Safety Climate and the Theory of Planned Behaviour: Towards the Prediction of Unsafe Behaviour

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Abstract

The present study is concerned with the human factors that contribute to violations in aviation maintenance. Much of our previous research in this area has been based on safety climate surveys and the analysis of relations among core dimensions of climate. In this study, we tap into mainstream psychological theory to help clarify the mechanisms underlying the links between climate and behaviour. Specifically,we demonstrate the usefulness of Ajzen's Theory of Planned Behaviour (TPB) to understanding violation behaviours in aircraft maintenance. A questionnaire was administered to 308 aircraft maintenance workers. constructs measured by the survey included perceptions of management attitudes to safety, own attitudes to violations, intention to violate, group norms, workplace pressures, and violations. A model based on the TPB illustrated hypothetical connections among these variables. Path analyses using AMOS 4.01 suggested some theoretically justifiable modifications to the model. Fit statistics of the revised model were excellent and R-Squared values for all endogenous variables were encouraging. The model highlighted the importance of management attitudes and group norms as direct and indirect predictors of violation behaviour. We conclude that the TPB is suitable for the analysis of this type of safety behaviour but that to be truly useful it should be extended to incorporate management attitudes.

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Traditionally, occupational health and safety (OH&S) interventions have centred on controlling the physical work environment and work procedures of employees in an effort to prevent errors and accidents. Examples include the documentation of detailed procedures designed to provide the safest way of completing tasks, procedures for handing over uncompleted tasks to colleagues, strict safety guidelines for the operation of machinery, and the wearing of personal protective equipment. A complementary approach to human error focuses on the human factors in work accidents. This approach takes into account the inevitability of human error and seeks to contextualise behaviour so that a greater understanding can be realised. Where strict procedural guidelines attempt to mechanise and standardise behaviour, a human factors perspective acknowledges individual differences and focuses on psychological pressures and factors that influence behaviour. The present study is concerned with the human factors that contribute to violations in aviation maintenance. Much of our previous research in this area (e.g., Fogarty, Saunders, & Collyer, 2001) has been based on safety climate surveys and the analysis of relations among core dimensions of climate. In this study, we tap into mainstream psychological theory to help clarify the mechanisms underlying the links between climate and behaviour. Specifically, it will be argued that Ajzen's (1988) Theory of Planned Behaviour can be applied to unsafe behaviour in the workplace. We will demonstrate the usefulness of this model by applying it to safety climate data derived from aircraft maintenance workers in the Australian Defence Force (ADF).

Models of Unsafe Behaviour

Within the safety climate approach (see review by Flin et al, 2000), a number of researchers have attempted to categorise safety climate variables with the aim of constructing models to explain the interactions among the variables. The most common means of categorising variables is to organise them according to the level at which the variable exerts influence. That is, variables are classified at either the organisational, group, or individual level. For example, Fogarty et al. (2001) developed a model to explain the causes of error in aviation maintenance. The study investigated the influence of organisational, job, and individual variables on errors using Structural Equation Modelling (SEM). The results suggested that the effect of organisational level factors on errors is mediated by individual level factors, such as health and stress. A similar study by Lawton (1998) examined the causes of violations among railway shunters working in the United Kingdom. Although the outcome variable was different in each case (errors versus violations), both models showed individual level variables mediating the relationship between organisational factors and measures of unsafe behaviour. Fogarty and Neal (2002) combined these two variables in their work on the causes of both violations and errors in the construction industry. The authors hypothesised that safety climate variables would predict violations, whereas individual level variables would predict errors. The relations among the variables used by Fogarty and Neal are modelled in Figure 1.

As illustrated by the model, safety climate variables are seen as impacting directly on violations and the personal resources of employees. The employees' resources influence the psychological strain they feel, which is directly responsible for the numbers of errors they make. According to Fogarty and Neal, there is also a causal link between violations and errors.

One weakness of models based on the safety climate approach is that they don't appear to draw upon explanatory accounts of behaviour developed within mainstream psychology, yet there are some points where connections can be made. Ajzen's (1988) theory of planned behaviour (TPB) appears well-suited to the explanation of the link between climate and safety behaviours that are intentional, that is, violations. A short introduction to this theory follows.

The Theory of Planned Behaviour

The main components of the TPB are a person's own attitude, subjective norms, perceived behavioural control, intentions, and behaviour (Ajzen, 1988). The relations among these variables are depicted in Figure 2.

[Insert Figure 2 about here]

Ajzen hypothesised that attitudes often fail to exhibit strong correlations with behaviour because of the large number of factors that potentially prevent the attitude from being converted to behaviour. Consequently, Ajzen introduced the concept of intention as a link between attitude and behaviour to strengthen the relationship. In this way, attitudes can be used to predict an individual's intention to perform a behaviour, which in turn can be used to predict the occurrence of the actual behaviour. The incorporation of intention as a mediating variable has served to strengthen the relationship between attitudes and behaviour in the application of the TPB across a variety of settings (e.g., Conner, Warren, Close, & Sparks, 1999; Furnham & Lovett, 2001). The concept of subjective norms is more complex. Subjective norms refer to the beliefs and behaviours of people who are likely to influence the view of the individual. In a work situation, this is likely to include both managers and those coworkers who are closely associated with the individual. For example, if an employee does not believe that management or colleagues are concerned with safety, then they are less likely to consider safety as important. The third predictor of intention and also a direct predictor of behaviour is the component of perceived behavioural control. According to Ajzen, perceived behavioural control strengthens the relationship between intentions and behaviour. Ajzen argued that people often intend to perform certain behaviours, yet fail because of factors which fall outside their control.

To a large extent, the constructs included in the TPB mirror the individual, group, and organisational level variables measured in safety climate studies. Individual attitude toward safety is often used as a safety climate variable (e.g., Mearns et al., 2001). Safety climate studies have also looked at the influence of subjective norms. Individuals in organisations tend to regard themselves as members of workgroups. The norms developed by these groups influence the behaviour of employees who feel they are a part of any such group. The inclusion of group level factors in safety climate studies is supported by research that has looked at the role group norms play in safety behaviours (e.g., Hofmann and Stetzer, 1996; Zohar, 2000). Finally, perceived behavioural control is represented throughout the safety climate literature by way of workplace pressures that prevent employees from following procedures. Perceived behavioural control suggests there are times where, despite best intentions to act in a certain manner, individuals feel incapable of fulfilling a planned activity. In the same way, employees may feel that they are not able to complete work tasks according to procedures and rules because of external factors that are beyond their direct control. Examples of these external influences include lack of equipment, lack of personnel, lack of time, and production pressures. In safety literature these factors are often combined under the construct of workplace pressures, elements of work that are beyond the control of individual workers, yet likely to impact on their perceived ability to complete tasks in accordance with procedures. Consequently, it is suggested that workplace pressures will be associated with employee intentions to violate and actual violations of procedures.

Thus, the TPB maps quite nicely onto models generated by some studies of safety climate (Fogarty & Neal, 2002). The safety climate research, in turn, suggests ways in which the TPB model can itself be refined. As shown in Figure 2, the relations among own attitude, subjective norms, and perceived behavioural control remain unanalysed. This study will extend the TPB by suggesting management attitude to safety is responsible for the spurious link between these unanalysed variables The importance of management attitudes to safety is well-documented, indeed, it extends back to Zohar's (1980) initial study of safety climate. Zohar found that an employee's perception of his or her manager's attitudes toward safety was the most important predictor of safety climate. Since then, studies applying safety climate and culture to mining accidents, the aviation industry, and construction workers have all highlighted the important role played by management in ensuring the safety of organisations. We suggest here that management attitudes will exert an indirect influence on violation behaviour via own attitudes, subjective norms, and perceived control. We also suggest that subjective norms will have a direct effect on own attitudes. The resulting model is shown in Figure 3.

[Insert Figure 3 about here]

The aim of the present study was to test this model on a set of data collected from aviation maintenance engineers.

Method

Participants

Participants included 312 aircraft maintenance personnel from the Australian Army (*N* = 105, 33.7%), Navy (*N* = 86, 27.6%), and Air Force (*N* = 116, 37.2%). The majority of the participants were aircraft maintainers (52%) or avionics maintainers (39%), while the remaining nine percent were involved in other maintenance support roles. Sixty-two percent of participants indicated that they were tradespersons or technicians, while the remaining thirty-eight percent included supervisors, inspectors, maintenance quality inspectors, maintenance coordinators, and maintenance managers.

Materials

Scales needed to obtain measures of variables found in Figure 3 were embedded within a much larger instrument constructed by the authors and military staff to measure safety climate within the ADF aviation maintenance environment. The relevant scales are described below. Internal consistency estimates of reliability (Cronbach's alpha) obtained in this study are shown in brackets. All items employed a Likert-style response format.

1. Management Attitude to Safety: Comprising seven items representing participants' perceptions of management beliefs and actions about safety topics and situations. For example: *Managers turn a blind eye to risk taking by supervisors if the flying programme or task deadline is met.* ($\alpha = .86$)

2. Own Attitudes to Violations. This scale contained nine items. For example: *Short cut that help to get a job done are still violations of procedures*. ($\alpha = .73$)

3. Group Norms. Seven items were chosen to represent participants' perceptions of group safety norms. These questions focused on the respondents' beliefs about usual group practices in relation to violations. For example: *Other people in my workplace violate procedures.* ($\alpha = .78$)

4. Workplace Pressures. Eight items were chosen to represent participants' perceptions of workplace pressures. These questions focused on the extent to which respondents felt they were under pressure to complete tasks. For example: *Adequate time is allocated to complete assigned tasks.* ($\alpha = .84$)

5. Intention to Violate. This scale contained five items. For example: *I am prepared to take short cuts to get a task done.* ($\alpha = .74$)

6. Violations were measured by a four-item scale. For example: *When given a task, I ensure that approved procedures are followed.* (NB. reverse-scored item). ($\alpha = .72$)

Procedure

Surveys were administered and collected during August 2001 by psychologists from the ADF who travelled to the military bases of the units taking part in the survey. All members of the units who were available at the time participated in the survey; due to shift work, this represented approximately 75% of the members of each unit. The full survey took approximately 30 to 45 minutes to complete.

Results

Correlations

As specified by the model, the correlations among the variables were all significant at the $p < .01$ level. The descriptive statistics and correlations are presented in Table 1.

[Insert Table 1 about here]

Path Analysis

Amos 4.01 (Arbuckle, 1999) was used to test the fit of the path model shown in Figure 3 to the covariance matrix generated from the set of six variables. Initial fit statistics were unsatisfactory: χ^2 (7, N = 308) = 99.59, p = .00; TLI = .70; CFI = .88; RMSEA = .22. Revisions were made on the basis of modification indices and theoretical considerations. The main changes required were to the section of the model dealing with the relations among own attitudes, group norms, and work pressures where the spurious contribution of management attitudes failed to give an adequate account of these relations. The model was modified to show group norms contributing to own attitudes and also to work pressures. Direct pathways were also fitted from own attitude and group norms to violations. The direct pathway from management attitude to violations was deleted but all other pathways were left. The resulting model is shown in Figure 4.

[Insert Figure 4 about here]

Fit statistics for this model were excellent: χ^2 (4, N = 308) = 3.40, p = .49; TLI = 1.00; CFI = 1.00; RMSEA = .00 and all pathways were significant. The model accounted for 50% of the variance in violations, 47% of the variance in intention to violate, and a substantial proportion of the variance of the mediating variables.

Discussion

The importance of management attitudes is again highlighted in this study. Either directly, or indirectly, it influenced every variable in the model. To spell out its influence in more detail, perceptions of management attitudes has a direct effect on the shaping of a worker's own attitudes and also on group norms. It also has a direct effect on work pressures. This last connection may not appear obvious but the fact is that workers do see managers as exerting control over the quality of their work through the relative emphasis managers place on such things as quality versus production, working safe versus working quickly (the old saying: "Safety works until we are busy"), and the attitude of management to errors and violations. Group norms is another key variable in our model. It has a strong influence on individual attitudes, violation intentions, and actual violation. The importance of group norms is shown in the correlation matrix itself where its relationship with violations is equivalent to the relationship between intention to violate and violations. The only pathway in the model that had to be discarded was the direct link from workplace pressures to violations. The TPB suggests this link should be present but own data lead us to conclude that its influence is indirect and rather weak. A possible explanation is that work pressures was not an adequate substitute for the perceived behaviour control variable found in the TPB.

In summary, the Theory of Planned Behaviour has been helpful in refining a model that can be used to explain variance in this aspect of safety behaviour. The theory does not lend itself to the analysis of errors because these are – by definition – unintentional behaviours. The TPB draws our attention to the role of subjective norms and the mediating construct of intentions, both of which are useful additions to the network of variables that interact to influence safety behaviours. The role played by management, on the other hand, is not something that was suggested by the TPB.

Rather, it was suggested by our previous research on safety climate. The practical implications of safety climate research are predominantly concerned with highlighting courses of action that can be followed by organisations to reduce the risk of accidents. Because managers are viewed as the vehicle through which organisations influence the workforce, management behaviours and attitudes are usually of particular interest. Our findings highlight the pervasiveness of management influence in all aspects of safety behaviours. For these reasons, it is suggested that the manner in which management variables influence safety behaviours within organisations should be of prime interest to researchers and practitioners in the immediate future. The Theory of Planned Behaviour could be extended to include management attitudes.

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Table 1

Correlation matrix for all variables (N = 308)

Variable	*M*	*SD*	1	2	3	4	5
1. Management Attitude	3.58	.72	1.00				
2. Own Attitude	4.47	.45	.44	1.00			
3. Group Norms	3.86	.59	.61	.50	1.00		
4. Workplace Pressures	3.76	.56	.57	.38	.55	1.00	
5. Intention to Violate	3.81	.70	.42	.58	.60	.44	1.00
6. Violations	3.82	.66	.45	.53	.65	.45	.60

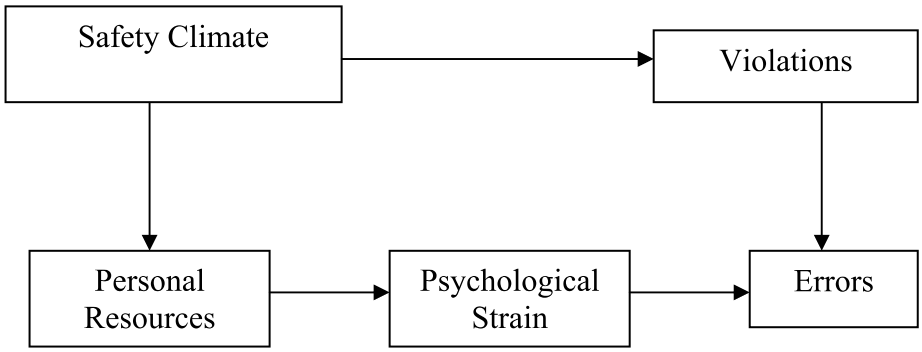

Figure 1. Fogarty and Neal's (2002) model of the organisational and individual level variables that act as predictors of violations and error in the construction industry

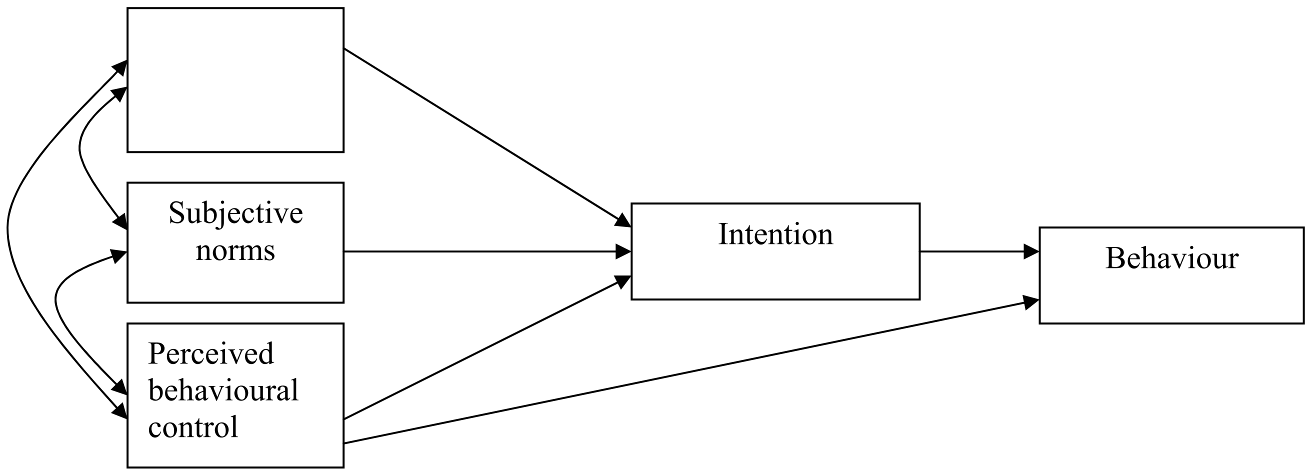

Figure 2. The Theory of Planned Behaviour (Ajzen, 1988)

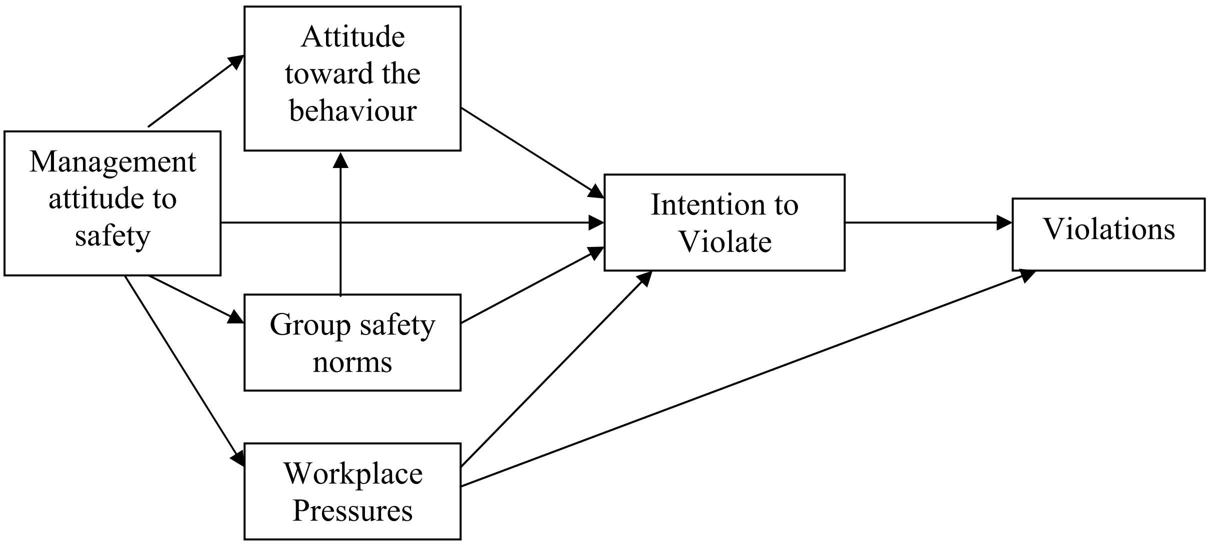

Figure 3. A model of safety behaviour based on the Theory of Planned Behaviour

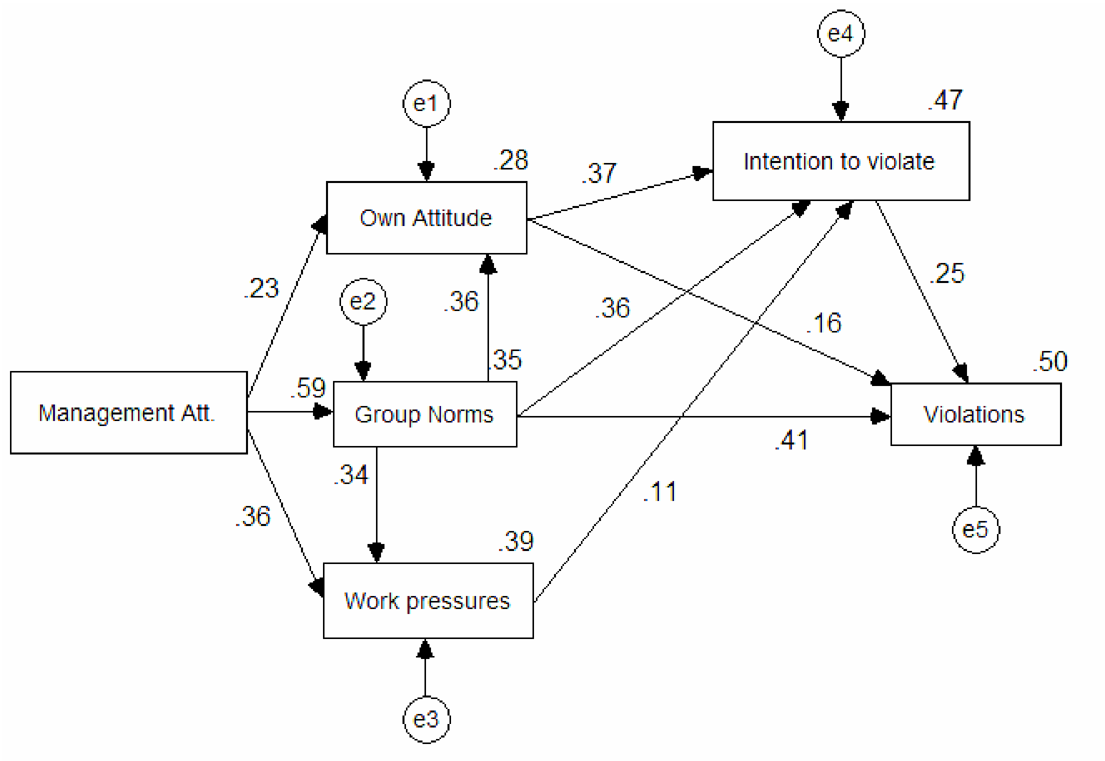

Figure 4. Adjusted path model showing various direct and mediated pathways to violation behaviours