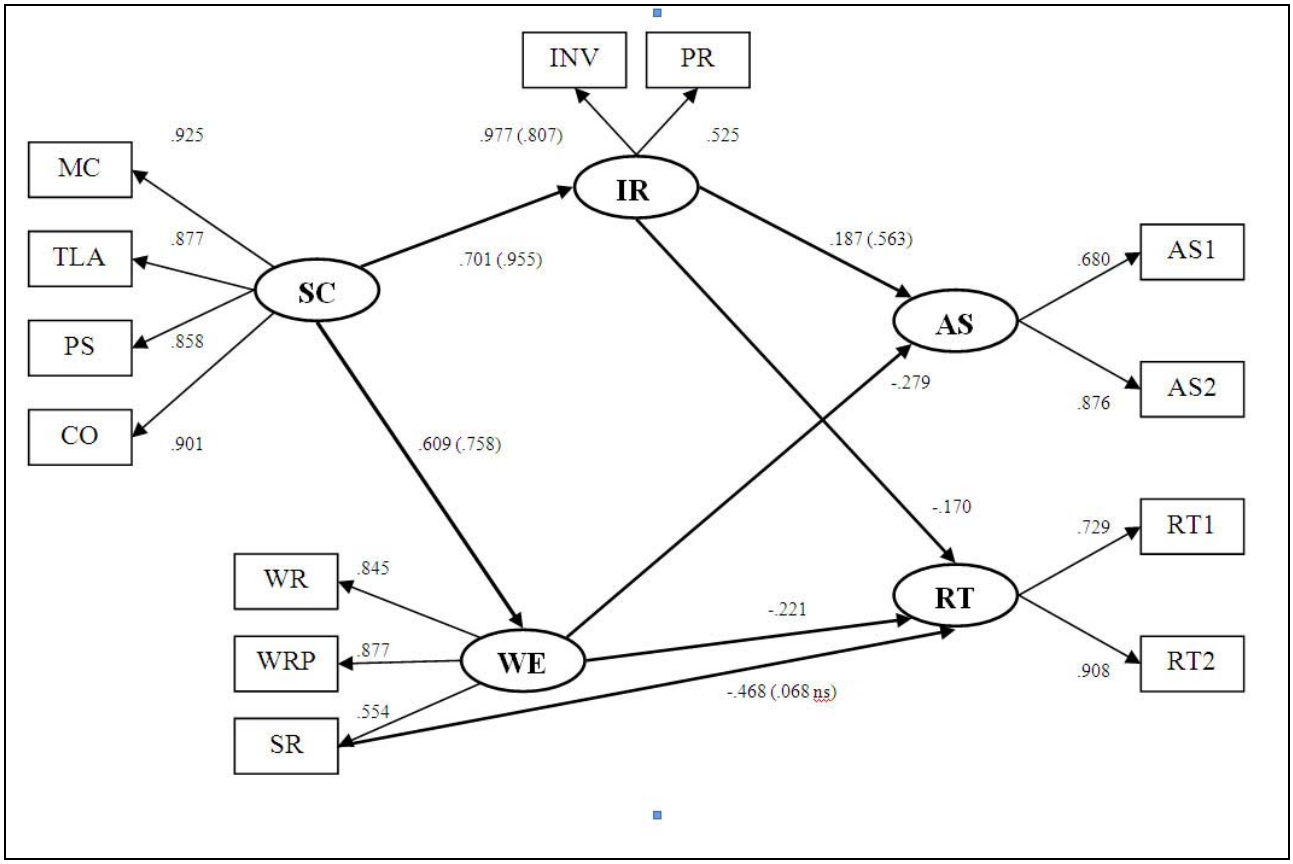

Figure 1: Multisample structural model estimated across the three samples.
Notes: Abbreviations are explained in the section describing the survey instrument.

4. DISCUSSION

The hypothesis presented in this paper, that different employee groups would exhibit different attitude/climate structures, is particularly important for planned improvements which target all employees across the organisation. While any safety initiative is likely to take account of differing work practices, such a comparison can highlight common ground and give members of the organisation some understanding of how others perceive safety issues.

The first aim of this study was to test for mean differences across the three work groups. In summary, the series of MANOVAS found statistically significant mean differences across the three work groups. Administration workers systematically differed from the other two groups: they had more positive evaluations of safety climate and their work environment, but lower levels of personal responsibility, active safe behaviour and risk taking (or compliance). However, all groups had, in general, positive views, scoring above the scale mid-points and reporting relatively safe behaviours. These statistical differences are easily reconciled with an appreciation of the individual's working environment. Cox et al. (1998) suggested that differences in attitudes and perceptions may be due to expectations being unmet. If that is the case then in this study it may be easier to meet expectations for safety in some environments than in others.

The differences in intensity of attitudes would suggest that sub-climates exist in this sample, with a particular differentiation, perhaps not surprisingly, between administration workers and the other two groups. The comparison of structural relationships between the factors and measures allowed the full extent of the similarities and differences between the work groups to be examined.

The second aim of the study was to specify and test a structural model to predict outcome behaviours (Active Safety Behaviour and Risk Taking). The multisample model fitted the data quite well in the three groups under study, but with several differences emerging among the groups. In general the predictors had moderate to large effects on both dependent variables as proposed. The larger effects on Active Safety Behaviour were in the administration group, mainly due to the strong effect of Individual Role. However, the amount of variance of Risk Taking explained for in the model was larger for the other two groups. This differential result was mainly due to the larger effect of Safety Rules on Risk Taking in groups one and two, a result that may be due to the more hazardous environment in which these two groups work, that may require highly regulated work practices.

The structural models derived from the three work sub-samples were quite different. The multisample analysis highlighted four statistical differences from a total of seven structural relationships in the model. The greatest difference among the three sub-samples seems to be between the administration group model and those models for other workers. While the administration group shares some common elements with each of the other groups, the results suggest that the conceptualisation of safety issues and the role played by individuals involved in administration is quite different from the other two groups. This may belie the common belief that the office provides a safe environment in which to work, and so those in group three find themselves with less opportunity to 'take risks' and more ability to get actively involved in safety.

There is further support for this view from the final main difference in the structural relationships, relating to the direct association between safety rules and risk taking behaviour for the two, more operational groups. Whereas other variations in the models relate to changes in loadings, this is the only difference that is not significant, or apparent, in one of the groups. The obvious explanation for this may lie with the lack of salience given to safety rules and regulations in the office environment, or feelings that they do not apply to those environments. While not surprising, this lack of awareness or recognition of rules could have obvious implications for the targeting of initiatives across the organisation.

The differences between the three sub-samples are important if considered in light of early theories and definitions of safety culture and climate. An important aspect of definitions of culture is its shared nature (HSC, 1993; Schein, 1985), a feature also attributed to climate (Moran and Volkwein, 1992). The models derived in this study show that not all of safety climate's interrelationships are shared. In fact, it is difficult to see any pattern of shared aspects, that are equal in the statistical sense, between the administration group and the other employees. It could clearly be argued that each of these employment groups has its own sub-climate and that which might be shared between them (in particular between the delivery personnel and warehouse operatives) helps to define the organisation's, or indeed the sector's, overall climate. The differentiation of safety sub-climates parallels many of the views of the nature of organisational culture. Organisational hierarchies have been held to provide the status differentials necessary to produce sub-cultures (Trice & Beyer, 1993), it may be that in this case job role is providing the basis for some sort of hierarchical differentiation. The result of the cross group comparison described above provides evidence that this is also the case in terms of safety climate as suggested for occupation specific safety sub-cultures in the offshore environment (Mearns, Flin, Fleming & Gordon, 1997).

4.1 Conclusions

The fact that some workers see things differently from others is important in terms of promoting a positive, or appropriate, culture for safety. It has implications for the success of improvement programmes aimed at all employment groups and the development of an organisational ethos for safety. A beneficial approach, suggested by Cheyne et al. (2003), might be to attempt to 'align' the different groups within the organisation to give an appreciation of how other workers view things, and reduce the distance between the three groups if appropriate. This might be particularly important if individuals are being encouraged to take more responsibility for safety and not view safety issues as the preserve of only some parts of the organisation.

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