

EXPLORING THE RELATIONSHIP BETWEEN LEADERSHIP STYLE AND SAFETY CLIMATE IN A LARGE SCALE DANISH CROSS-SECTIONAL STUDY

HANS H.K. SØNDERSTRUP-ANDERSEN

Roskilde University, Roskilde, Denmark, E-mail: hsan@ruc.dk (Corresponding author)

KATHRINE CARLSEN

National Research Centre for the Working Environment, Copenhagen, Denmark

PETE KINES

National Research Centre for the Working Environment, Copenhagen, Denmark

JAKOB B. BJØRNER

National Research Centre for the Working Environment, Copenhagen, Denmark

CHRISTIAN ROEPSTORFF

National Research Centre for the Working Environment, Copenhagen, Denmark

ABSTRACT

Recent studies provide evidence that high quality management is a determinant for a positive safety climate, but the majority of these studies are predominantly based on small samples from individual industries. The purpose of this paper is to scrutinize the association between transactional and transformational leadership and safety climate, and to explore how safety climate is affected by a number of socio-demographic factors and within different industries and company sizes. The analyses are based on data from a recent Danish work environment cross-sectional study including 3681 employees from a wide range of industries and who report that safety climate is relevant for their job. We use two safety climate items, (one regarding management safety empowerment; one regarding co-workers' safety priority), one question about transactional leadership and two scales concerning transformational leadership. In addition, we consider the impact of age, gender, education, job type and seniority as well as company size and industrial sector on the rating of safety climate. Predictors of safety climate ratings are analysed by use of multiple regression analysis. Our results show that the leadership style measured by items related to transactional and transformational leadership have a significant positive association with management safety empowerment, whereas workers' safety priority is only significantly associated with transformational leadership. Younger workers have significantly lower safety climate ratings, and low co-worker safety priority is associated with job type, education and in companies with less than ten employees. These results have important theoretical and practical implications for safety climate interventions and for planning and implementing management strategies that better support employees' engagement in proactive work environment behaviours.

1. INTRODUCTION

For more than a decade we have witnessed an increased research and enterprise interest in not only a focus on physical, technical, mechanical and organizational elements in preventing working environment accidents (1), but also in incorporating employee's shared safety perceptions, as well as the enterprises approach to managing these various types of risks in their contribution to accidents and injuries (2).

From a statistical point of view, there are often far too few work accidents in a company to establish the effects of safety initiatives (3). Newer research regarding occupational accidents and injuries focus on the feasibility of applying positive and proactive safety measures like safety observations(4), daily safety communication (5;6) and safety climate measures compared to more reactive measures like accident and injury frequencies (7). In a recent meta-analytic review, Clarke (8) argues that creating a more positive safety climate possibly will lead to a reduction in work accidents.

A substantial amount of research provides evidence that high quality management is a determinant for a positive safety climate (9-14). In addition, as pointed out by Zohar (15), general organizational factors characterized by a series of leadership dimensions could be possible determinants for facilitating such a positive safety climate.

The safety climate concept has been defined in many ways, but it is a generally accepted view that safety climate can be defined as the employees' shared perception of objective risks at work and the way that this work is organized and embedded in an organizational context (16-18). Recently Zohar (19) has suggested incorporating multi-level and multi-climate dimensions into the traditional view of the safety climate framework.

Zohar (15) focuses on styles of leadership and the influence this has on safety climate. The argument is that this influence is caused by the effect of the social interactions between superiors and subordinates concerning the subordinates' wellbeing at work.

In transformational leadership theory (20) the assumption is that subordinated employees are motivated by leaders who: a) Convey the importance of and values of tasks to them, b) Put emphasis on the organizational or team-based goals instead of promoting employees' own individual interests, c) Provide an appropriate model or plan for tasks, d) Have high expectations with respect to task performance, e) Provide support on an individual level, and f) Foster intellectual stimulation in task assignments. In transactional leadership the assumption is that the leader and the subordinate interact through contingent reward, management by exceptions (active and passive), and through a non-interaction laissez-faire leader attitude towards the welfare of the subordinates (20). In other words, the leaders engage subordinates in mutually dependent and rewarding relationships (21).

From our point of view the transformational and the contingent reward dimension of the transactional leadership approach might serve as an explanation for how leaders should engage in mutual interactional relationships with subordinates in order to build up and maintain a positive safety climate. That is, we want to explore if a significant relationship exists between the quality of the supervisor-subordinate relationship, and the subordinates' shared perception of risks in the working environment. Our hypothesis is that the leadership style represented by transformational leadership dimensions and the contingent reward transactional leadership dimensions are positively related to safety climate. That is, the more positive the employees rate the leadership style, the more positive their perceptions of the safety climate.

It has previously been documented that individual factors such as age, gender, education, seniority as well as factors related to the company, such as number of employees and type of industrial sector have a profound impact on the risk for work accidents (8;22-24). Only a few studies have, however, investigated to what extent these factors influence safety climate ratings (25-29). In this study we have the opportunity to investigate demographic factors as well as company factors on the perception of safety climate in a large population-based sample.

Questionnaire based data-acquisition is the most preferred method for scrutinizing to what extent the perception of safety norms, attitudes and prioritizations and leadership styles are shared among members. This can be measured at the level of the e.g. work-group, department, company, industrial sector and national level (12;15;16;30;31). These studies are predominantly based on small samples from individual industries. In this paper we want to explore these findings further using a national representative sample covering all industrial sectors and company sizes.

2. METHOD

2.1 Study design and population

The Danish National Working Environment Survey (DANES) is a cross-sectional study regarding health and working conditions for the Danish population, and is made up of four random samples: a) A main sample comprising 10.000 Danish residents in their working-age irrespective of their working status was identified through the Central Person Register; b) A 'senior' sample of 4.000 persons above the age of 50 who were employed at time of sampling and identified through the register of earnings administrated by Statistic Denmark; c) A company sample including 4.000 persons employed in 270 companies with 10-500 employees; and finally d) A study including 2.600 randomly sampled persons who participated in studies of questionnaire reliability and effects of method of administration..

This paper includes the main sample (a) and the company sample (c). The survey data were collected in the autumn of 2008 by mailed questionnaires, including an opportunity to answer the questionnaire on-line in an internet based version. Non-responders were mailed a reminder and a new questionnaire, and were eventually contacted by phone. In order to increase the response rate, people were offered to get a personalized feedback letter with their ratings on several scales from the questionnaire. The overall response rate was 70%. In contrast to responders, non-responders were significantly younger, more often men and living alone ($p < .0001$).

The questionnaire is mainly composed of validated scales which previously have been widely used in studies with the Danish population. The participants were asked to answer questions about their general health, including number and type of diagnosed chronic diseases, the Major Depression Inventory scale (32), mental health derived from SF-36 (33), burnout, sleeping troubles and cognitive stress. The latter three scales have been validated and used in The Copenhagen Psychosocial Questionnaire (COPSOQ) (34). Socio-demographic elements, health behaviour and aspects about main employment were all measured by single items, as were questions about demands, conflicts, workability and social support. Scales in relation to influence at work, emotional demands, possibilities for development, work family conflict and predictability were also obtained from COPSOQ from where we also used five questions about leadership style (35). Finally, the participants were asked five questions regarding safety climate (36).

We analysed the impact of leadership style on safety climate. Of the 9156 respondents we excluded 1394 who were not working at time of inclusion, 405 who were self-employed, 354 managers, 1484 who stated that safety climate was irrelevant in their job, and 1838 who did not complete the core questions. This resulted in a study sample of 3681 participants.

2.2 Measurement of safety climate

The questions about safety climate were derived from a questionnaire developed by a Nordic network of occupational safety researchers, headed by the National Research Centre for the Working Environment, Denmark (36). The Nordic occupational safety climate questionnaire (NOSACQ-50) is composed of 50 items divided into seven dimensions. Items with the highest loading on each of the dimensions were selected for the present questionnaire and two were selected for further analysis in this study. Participants were asked to state to what degree they agreed with the following statement "Management encourages workers to participate in decisions which affect their safety" and "We, who works here, consider minor accidents as a normal part of our daily work". The statements reflect the two dimensions management safety empowerment and workers' safety priority and risk non-acceptance, respectively. The response categories were "Strongly disagree", "Disagree", "Agree" and "Strongly agree", and the answers were dichotomised. As the statement regarding workers' safety priority is reversed compared to the other statement, the dichotomisation was done in respect to this in order to score safety climate in a positive manner, i.e. the higher score the better climate. "Strongly disagree" and "Disagree" were collapsed into one category "Agree" and "Strongly agree" into the other.

2.3 Measurement of relation to managers, management and covariates

Leadership style was measured by one single item and one scale. Transactional leadership was identified by one item: "Is your work acknowledged and appreciated by the manager?" Transformational leadership was measured by one scale (made up of four items, Cronbachs alpha: 0.8): "Do you get information in advance about e.g. important decisions, changes and plans for the future at your workplace?" and "Do you get all the information you need to do your job satisfactorily?", "To what degree can you say that the closest manager at your workplace pays a great deal of attention to job satisfaction?" and "To what degree can you say that the closest manager at your workplace is good at organizing the work?". All four items were rated on a five point Likert scale from "To a very high degree" to "To a very low degree", where a high score indicates better management. As covariates we

assessed gender, age (in five groups) and education categorized as no education including under education, vocational training, short-cycle higher non-university programmes (< 3 years), the medium-cycle university and non-university programmes (3-4 years) and the long-cycle university programmes (> 4 years). Main employment was measured as private versus public assignment, size of company, job type (categorized as skilled, unskilled, salaried worker and other including subsidised jobs and trainees), length of employment and whether the appointment was permanent or temporary. Industrial sectors were originally classified into 11 groups. Groups with less than 5% of the respondents were collapsed into one group, resulting in five groups (manufacturing, construction, trade and transport, public administration and other).

2.4 Statistical analysis

Inter-group comparisons of categorical and continuous variables were examined using chi-square test and unpaired t-test, respectively. Multiple regression analyses were used to examine predictors of safety climate ratings. Respondents' ratings of safety climate were entered into the analysis as dependent variables. Leadership style, work related factors and demographic factors were entered as independent variables. We tested for interactions between the three measurements of leadership style and the other independent variables which had significant associations with the outcome. We analyzed data using the LOGISTIC procedure of SAS-software version 9.2. Results are presented as odds ratios (OR) with 95% confidence intervals (95% CI).

3. RESULTS

More than ¼ of the respondents rate their safety climate low. Of the 3681 included persons 28% stated that they strongly disagreed or disagreed with the management safety empowerment statement: 'Management encourages workers to participate in decisions which affect their safety'. 27% were strongly in agreement or agreed with the statement: 'We, who work here, consider minor accidents are a normal part of our daily work', which reflects the dimension regarding workers' safety priority and risk non-acceptance. In the group who reported a low safety climate there was a significantly lower mean score on both aspects of quality in management ($p<.0001$). Correspondingly, low safety climate was significantly more widespread among persons with low education, unskilled workers, persons working in manufacturing and in companies with less than 10 employees. In addition, low ratings of management safety empowerment was more pronounced among employees in the private sector, and persons with one to nine years of employment, and young women were more likely to rate workers' safety priority and risk non-acceptance low. After adjustment for potential confounders, the probability of high ratings of management safety empowerment was strongly associated with high ratings of transactional as well as transformational leadership (Table 1). For each unit of increase in score on leadership style the probability of rating a good safety climate increased by 33% to 36%. In a model where leadership style was analysed one by one, and not mutually adjusted, the observed odds ratios varied between 2.35 (95% CI 2.16-2.56) to 1.44 (95% CI 1.40-1.48), indicating that the effect of transactional leadership to some extent was confounded by transformational leadership. Persons employed in the public sector (OR: 1.36, 95%CI: 1.01-1.83), persons employed more than 20 years in their present job (OR: 1.52, 95% CI: 1.15-2.00) and employment in companies with more than 500 employees (OR: 1.70, 95% CI: 1.17-2.46) rated their safety climate significantly higher than their counterparts.

Both measures of quality in management were strongly associated with the dimension regarding "workers' safety priority and risk non-acceptance" in an unadjusted model (Data not shown). In contrast to the former dimension, only transformational leadership was significant in a mutually adjusted model (OR: 1.04, 95% CI: 1.01-1.08). The probability of having a high safety climate rating was reduced by approximately 40% among persons with no education (OR: 0.56, 95% CI: 0.41-0.77) or vocational training (OR: 0.63, 95% CI: 0.48-0.82) compared to persons with higher education less than three years and among skilled (OR: 0.59, 95% CI: 0.47-0.75) or unskilled workers (OR: 0.53, 95% CI: 0.41-0.70) compared to salaried workers. Young age (OR: 0.51, 95% CI: 0.48-0.82) was a strong predictor for low safety climate ratings, whereas the effect of gender disappeared in the adjusted model. In a model where we tested for interaction, we did not find any effect modification between the significant variables and the two aspects of leadership style. The analyses point to leadership style being significantly associated with dimensions of safety climate. Leadership has a much stronger impact on 'management safety empowerment' than on the other dimension 'co-worker safety priority'. The latter was, however, much more strongly influenced by personal factors such as age, job type and education.

4. DISCUSSION

In this paper we aimed first to scrutinize the association between two types of leadership styles and safety climate, and second, to explore whether a number of socio-demographic factors were related to safety climate

ratings. The analyses were based on data from a cross-sectional questionnaire study across all industrial sectors and company sizes.

4.1 Leadership style and safety climate

Our results show that the leadership style measured by items related to transactional and transformational leadership is associated with safety climate, and that age, job type, education and type of industrial sector have an influence on respondents' safety climate ratings. We looked at two dimensions of safety climate: management safety empowerment and workers' safety priority. The rating of management safety empowerment was significantly associated with both aspects of leadership, whereas workers' safety priority, in an adjusted model, was only significantly associated with transformational leadership.

Table 1: Predictors for rating a good working climate among 3681 Danish employees, Denmark 2008. Scale: Strongly agree=1, Agree=2, Disagree=3, & Strongly disagree=4

Management safety empowerment - Strongly agree / agree: 'Management encourages workers to participate in decisions which affect their safety'

Co-worker safety priority - Strongly disagree / disagree: 'We, who work here, consider minor accidents as a normal part of our daily work'

	Management safety empowerment		Co-worker safety priority	
	Adjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
Transactional leadership Standardized (SD=1)	1.33 (1.19-1.48)	<.0001	1.06 (0.96-1.17)	0.28
Transformational leadership Standardized (SD=1)	1.43 (1.38-1.47)	<.0001	1.04 (1.01-1.08)	0.006
Gender		0.55		0.67
Men	1		1	
Women	0.95 (0.78-1.14)		1.04 (0.88-1.23)	
Sector s45		0.12		0.10
Private	1		1	
Public	1.36 (1.01-1.83)		0.80 (0.61-1.05)	
Unknown	0.97 (0.50-1.89)		0.64 (0.36-1.15)	
Appointment s44		0.60		0.80
Permanent	1		1	
Temporary	1.20 (0.80-1.79)		0.95 (0.68-1.33)	
Unknown	1.57 (0.28-8.67)		0.67 (0.18-2.46)	
Education s19		0.27		<.0001
No / under education	0.85 (0.60-1.21)		0.56 (0.41-0.77)	
Vocational training	0.86 (0.65-1.15)		0.63 (0.48-0.82)	
Higher education <3 years	1		1	
Medium education 3-4 years	1.12 (0.84-1.51)		0.97 (0.72-1.29)	
Long education >4 years	1.11 (0.77-1.60)		0.86 (0.60-1.22)	
Unknown	1.10 (0.58-2.11)		0.41 (0.24-0.70)	
Job type s20		0.05		<.0001
Skilled	1.03 (0.81-1.32)		0.59 (0.47-0.75)	
Unskilled	0.81 (0.60-1.08)		0.53 (0.41-0.70)	
Salaried worker	1		1	
Other	1.19 (0.91-1.54)		0.57 (0.45-0.73)	
Industrial sector		0.21		0.004
Manufacturing	1		1	
Construction	1.17 (0.82-1.69)		0.81 (0.60-1.10)	
Trade and transport	0.80 (0.62-1.03)		0.95 (0.76-1.19)	
Public administration	0.82 (0.56-1.19)		1.16 (0.83-1.63)	
Unknown	0.86 (0.65-1.12)		1.45 (1.13-1.88)	
Length of employment		0.02		0.98
<1 year	1.07 (0.80-1.42)		1.00 (0.78-1.30)	
1-2 years	0.94 (0.74-1.18)		0.94 (0.76-1.16)	
3-9 years	1		1	
10-19 years	1.04 (0.82-1.33)		0.96 (0.77-1.21)	
>20 years	1.52 (1.15-2.00)		0.97 (0.76-1.24)	
Size of company s22		0.002		0.03
<10 employees	0.77 (0.58-1.02)		0.69 (0.53-0.89)	
10-100 employees	1.01 (0.82-1.24)		0.86 (0.71-1.05)	

100-500 employees	1		1	
>500 employees	1.70 (1.17-2.46)		0.80 (0.58-1.10)	
Unknown	0.64 (0.34-1.21)		0.56 (0.32-0.98)	
Age		0.20		0.003
18-29	0.71 (0.53-0.95)		0.63 (0.48-0.82)	
30-39	1		1	
40-49	0.91 (0.72-1.16)		0.84 (0.68-1.05)	
50-59	0.96 (0.75-1.22)		1.00 (0.79-1.26)	
60+	0.99 (0.60-1.63)		0.81 (0.52-1.26)	

Similar trends have been shown in research in such diverse work domains as health care and in the offshore oil and gas industry (37;38). It appears that transformational leadership promotes employees' compliance to safety rules and regulations, and it encourages employee involvement in working in a safe manner across all industries. That is, our study indicates that the following transformational leadership elements could have an impact on the safety climate across work domains: (a) Encouraging employees to participate in decision making; (b) Articulating future plans for employees; and (c) In an open way to convey information in advance with employees. We measured transactional leadership behaviour using only one item, and found that 'appreciation' is significantly related to the perceived safety climate. It seems that leaders who give verbal feedback in terms of appreciation on a day-to-day basis could foster a safe work climate. As also shown by Hoffmann and Morgeson (14), communicative social exchange acts between leaders and followers are a pre-requisite for performing in a safe manner.

This is also discussed by Zohar (15), who suggests that the relationship between transactional leadership and safety climate could be explained by a supervision-based safety model, where workplace safety is facilitated by leaders' close monitoring and verbal feedback. Managers use reward/punishment mechanisms in relation to their sub-ordinates' safety behaviour. With respect to explaining the role of transformational leadership and its impact on safety climate, Zohar (15) proposes a leadership-based safety model, where workplace safety is made possible by leaders and workers engaging in conversational-like interactive forms of behaviour in pursuit of reaching mutual understandings in the proposition of solutions on emerging problems in non-routine situations at work.

4.2 Age and length of job experience

Our finding of a significant lower rating of safety climate among younger age groups (18-29 years) is in line with previous studies, which show that age has an effect on the perceptions and judgments of safety climate aspects. Lee (39) and Lee and Harrison (40) showed that the higher age of respondents, was correlated with higher scores on the safety climate scales applied in the study. Wu et al. (41) and Siu et al. (42) also found that older employees tend to express more positive attitudes toward safety when compared to a group of younger employees.

In these studies it is argued that the association between age and safety climate might be due to the higher impact of job stressors or failed expectations of younger employees, but in the same vein, it is hypothesised that duration of employment might also be an explanation. In our study young age was negatively associated with safety climate - also after adjustment for tenure, indicating that age has an effect by itself. Moreover, employees' career development stages and work skill maturity development are used as explanatory factors. In the present study, we found no correlation between duration of employment and respondents' safety climate ratings.

Other studies have found more mixed results. Cooper and Phillips (22), for example, received differing result from a pre- and post test survey distribution. In the pre-test no significant differences were found between four different age groups. In the post-test, a significant difference was found between the youngest group and the three older age groups in the study. They do not discuss this finding further, but argue that safety interventions might have a positive effect upon the attitudes of older employees, while such interventions might have little impact upon the youngest employees.

Finally, some studies have found no correlation between age and safety climate. In a study of air traffic controllers, it was found that age had very little impact on safety culture aspects (43). The explanation given was that air traffic controllers share a lot of similarities in terms of education, training and the highly regulated working methods within their work domain.

In the present study younger age was negatively associated with the rating of safety climate. A contributing factor could be lack of experience and knowledge regarding the special work environment many trainees face, and that they have to adapt to the specific safety climate at a given workplace. Another explanation could be that

younger people are working at more insecure jobs, and that they progressively move to safer jobs with relatively less hazardous exposure during their career (44).

4.3 Types of Job

Even after adjustment for factors such as age, industrial sector and education we found that type of job had an impact on the respondents' safety climate ratings. This is in line with results found by Glendon and Litherland (45) in their study of road construction. They found job-group differences on a scale measuring safety climate by way of employees' organisational relationship - indicating that sub-safety climates may exist within organisations. Likewise Lee and Harrison (40) found job type differences on four safety climate scales, among these were perceived empowerment and risk versus productivity. One finding in their study was that nuclear power plant managers were older than operators at the plants. It appears that age might have an influence on the type of job people possess. In the present study salaried workers, in contrast to skilled and unskilled workers, were more often employed in less hazardous jobs such as office, teaching and nursing. Even though they stated that safety climate was relevant in their job, it was at a reduced level.

4.4 Education

In the present study we found an association between educational background and respondents' safety climate ratings. These findings are in line with results found by Vinodkumar and Bhasi (46) who studied safety climate factors in the chemical industry in India. They found that the ratings increased with some qualifications. It seems that higher-educated employees are more amenable to safety regulations and rules, as their education has the effect of making them better prepared for being aware of process states, possible risks and hazards, than employees with lower educational backgrounds. This line of explanation is also brought forth by Gyekye and Salminen (28), who state that higher-educated employees are more motivated to act in accordance with safety policies, as they possess the pre-requisite work domain knowledge, and perceive themselves as safety role-models for their lower-educated colleagues. In addition, it may be that higher-educated employees have gained seniority and moved to safer jobs with less exposure to hazards. This is also a relevant discussion with respect to our findings on the relationships between safety climate ratings and age and length of employment.

4.5 Size of company

As discussed previously, small enterprises had a higher injury risk than larger enterprises (47), which could be caused by challenges in the systematic prevention of accidents in the small enterprises. Small enterprises (with less than 10 employees) in Denmark are not obliged to have a safety steward, and the close relationship between owners and workers might often result in an attitude that accidents are unforeseeable (48). This is in line with the results in the present study, where we found that respondents in companies with less than 10 employees rated the safety climate among co-workers significantly lower than persons employed in larger companies. On the other hand, we found that companies with more than 500 employees rated the managers' safety empowerment significantly higher compared to the other groups. In companies of that size the safety environment is highly formalized, and the managers are obligated to pay greater attention to the safety of the workers.

4.6 Trades – industrial sectors

There is evidence in the literature that safety climate has an effect on safety performance, and thereby on the risk for work accidents (2). This is seen over a broad range of industries and countries, but only few studies have included many different industries simultaneously. In this study we found a significant association between industrial sector and co-workers' safety climate ratings, but not between industrial sector and the impact managers have on safety climate. This discrepancy could be caused by industries such as construction and trade and transport, where workers often work in small transient teams, more isolated from their managers.

There are some potential limitations to our study. First, on the basis of cross-sectional data we are not able to explore the relationship between leadership styles and safety climate over time. This is a severe limitation with respects to discussing any causal inferences concerning our study object. Secondly, our data is based only on a few leadership and safety climate questionnaire items. Although these items have been validated in other studies, caution must be exercised with respect to generalizing from our findings. Thirdly, although we are able to point at several significant relationships between leadership and safety climate items, our models need to further explore their potential to predict site safety performance in terms of work environment accident measures.

5. CONCLUSION

In this population based cross-sectional study we found evidence for leadership style being associated with ratings of the safety climate. The rating of both management safety empowerment and workers' safety priority were influenced by personal factors and factors related to the company. These results have important theoretical and practical implications for safety climate interventions and for planning and implementing management strategies that better support employees' engagement in proactive work environment behaviours.

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