

Designing a Safer Workplace: Importance of Job Autonomy, Communication Quality, and Supportive Supervisors

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The direct and indirect effects of work characteristics on self-reported safe working were investigated in a longitudinal study of frontline manufacturing employees ($N = 161$). The work characteristics included job autonomy, role overload, role conflict, supportive supervision, training adequacy, job security, and communication quality. Job autonomy and communication quality were positively associated with safe working after prior levels of these variables were controlled for, and supportive supervision had a lagged positive effect on safe working 18 months later. Additional analyses showed that organizational commitment fully mediated the effect of job autonomy on safe working and partially mediated the effect of communication quality on safe working. The study suggests that work characteristics are important antecedents of safe working.

Those involved in managing workplace safety often have a strong control orientation, assuming that accidents are the fault of employees (Barling & Hutchinson, 2000). Occupational safety research literature has frequently reinforced this point of view by emphasizing the relationship between individual-level factors and workplace injury (e.g., Hale & Glendon, 1987; Hansen, 1989; Sutherland & Cooper, 1991). Taken together, industrial tradition and prevailing research have encouraged managers to control safety through selecting particular types of employees and by introducing interventions that focus on modifying individual behaviors, often in isolation from wider organizational influences.

However, a growing body of research has begun to challenge this control and individualistic orientation by recognizing that broader management practices and other elements of organizational systems can

affect safer working (e.g., Barling & Hutchinson, 2000; Hofmann, Jacobs, & Landy, 1995; Neal, Griffin, & Hart, 2000; Shannon, Mayr, & Haines, 1997; Tomás, Meliá, & Oliver, 1999; Zohar, 2000). Among these studies, factors such as work design, leadership, training, safety climate, and safety communication have been identified as potential facilitators of greater safety. This approach highlights the role of organizational interventions to enhance safety, such as improving management style or redesigning work. This approach also raises awareness of the potential effects on safety of increasingly prevalent organizational changes, such as mergers, downsizing, and restructuring, all of which can affect organizational practices and systems.

This article aims to extend the organizational approach to understanding occupational safety by investigating the relationships between key work characteristics (i.e., job autonomy, communication quality, training adequacy, role overload, role conflict, supportive supervision, and job security) and safe working and by investigating the potential role of organizational commitment (OC) in mediating these relationships. We describe the conceptual framework underpinning the study next.

Conceptual Framework

Based on a synthesis of existing safety research, and drawing on Pfeffer's (1998) ideas about high-performance work systems, Barling and Zacharatos (1999) proposed a set of 10 work practices that are likely to promote greater occupational safety. Essentially, they argued that the management of safety in organizations is no different to the management of

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any other behavior of concern to managers, such as high performance, and therefore that many of the well-known determinants of high performance will also affect safety. The specific factors they proposed as enhancing occupational safety were as follows: self-managing teams and decentralized decision making (i.e., job autonomy), high-quality jobs (e.g., low role overload), employment security, transformational leadership, extensive training, information sharing/communication, measurement of appropriate behaviors (i.e., systematic measurement of inputs into safety, such as management practices), compensation contingent on safety performance, selective hiring, and reduced status distinctions. Barling and Zacharatos also proposed in their model various psychological and behavioral mechanisms by which these work practices might increase safety performance, including trust in management, OC, perceived fairness, organizational citizenship behaviors, and perceived safety climate.

In the present study, we tested important elements of Barling and Zacharatos's (1999) model. Specifically, the work characteristics we investigated in relation to safety included a key work design variable (job autonomy), two role demand variables (role conflict and role overload), and four variables that support the context within which roles are carried out (job security, supportive supervision, training adequacy, and communication quality). Because our focus was on a single organization, we restricted our attention to those work factors suggested by Barling and Zacharatos that varied within the organization (i.e., job autonomy, role overload, role conflict, job security, leadership, training, and communication) rather than those factors that were more likely to vary across organizations (i.e., measurement of appropriate behaviors, compensation contingent on safety performance, selective hiring, and reduced status distinctions). In the organization we investigated, the latter variables reflected organizationwide human resource policies and did not vary much from area to area or as a function of particular managers. For example, selection procedures and criteria were consistent across the company, and there was therefore insufficient variance to test the effects of selective hiring in this study.

We also investigated whether the work characteristics were associated with safer working through the mechanism of OC (see Figure 1 for our proposed model). Barling and Zacharatos (1999) proposed several mechanisms, as have other researchers (e.g., the mechanism of individual safety knowledge and safety motivation, Neal et al., 2000; or the mecha-

nism of manager-employee value congruence, Maierhofer, Griffin, & Sheehan, 2000). However, here we focused on the role of OC. OC is a key variable within organizational behavior research, and as we describe later, there is much evidence linking work characteristics to OC as well as highly plausible reasons to suggest that OC will affect workplace safety behavior.

The main dependent variable in our study was safe working. This construct has been operationalized differently across a range of contexts, including military (e.g., Hofmann & Morgeson, 2000), manufacturing (e.g., Zohar, 2000), and health care (e.g., DeJoy, Searcy, Murphy, & Gershon, 2000; Hemingway & Smith, 1999). Our focus was on safe working in terms of compliance. Thus, it encompassed behaviors such as wearing personal protection equipment, following safety procedures, and reporting safety incidents through proper channels. This type of safety behavior can be distinguished from more discretionary safety behaviors such as volunteering to participate in safety audits or developing new ways of improving shopfloor housekeeping (e.g., Marchand, Simard, Carpentier-Roy, & Ouellet, 1998; Neal et al., 2000).

In the following section, we review evidence that suggests that the proposed work characteristics affect safe working and outline our hypotheses. We then propose OC as a mediator of the relationship between the work factors and safe working. Finally, we describe the methods by which we investigated our hypotheses.

Safe Working and Job Autonomy

The first work characteristic we focused on was job autonomy, which refers to the degree of discretion employees have over important decisions in their work, such as the timing and methods of their tasks. Job autonomy has been identified as one of the important features of work design for employee outcomes such as job satisfaction and motivation (Hackman & Oldham, 1980; Parker & Wall, 1998). In relation to safety, job autonomy was highlighted by Barling and Zacharatos (1999) when they proposed the importance of self-managing teams and job quality for safety. Studies have demonstrated an association between job autonomy and a range of safety outcomes, including actively caring for safety (Geller, Roberts, & Gilmore, 1996), a decrease in lost time to injury frequency (Shannon et al., 1997), effective responses to safety critical situations (e.g., Wright, 1993), and lower accident rates at an orga-

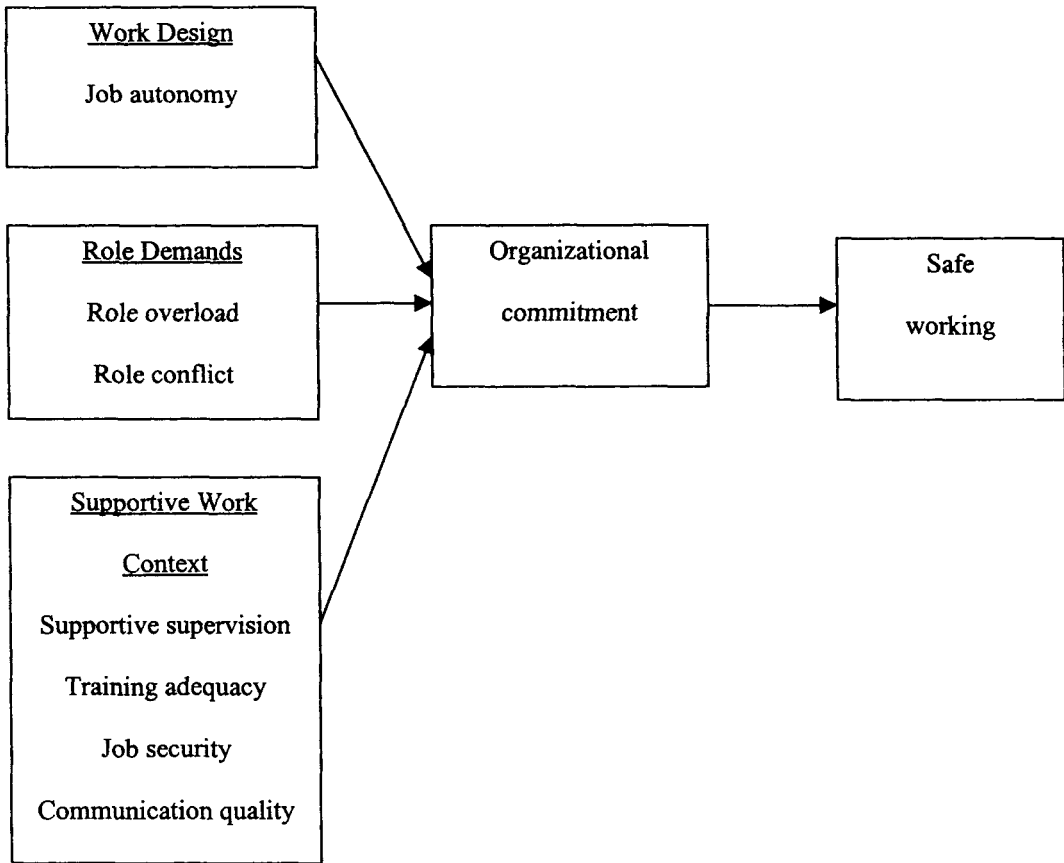


Figure 1. Hypothesized model of antecedents of safe working.

nizational level (e.g., Betcherman, McMullen, Leckie, & Caron, 1994). A likely precondition of many of these outcomes is compliance with safety procedures. We therefore proposed the following:

Hypothesis 1a: Job autonomy will be positively associated with safe working.

Safe Working and Role Demands

We investigated two types of role demands that have been found to affect important employee outcomes such as well-being and commitment: role overload and role conflict (e.g., Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964). Role overload refers to excessive work demands. Evidence suggests that this characteristic can be a detriment to safe working. In particular, Hofmann and Stetzer's (1996) study showed that role overload was significantly associ-

ated with unsafe behaviors, and Frone (1998) found that adolescents with heavier work overloads were more likely to report having experienced a workplace injury. In addition, Rooney (1992) suggested that, under difficult economic conditions, changing work organization, and increased workloads, employees could become more complacent and take greater risks. Under strained conditions like these, one could anticipate both decreased OC and less attention to the aspects of work that are designed to protect safety. We proposed the following:

Hypothesis 1b: Role overload will be negatively associated with safe working.

Role conflict refers to a lack of congruent expectations between and within job roles, such as receiving conflicting messages from different parties about what is expected of the job incumbent or being ex-

pected to carry out tasks in ways that conflict with internal standards (Kahn et al., 1964). A classic role conflict in production settings is that employees are often expected to achieve unrealistic production targets while also adhering to time-consuming safety procedures. Although there is some anecdotal evidence to this effect, there is currently no systematic research investigating specifically whether role conflict affects safety; nevertheless, it is plausible to expect that the confusion arising from having conflicting expectations (e.g., the tradeoff between production and safety) could reduce employees' focus on safety. Our hypothesis was as follows:

Hypothesis 1c: Role conflict will be negatively associated with safe working.

Safe Working and Supportive Work Context

In addition to the above characteristics of jobs and roles, we also investigated four work aspects that support the context within which work is carried out. The first of these was supportive supervision. In their model, Barling and Zacharatos (1999) proposed that an important influence on safety is transformational leadership behaviors, which collectively represents one approach to supportive supervision in the workplace. Hofmann and Morgeson (1999) explored the impact of leader-member exchange and found it to be an important predictor of safety behavior and indirectly related to a reduction in accidents. Other recent empirical studies (e.g., Griffin, Neal, & Burley, 2000) have operationalized inspirational styles of leadership and support earlier findings that leadership can play an important role in enhancing employee safety. Our hypothesis was as follows:

Hypothesis 1d: Supportive supervision will be positively associated with safe working.

The second contextual work characteristic that we investigated was training adequacy. In part, training involves imparting the correct way to do things. We therefore expected that the more people feel they have adequate training for their work role, the more likely they will adhere to safety procedures. Additionally, this sense that management cares about employee well-being by investing in training sends a credible message to employees and is further encouragement to work toward the mutual goal of safety (Barling & Zacharatos, 1999). Our hypothesis was as follows:

Hypothesis 1e: Training adequacy will be positively associated with safe working.

The third contextual characteristic we examined was communication quality. Studies have identified the importance of workplace communications in promoting safer working (e.g., Griffin & Neal, 2000; Hofmann et al., 1995; Hofmann & Stetzer, 1996). Sharing information and encouraging others to talk about aspects of work might alert employees to potential hazards and educate them about procedures. Therefore, one way in which good-quality communications allows employees to behave safely is to provide them with the information they need to work safely, for example, when to wear protection equipment or follow specific procedures. In addition, a culture of open and honest communication might result in employees' feeling safe to raise and discuss safety concerns. Therefore, we proposed the following:

Hypothesis 1f: Communication quality will be positively associated with safe working.

The final contextual aspect we examined in relation to safe working was the perception of job security. Grunberg, Moore, and Greenberg (1996) found across a range of enterprises that there were small but significant correlations between a lack of job security and levels of accidents, injuries, and days missed owing to injuries. More recently, Probst and Brubaker (2001) demonstrated in a longitudinal study of manufacturing workers that a lack of job security was indirectly related to self-reported accidents through safety-specific knowledge, extrinsic safety motivation, and compliance. We hypothesized the following:

Hypothesis 1g: Job security will be positively associated with safe working.

Mediating Role of OC

Assuming the above hypotheses are supported, the question arises as to why these effects occur. Some evidence we described has proposed safety-specific mechanisms. However, here we tested the possibility proposed in Barling and Zacharatos's (1999) model that OC mediates the relationship between work factors and safe working. First, there is reason to expect that higher OC will be associated with safe working. Second, each of the work and context characteristics we examined has been identified as a determinant of OC.

The concept of OC, or the degree of identification and emotional attachment to an employing organization, has been the focus of much organizational behavior research (Meyer, 1997; Meyer & Allen, 1997).

There is evidence linking OC to a variety of outcomes, including reduced turnover and turnover intentions (Allen & Meyer, 1996; Hackett, Bycio, & Hausdorf, 1994), lower absence (Mathieu & Zajac, 1990), and greater in-role and extra-role behaviors (Meyer & Allen, 1997; Organ & Ryan, 1995). As O'Reilly and Chatman (1986) explained, a sense of affective attachment to an organization can result from identification with organizational goals and an internalization of the values they embody. In this way, employees who feel they are benefiting from employment with their organization will engage in behaviors that align with these goals.

Theoretical papers (e.g., Barling & Zacharatos, 1999; Erickson, 1997) have suggested that employee OC plays a key role in promoting occupational safety. Collectively, they argue that safety performance will be higher when employees have a sense of commitment to the firm generated by organizational practices and experiences that engender trust and respect. Empirical studies that have investigated the link between OC and safe working are rare, but the few that have included these variables are mostly supportive. Although not stated explicitly in their report, Hackett et al. (1994) found a significant negative correlation between affective commitment and accidents (controlling for age, job tenure, and job satisfaction) in a sample of bus drivers. Kivimaeki, Kalimo, and Salminen (1995) reported that committed employees perceived the likelihood of harmful workplace incidents as significantly lower than non-committed employees did. Finally, Cohen and Ledford (1994) found that, although commitment was not linked to the number of safety incidents (perhaps because of restricted range in the latter measure), there was a negative relationship between OC and the number of days missed following a lost-time accident.

We proposed that the relationship between OC and safe working exists in the same way as it does for other aspects of work performance. In line with existing evidence that high levels of OC predict greater adherence with corporate procedures (e.g., Kim & Mauborgne, 1993; Shore & Wayne, 1994), we hypothesized that employees who identify more strongly with their organization will be more likely to comply with organizational safety practices. More specifically, employees who are committed to their organization will align their behavior with organizational goals that include the objective of a safe working environment. Our hypothesis was as follows:

Hypothesis 2: OC will be positively associated with safe working.

OC is generated by the presence of work characteristics and practices that enable employees to recognize and work toward organizational goals. High-quality job design and the way managers behave must signify to employees that the organization believes they are capable of working toward these goals and that their contributions are valued (Tsui, Pearce, Porter, & Tripoli, 1997). This idea is fundamental to organizational practices that collectively represent high-performance work systems (e.g., Arthur, 1994; Huselid, 1995), of which autonomous job designs with reasonable role demands supported by adequate training, effective leaders, the flow of information, and employment security are fundamental components (Barling & Zacharatos, 1999; Parker & Wall, 1998).

More specifically, the link between work characteristics and OC is well established. Mathieu and Zajac's (1990) meta-analysis showed that employees who experience role conflict in their jobs are more likely to exhibit lower OC than employees who know what is expected of them. Subsequent research (e.g., Dunham, Grube, & Castañeda, 1994; Meyer, Bobocel, & Allen, 1991) on OC suggested that job autonomy and OC are positively related, whereas excess workload (i.e., role overload) has also been associated with lower commitment to the organization (Meyer & Allen, 1997). This complements evidence (e.g., Bycio, Hackett, & Allen, 1995) that high-quality leadership is also a determinant of OC.

The resources that allow employees to meet organizational objectives, such as good-quality communication and effective training, represent another potential influence on OC (Meyer & Allen, 1997). Ensuring employees have good-quality communication and training is a sign of organizational support and one that will be reflected in employees directing their efforts toward meeting organizational goals. Communication provides employees not only with details about their work but also with a sense of their wider work environment. As such, high-quality communication allows employees to complete tasks more effectively (Lawler, 1986) and contributes to employees' perceptions of their competence, both of which are associated with higher OC (Saks, 1995).

A sense of job security is recognized as an important component of high-performing work systems (Barling & Zacharatos, 1999). Job security provides employees with another signal that their efforts are valued by the organization. Like training and com-

munication quality, secure employment implies an organizational investment in the employee, and empirical studies have found evidence for the relationship between job security and OC (Davy, Kinnicki, & Scheck, 1997; Kuhnert & Vance, 1992).

On the basis of the proposed links between work characteristics and OC, we therefore proposed the following:

Hypothesis 3: OC will mediate the relationship between work characteristics and safe working.

Research Approach

We investigated the hypotheses described above using a longitudinal research design. Previous safety research has been dominated by cross-sectional studies (Shannon, Robson, & Guastello, 1999; Veazie, Landen, Bender, & Amandus, 1994). Moreover, many past studies have used the number of safety-related incidents as their sole outcome measure. Because the reliability of injury rates is often questionable (e.g., see Hopkins, 1995, for further critique), we used a measure of self-reported safe working as a criterion measure. Proximal measures such as this have been shown to be associated with workplace injury (e.g., Hofmann et al., 1995; Hofmann & Stetzer, 1996; Thompson, Hilton, & Witt, 1998).

Nevertheless, because the self-report measure might be susceptible to bias, the first part of the study investigated the link between self-reported safe working and team leader ratings of safety-related behaviors. We expected a moderate positive correlation between self-ratings and team leader ratings on safety behaviors. A perfect correlation was not expected for several reasons (Harris & Schaubroek, 1988). One is that the team leader cannot observe the team member at all times, and the team member might behave in a safer manner when the team leader is observing (i.e., observational bias). Another reason is that self-ratings can suffer from egocentric bias in which, for example, the self-rater is inclined to inflate his or her rating to enhance the evaluation. Attribution biases (e.g., in which actors attribute good performance to their own behavior whereas observers tend to attribute good performance to external factors) can also result in differences between self- and other ratings. Because of these various biases, we expected only moderate-sized correlations between self and team leader ratings of safe working.

To provide a further validity check in the form of differential validity, we examined the association between self-reported safe working and a quite separate

dimension of performance assessed by team leaders (personal initiative). A low and nonsignificant correlation was expected between self-reported safe working and personal initiative, particularly because the measure of safe working focused on compliance behaviors (e.g., wearing safety equipment) rather than more proactive safety behaviors.

Method

Organizational Background

The study was conducted in two sites of a large glass manufacturing company in the north of England. Safety was identified as an essential concern for the organization, which had recorded accident levels higher than local industry norms. Throughout the period, interventions were introduced to increase employee compliance to safety procedures and to reduce safety risks, including (a) a campaign to increase wearing of protective equipment, (b) behavioral-based safety training, (c) the inclusion of safety topics in improvement groups, and (d) a refocused health and safety committee that aimed to signal management's commitment to safety by approaching it proactively. It is noteworthy that the frequency of reported accidents was stable in the year before the study but decreased over the investigation period. Specifically, there were 46 incidents per month ($SD = 10.25$) in 1996 and 43 incidents per month ($SD = 7.19$) in 1997, which was the period prior to the study. However, accidents declined from 43 per month in 1997 to 31 incidents per month ($SD = 4.89$) in 1998, which was approximately the study period. This reduction in accidents was statistically significant, $t(11) = 4.26, p < .001$.

It is also important to note that there were other changes occurring within the company during the study. Staff numbers were reduced because the number of production orders was falling. At the same time, initiatives that had previously been introduced to build morale and commitment were continued and expanded. This included interventions to enrich jobs (e.g., such as by encouraging a coaching-oriented supervisory style and enhancing operator control over machine maintenance), renewed attention to implementing a system of weekly communication briefings, and the extending of a continuous improvement initiative. These initiatives to build commitment were successful in some areas of the organization but were unsuccessful or had little impact in other areas, especially those areas that had a decrease in production orders and were under a threat of closure.

Procedure and Sample

Participants completed questionnaires during work hours in group sessions facilitated by researchers. The response rate was 62% for the first survey and 52% for the second survey completed 18 months later. Only operational employees (e.g., machine operators, process controllers, and maintenance technicians) were included in the present sample. White-collar employees (e.g., managers, professionals, and administrative support) were excluded from the analysis because the safety issues for these personnel are likely to be

quite distinct from those employees working in operational jobs.

The sample used to test the hypotheses included those operational employees who had complete data for both administrations of the survey ($N = 161$). For this sample, respondents' ages at Time 1 (T1) ranged from 19 to 62 years of age ($M = 39.30$, $SD = 10.92$), and their tenure at T1 ranged from less than 1 year to 38 years ($M = 11.29$, $SD = 9.52$). Twenty-seven of the respondents were female.

In addition to this sample, we also focused on a sample of employees to validate the measure of self-reported safe working. This sample consisted of all those employees who had completed the T1 survey (although not necessarily the Time 2 [T2] survey) and who had also been appraised by a supervisor at T1 ($N = 166$). For this sample, respondents' ages at T1 ranged from 17 to 69 years of age ($M = 39.99$, $SD = 10.89$), with their tenure at T1 ranging from less than 1 year to 41 years ($M = 10.78$, $SD = 9.37$). Eighteen percent of the respondents were female.

It is important to note that some employees in this study have been included in earlier samples, although there is no overlap in the content of these studies. First, some of the frontline employees from Site 1 (T1) formed part of a larger sample including operational and white-collar employees ($N = 669$) used in Parker (1998), which investigated the cross-sectional association between work characteristics and role breadth self-efficacy. Second, some of the employees from Site 2 were included in Parker and Axtell (in press), which investigated employee perspective taking. In both studies, the only variable in common with the present one is the measure of job autonomy.

Measures

Biographical information. Each respondent indicated their age (in years), tenure (in years), gender (*male* = 1, *female* = 0), site, and job title. Job titles were used to classify employees into two major job groups that have different types of work: shopfloor employees (mostly machine operators) and technical support staff (e.g., maintenance technicians). Job group membership and site were coded using dummy variables.

Safe working. Safe working was assessed by averaging scores on three survey items (T1 $\alpha = .57$,¹ T2 $\alpha = .56$): "I always wear my protective equipment, even when it's inconvenient," "Occasionally I bend the safety rules when I know it's safe to do so" (reverse scored), and "When my boss is not around I can be more flexible with which safety procedures I follow" (reverse scored). The latter two items were deliberately worded to appear as legitimate behaviors, thereby minimizing the propensity to respond in a socially desirable way. The response scale was from 1 (*strongly disagree*) to 5 (*strongly agree*). The distribution of scores was reasonably normal ($M = 3.83$, $SD = 0.77$, range = 1.3 to 5), suggesting that the desire to respond in a socially desirable way did not have an excessive influence on responses.

Measures used to validate safe working. We investigated the validity of the self-reported safe working measure (described above) by comparing scores on this variable at T1 with team leader ratings on three dimensions for employees who also had appraisal data compiled shortly after the T1 survey administration ($N = 166$). Two of the dimen-

sions assessed by team leaders were expected to have positive and moderate correlations with self-reported safe working (safety compliance and safety-related conscientiousness). However, one dimension assessed by team leaders (personal initiative) was not expected to have a significant positive correlation with safe working.

Team leaders were asked to indicate how often employees behaved in particular ways on a scale from 1 (*rarely*) to 4 (*always*). The first dimension, safety compliance, was formed by summing team leader ratings on the frequency of two directly relevant behaviors ("working safely and complying with safe working practices" and "wearing the appropriate personal protective equipment"; $\alpha = .73$). Scores for team leader ratings had a restricted range, ranging from 2 to 4, with most (67%) of the employees scoring a 4 ($M = 3.73$, $SD = 0.44$). The second dimension, safety-related conscientiousness, was formed by summing team leader ratings on four additional behaviors that would be expected to relate to safe working ("working neatly and tidily, paying full attention to detail," "keeping the work area clean and tidy," "looking after equipment in a careful and proper manner," and "producing a good consistent work rate, and finishing tasks on time"). Scores on this variable were also rather restricted in range, with scores ranging from 2.75 to 4.00 and a mean score of 3.46 ($SD = 0.37$). The third dimension, personal initiative ($\alpha = .74$), assessed the following behaviors: "showing initiative by generating ideas and leading continuous improvement initiatives" and "showing initiative by generating ideas and getting involved in continuous improvement initiatives." The mean score for personal initiative was 2.18 ($SD = 0.75$).

Job autonomy. Job autonomy was assessed using P. R. Jackson, Wall, Martin, and Davids's (1993) measure of job control (T1 $\alpha = .94$, T2 $\alpha = .93$). Items assessed the extent to which employees have control over the timing of their tasks (i.e., autonomy over work pace and scheduling) and autonomy over their work methods (i.e., choice in how to carry out work tasks). The response scale for items ranged from 1 (*not at all*) to 5 (*a great deal*).

Role overload. Four items (T1 $\alpha = .78$, T2 $\alpha = .85$) were derived from Caplan, Cobb, French, Harrison, and Pinneau's (1975) measure of quantitative workload. Illustrative items include "How often do you find yourself working faster than you would like to complete your work?" and "How often does it seem like you have too much for one person to do?" The response scale for items ranged from 1 (*rarely or never*) to 5 (*constantly*).

Role conflict. Role conflict (T1 $\alpha = .87$, T2 $\alpha = .88$) was assessed using six items from Rizzo, House, and Lirtzman's (1970) measure, which has been shown in several reviews (e.g., S. E. Jackson & Schuler, 1985) to have sufficient discriminant and construct validity to be highly appropriate for research. Items concerned the frequency of person-role conflict (e.g., "I have to do things that should be done in a different way") and intersender conflict (e.g., "I receive incompatible requests from two or more people").

¹ This alpha was increased to .68 by excluding the first item; however, this shorter scale had a weaker correlation with the supervisor ratings of safe working. All three items were therefore used in the main analyses. Repeating the analyses with the two-item scale resulted in the same pattern of findings.

Supportive supervision. Supportive supervision ($T1 \alpha = .89$; $T2 \alpha = .91$) was assessed by summing four items from Cook and Wall's (1980) leadership scale. Employees were asked to rate the extent to which their cell leader behaved in various supportive ways on a 5-point scale from 1 (*not at all*) to 5 (*a great deal*). The items were (my leader) "is approachable," "encourages people who work for him/her to make suggestions," "provides, or arranges for, help so that the group can work effectively," and "encourages people who work for him/her to work as a team."

Training adequacy. Training adequacy was assessed by summing together scores on four items ($T1 \alpha = .85$; $T2 \alpha = .84$). The first item was "How satisfied are you with the training you receive?" (scored on a 7-point response scale from 1 = *extremely dissatisfied* to 7 = *extremely satisfied*). The remaining three items assessed the extent to which employees felt that they get the opportunity to develop new skills, the training they receive helps them do their job better, and they receive adequate follow-up training (e.g., encouragement to use the skills they have learned). A 5-point response scale from 1 (*not at all*) to 5 (*a great deal*) was used for these three items.

Communication quality. This scale ($T1 \alpha = .71$, $T2 \alpha = .65$) assessed the extent that respondents feel that they have enough communication to do their job effectively, reasons for changes that affect them are explained, they are safe to say what they feel, and they find out all they need to know through official communications. The response scale was from 1 (*strongly disagree*) to 5 (*strongly agree*).

Job security. Job security was assessed using Caplan et al.'s (1975) four-item scale ($T1 \alpha = .87$; $T2 \alpha = .87$). Demonstrating convergent validity, this scale has been shown to correlate with other measures of job security (Ashford, Lee, & Bobko, 1989). Respondents indicated how certain they feel about aspects of their future job and career (e.g., "what your future career looks like" and "whether your job skills will be valued five years from now") on a 6-point response scale from 1 (*very uncertain*) to 6 (*very certain*).

Organizational commitment. OC, an individual's emotional attachment to the organization, was assessed using six items ($T1 \alpha = .75$; $T2 \alpha = .79$) from Cook and Wall's (1980) measure that has been used extensively in occupational studies. Respondents indicated on a 5-point scale whether they agreed or disagreed with four statements, such as "I feel myself to be part of this company" and "I am quite proud to tell people who it is I work for."

For all scales, the items were summed and a mean obtained. A higher score indicates more of the focal construct.

Results

Validity Checks for the Criterion Variable

As expected, there was a statistically significant correlation between team leader ratings of safety compliance and self-reported safe working ($r = .22$, $p < .01$) and between team leader ratings of safety-related conscientiousness and self-reported safe working ($r = .18$, $p < .05$). These correlations would be higher if they were corrected for unreliability and restricted range, although even corrected correlations

of self and supervisory ratings of performance remain moderate in size. For example, in a meta-analysis of 36 such correlations, Harris and Schaubroek (1988) reported a mean corrected correlation of .35 ($SD = .11$). We therefore concluded that our statistically significant, positive, and moderate-sized correlations provided at least modest support for the validity of the self-rated measure of safe working. Evidence for the differential validity of the self-report measure of safe working was shown by the finding that its correlation with team leader ratings of personal initiative was low and not significant ($r = .03$, $p > .05$).

Hypotheses Tests

Table 1 shows the cross-sectional correlations, means, and standard deviations of all variables at T1 and T2. The longitudinal correlations between variables at T1 with those at T2 are shown in Table 2. The longitudinal data were used to test the main hypotheses.

Work characteristics and safety (Hypotheses 1a to 1g). The first set of hypotheses concerned the link between work characteristics and safe working. We tested these hypotheses with a hierarchical regression analysis with safe working at T2 as the dependent variable. Safe working at T1 was entered at Step 1, therefore effectively controlling for the initial levels of safe working. We entered background variables at Step 2, T1 work characteristics at Step 3, T2 work characteristics at Step 4, and OC at T1 and T2 at Steps 5 and 6, respectively (Steps 5 and 6 were used to test Hypothesis 3, which we return to later). Steps 3 and 4 are the focus of interest for testing Hypotheses 1a to 1g, as we describe next.

Step 4 shows the contribution of work characteristics at T2 to the prediction of safe working at T2 after controlling for variance attributable to T1 work characteristics and T1 safe working. Step 4 provided a stronger test of the association between work characteristics and safe working than cross-sectional associations because the effects of stable common causes (e.g., personality) were controlled (Kessler & Greenberg, 1981) and because autoregressive effects were excluded (Gollob & Reichardt, 1987). However, causality can only be conclusively demonstrated if there is evidence that a preceding variable is associated with a later variable (Gollob & Reichardt, 1987) or, in this case, if there is a lagged effect of T1 work characteristics on safe working at T2, after controlling for T1 safe working. Step 3 allows a test of lagged effects. Listwise deletion of missing cases was used for all analyses.

Table 1
Cross-Sectional Correlations Between Variables at Time 1 (Above Diagonal) and Time 2 (Below Diagonal) for Longitudinal Sample ($N = 161$)

Variable	Time 1		Time 2		1	2	3	4	5	6	7	8	9	10	11	12	13
	M	SD	M	SD													
1. Age	39.30	10.92	40.74	10.55	—	.20*	.55**	-.06	.15	-.07	-.07	-.08	.05	.03	.01	.01	.20*
2. Gender	0.68	0.47	0.68	0.47	.20*	—	.04	-.05	-.06	.11	.03	.18*	-.15	-.17*	-.20*	-.13	-.03
3. Tenure	11.29	9.52	13.11	9.63	.55**	.01	—	.09	.09	.08	.00	-.05	-.10	-.10	-.05	-.03	.05
4. Site	0.71	0.45	0.71	0.45	-.05	-.05	.17*	—	-.04	-.03	-.10	-.17*	-.07	-.10	.05	.03	-.09
5. Safe working	3.83	0.68	3.89	0.69	.15	.06	.15	-.08	—	-.18*	-.10	-.33**	.06	.19*	.18*	.16*	.15
6. Job autonomy	3.01	1.10	3.13	1.14	-.04	.18*	-.02	-.13	.05	—	-.03	.00	.23**	.28**	.22**	.12	.13
7. Role overload	2.79	0.93	3.12	1.00	-.01	.11	-.11	-.07	-.09	-.14	—	.43**	-.11	-.17*	-.28**	-.22**	-.07
8. Role conflict	1.90	0.74	1.79	0.80	-.06	.17*	-.08	-.16*	-.05	.00	.28**	—	-.13	-.34**	-.42**	-.22**	-.15*
9. Supportive supervision	3.72	0.92	3.54	1.04	-.00	-.15	.09	-.02	-.02	.26**	-.25**	-.10	—	.39**	.45**	.30**	.36**
10. Training adequacy	2.87	1.11	2.69	0.99	-.04	-.26**	.08	.00	.09	.14	-.19*	-.11	.42**	—	.54**	.50**	.43**
11. Communication quality	3.32	0.80	3.24	0.72	.04	-.22**	.07	-.02	.28**	.15	-.30**	-.25**	.37**	.43**	—	.53**	.29**
12. Job security	2.55	1.28	2.53	1.16	-.02	-.12	.03	.09	.00	.27**	-.30**	-.04	.14	.20**	.36**	—	.35**
13. Organizational commitment	3.22	0.69	3.01	0.72	.25**	.02	.20**	.04	.37**	.27**	-.21**	-.12	.34**	.23**	.46**	.40**	—

* $p < .05$. ** $p < .01$.

Table 2
Correlations Between Variables at Time 1 and Variables at Time 2 for Longitudinal Sample (N = 161)

Time 1 variable	Time 2 variable								
	Safe working	Job autonomy	Role overload	Role conflict	Supportive supervision	Training adequacy	Communication quality	Job security	Organizational commitment
Age	.12	-.05	-.08	-.07	-.00	-.02	.08	.03	.23**
Gender	.03	.16*	.10	.15	-.10	-.18*	-.12	-.02	.01
Tenure	.20*	.04	-.09	-.06	.01	.05	.04	.04	.18*
Site	-.11	-.10	-.05	-.19*	-.01	-.02	-.04	.04	.02
Safe working	.27**	-.13	-.07	-.24**	.04	.14	.13	-.04	.09
Job autonomy	-.07	.59**	-.08	.08	.14	.20*	.05	.16*	.18*
Role overload	.01	-.07	.45**	.36**	-.12	-.13	-.27**	-.15	-.04
Role conflict	-.05	.06	.28**	.89**	-.09	-.20*	-.25**	-.08	-.14
Supportive supervision	.11	.16*	-.14	-.11	.39**	.33**	.29**	.06	.21*
Training adequacy	.03	.13	-.19*	-.23**	.16*	.60**	.39**	.32**	.28**
Communication quality	-.02	.16*	-.32**	-.32**	.27**	.40**	.51**	.29**	.20*
Job security	.04	.07	-.24**	-.17*	.10	.26**	.35**	.43**	.25**
Organizational commitment	.12	.05	-.12	-.08	.18*	.10	.30**	.26**	.63**

Note. Values in boldface represent the stability coefficients of key variables.
* $p < .05$. ** $p < .01$.

Table 3 shows the results of the regression analysis. After controlling for initial safe working levels and background variables (i.e., Step 3), there was a significant and positive lagged effect of supportive supervision at T1 on T2 safe working ($\beta = .19, p < .05$). This result suggests that supportive supervision leads to safer working over an 18-month period. Step 4 shows that T2 job autonomy and T2 communication quality were both positively associated with T2 safe working ($\beta = .21, p < .05$; $\beta = .30, p < .01$, respectively) after controlling for background variables, for stable third-factor variables, and for prior levels of safe working and the work characteristics. The fact that these work characteristics did not have lagged effects means that there is no direct support for causal relations, although it is possible that this is because the period of the study did not match the true causal lag (Gollob & Reichardt, 1987). There was therefore strong support for Hypothesis 1d concern-

ing supportive leadership, as well as evidence consistent with Hypothesis 1a concerning job autonomy and Hypothesis 1f concerning communication quality. However, there was no support for the hypotheses concerning the independent effects of training adequacy, job security, role conflict, or role overload.

OC and safe working (Hypothesis 2). The relationship between OC and safe working is also shown in Table 3. Specifically, Steps 5 and 6 show the effect of OC on safe working after controlling for the work characteristics variables. Inspecting the beta weight for OC at Step 5 (after the variance due to T1 safe working, background variables, and T1 work characteristics were accounted for), there was no significant lagged effect of OC on safe working at T2 ($\beta = .08$). The incremental variance contributed at this step was also small and nonsignificant ($\Delta R^2 = .01$). However, at Step 6, after controlling for prior levels of the T1 OC as well as other variables, the entry of T2 OC

Table 3

Hierarchical Regression Results (β) for Predicting Time 2 Safe Working From Work Characteristics and Organizational Commitment ($N = 161$)

Step and predictor	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Step 1						
Safe working T1	.27**	.26**	.25**	.22*	.21*	.21*
Step 2						
Age T1		-.05	-.09	-.08	-.09	-.13
Gender T1		.04	.07	.06	.06	.06
Tenure T1		.22*	.26*	.21*	.20*	.21*
Site		-.12	-.11	-.06	-.06	-.09
Step 3						
Job autonomy T1			-.08	-.17	-.17	-.18
Role overload T1			.01	.10	.10	.05
Role conflict T1			-.02	-.18	-.17	-.17
Supportive supervision T1			.19*	.19*	.17	.19*
Training adequacy T1			.00	-.07	-.11	-.04
Communication quality T1			-.12	-.26*	-.25*	-.18
Job security T1			.03	.07	.06	.07
Step 4						
Job autonomy T2				.21*	.22*	.14
Role overload T2				-.11	-.11	-.09
Role conflict T2				.15	.13	.18
Supportive supervision T2				-.11	-.12	-.13
Training adequacy T2				.09	.12	.05
Communication quality T2				.30**	.28**	.20*
Job security T2				-.14	-.15	-.22*
Step 5						
Organizational commitment T1					.08	-.14
Step 6						
Organizational commitment T2						.37**

Note. R^2 at Step 1 = .07**; ΔR^2 at Step 2 = .05; ΔR^2 at Step 3 = .03; ΔR^2 at Step 4 = .09*; ΔR^2 at Step 5 = .01; ΔR^2 at Step 6 = .05**. T1 = Time 1; T2 = Time 2.

* $p < .05$. ** $p < .01$.

accounted for a significant amount of incremental variance in the prediction of safe working ($\Delta R^2 = .06, p < .001$), and the beta weight for T2 OC was significant and positive ($\beta = .37, p < .001$). This finding is consistent with Hypothesis 2 concerning OC and safe working, although there is no direct support for a causal relationship over the specific time frame of the study, as would be suggested by a lagged effect.

Mediating role of OC in the link between work characteristics and safe working (Hypothesis 3). The previous analysis showed a link between OC and safe working, after controlling for the work characteristics variables, which is consistent with the proposed mediating role for OC. Table 4 shows the results of a regression analysis predicting OC at T2 from work characteristics after controlling for T1 levels of OC and background variables. There is no evidence of lagged effects (Step 3); however, scores on various work characteristics were positively associated with OC after controlling for T1 levels of these variables and T1 OC (Step 4). Specifically, OC was

predicted by job autonomy ($\beta = .21, p < .01$), communication quality ($\beta = .24, p < .001$), training adequacy ($\beta = .19, p < .05$), and job security ($\beta = .20, p < .05$), after controlling for the a priori effects of these variables. Supportive supervision, role overload, and role conflict did not have significant independent effects predicting OC using the longitudinal data.

Stronger evidence of mediation (Kenny, Kashy, & Bolger, 1998) was shown by a reduction in any significant links between work characteristics and safe working when the effects of OC are partialled out of the equation. The work characteristics with significant associations with safe working were supportive supervision, job autonomy, and communication quality. Steps 5 and 6 of the initial regression analysis (see Table 3) show the effect of controlling for OC in the prediction of safe working from work characteristics. Focusing on Step 6, which shows the effect of controlling for OC at T1 and OC at T2, it can be seen that job autonomy was no longer a significant predictor of safe working at T2 ($\beta = .14, p > .05$),

Table 4
Hierarchical Regression Results (β) for Predicting T2 Organizational Commitment From Work Characteristics ($N = 161$)

Step and predictor	Step 1	Step 2	Step 3	Step 4
Step 1				
Organizational commitment T1	.63**	.62**	.60**	.60**
Step 2				
Age T1		.04	.07	.12
Gender T1		.01	.01	-.02
Tenure T1		.12	.09	.00
Site		.07	.06	.08
Step 3				
Job autonomy T1			.11	.02
Role overload T1			.03	.13*
Role conflict T1			-.04	-.03
Supportive supervision T1			-.03	-.06
Training adequacy T1			-.01	-.18*
Communication quality T1			-.01	-.17*
Job security T1			.04	-.02
Step 4				
Job autonomy T2				.21**
Role overload T2				-.06
Role conflict T2				-.10
Supportive supervision T2				.02
Training adequacy T2				.19*
Communication quality T2				.24**
Job security T2				.20**

Note. R^2 at Step 1 = .39**; ΔR^2 at Step 2 = .03; ΔR^2 at Step 3 = .01; ΔR^2 at Step 4 = .20**.
T1 = Time 1; T2 = Time 2.

* $p < .05$. ** $p < .01$.

suggesting that OC fully mediated this relationship. The effect of communication quality has been reduced (from $\beta = .30, p < .01$ at Step 4 to $\beta = .20, p < .05$ at Step 5), but its effect was still significant, suggesting only partial mediation of OC. In contrast, the lagged effect of supportive supervision shown in Step 3 is still significant in Step 6, which suggests this association is not mediated by OC. This finding is also consistent with the analysis showing that supportive supervision was not a significant predictor of OC (see Table 4, Steps 3 and 4). It is interesting to note that, after controlling for the effects of OC, job security had a negative association with increased safe working. We discuss this finding later.

Additional analyses. The main regression analysis (depicted in Table 3) involves considering all of the work characteristics simultaneously. The advantage of this approach is that it controls for spurious effects that could arise as a result of associations between the work characteristics. However, a disadvantage of this approach is that the regression parameters indicate the effects of residualized variables on safe working rather than the effects of the measured variables (Meyer & Allen, 1988). We therefore repeated the analysis described in Table 3 with each work characteristic considered separately. The results from these additional analyses were largely consistent with the previous findings. Thus, job autonomy at T2 was a significant predictor of safe working at T2 (Step 4: $\beta = .20, p < .05$), and OC was shown to fully mediate this association (Step 6: $\beta = .10$). Communication quality at T2 predicted safe working at T2 (Step 4: $\beta = .27, p < .01$), and OC partially mediated this association (Step 6: $\beta = .16, p < .10$). The lagged effect of supportive supervision on safe working was approaching significance (Step 3: $\beta = .13, p < .10$), and this effect was not mediated by OC (Step 6: $\beta = .15, p < .10$). Finally, role overload, role conflict, or job security did not have any significant lagged effects or any significant contemporaneous effects on safe working at T2. (Full details of these additional analyses are available from Sharon K. Parker on request.)

Discussion

Summary and Implications

Various researchers (e.g., Frone, 1998; Parker & Wall, 1998; Veazie et al., 1994) have called for investigations into the role of work design and other organizational factors in promoting occupational safety. The present longitudinal study took a step

toward this goal by investigating the importance of several work characteristics proposed by Barling and Zacharatos (1999) and the proposed mediating role of OC. Three work characteristics were shown to be important for safe working: supportive supervision, job autonomy, and communication quality.

Regarding the first of these, there was a lagged positive effect of supportive supervision at T1 on safe working at T2 in the main analysis. The importance of supportive supervision was not likely to be spurious as it was obtained even when all other work characteristics and background factors were included in the analysis. The finding suggests that having considerate, coaching-oriented team leaders causes employees to put greater effort into safe working at a period 18 months in the future. This conclusion is consistent with leadership and safety studies (e.g., Hofmann & Morgeson, 1999) we described earlier but adds to these by providing longitudinal evidence. The implication is that safe working might be enhanced by training and developing supervisors to be supportive and to adopt a coaching-oriented rather than coercive style.

In addition to supportive supervision, job autonomy and communication quality predicted safe working at T2 after controlling for initial levels of these and other work characteristics variables. These findings suggest a potentially important role for job autonomy and communication in promoting safety. Although we cannot be sure of the direction of causality of these associations because there was no evidence of a lagged effect over the period investigated, the obtained relationships are less likely than cross-sectional data to simply reflect autoregressive effects or confounds due to stable third variables. Additional research is needed that investigates causal lags for these antecedents over different periods. For example, it is likely that the effects of job autonomy occur more slowly than the 18-month period investigated here. For employees who have been exposed to simplified jobs for a long period, adapting to enhanced autonomy can be a gradual learning process that occurs over the long term (e.g., Parker & Wall, 1998).

The study further suggests that the positive effects of job autonomy on safe working occur primarily through the mechanism of OC. This mechanism also partly accounts for the observed relationship between communication quality and safe working. The study therefore provides partial support for a commitment-oriented approach to safety in which it is proposed that safety can be increased by generating and showing commitment toward employees (e.g., Barling &

Hutchinson, 2000; Barling & Zacharatos, 1999). Nevertheless, the study also suggests that variables such as communication quality and supportive supervision are associated with safe working for reasons over and above any link with OC. Some of the other mechanisms proposed by Barling and Zacharatos (1999) might come into play here. For example, supportive supervision might enhance employees' self-efficacy, which in turn leads them to work more safely. An explanation for the partial mediation for communication quality might reflect different types of communication. Open communication about general work aspects might enhance safety by promoting OC, whereas specific safety-focused communication might enhance safe working more directly.

Taken together, results from the study suggest that managers can do more than introduce rules, punishments, or other such control strategies to assure safety compliance. They can demonstrate a supportive, coaching management style; they can enrich work by enhancing job autonomy; and they can communicate and share information with their employees. Many workplace safety interventions (e.g., behavioral-based safety training) often rely on contingent reinforcement to control safety compliance in the short term, with little regard to how wider organizational variables might affect safety performance. Our study suggests that managers should consider alternative human resource-oriented approaches that might not only have positive effects on safety but could also promote other positive benefits for the organization, such as enhanced employee performance.

It is also necessary to consider the work characteristics that were not shown to be so important. As expected, training adequacy was positively associated with OC, which was in turn associated with safer working. However, the strength of this relationship was not large enough to show a statistically significant independent direct effect between this job factor and safer working. Role overload and role conflict had no significant unique negative association with either OC or safe working in the regression analyses. The finding that there is no link between these role variables and OC is surprising given previous evidence (Mathieu & Zajac, 1990). One explanation is that the levels of role overload and role conflict in the present sample were not sufficiently high to have much impact on important outcomes. Another explanation is that the present study is more rigorous than previous studies, which have been largely cross-sectional in nature and might therefore have been susceptible to inflated estimates. A further explanation is that, as has been proposed in the demand-control

model of job strain (Karasek, 1979), the effects of demand variables such as role overload might be mitigated by job autonomy or other such variables. Drawing on the demand-control model, increased levels of workload or even conflict might not be detrimental to safety compliance as long as levels of job control are also enhanced. Further research is needed to investigate these potential explanations.

A further unexpected finding was that job security was negatively associated with safe working once its positive effects on OC were controlled. This finding could simply be an aberrant one that has arisen because of the relatively small sample combined with the inclusion of multiple variables. Until this finding is replicated in a larger representative sample, conclusions cannot be drawn. Nevertheless, one possible explanation of a negative link between job security and safe working could be that employees who feel insecure might fear being made redundant on the basis of a poor accident record and therefore take extra care to comply with safety procedures. Such an explanation would fit the present situation as the company had undergone considerable downsizing, and the fear of redundancy was quite high. Another explanation worth exploring if the finding is replicated is that job security might reduce continuance commitment (i.e., attachment based on costs of leaving an organization; Meyer & Allen, 1997), which could play an intermediate role between job security and safety compliance.

Limitations and Further Directions for Research

Some limitations with the present study deserve note. As described above, there is a need to replicate the findings in other samples to show their generalizability. Another limitation is the relatively low reliability of the safe working measure. The low reliability has the effect of attenuating correlations (Murphy & Davidshofer, 1994); therefore, it is likely that a more reliable measure would show stronger associations. In addition, although we cross-validated the measure of safe working with team leader ratings, it was a self-report measure and therefore potentially suffers from a socially desirable response bias, meaning the study is susceptible to problems of common method variance. Fortunately, examining change over time eliminates the effect of stable response styles (such as the tendency to respond in a socially desirable way), and thus reduces the likelihood that common method variance is a plausible alternative

explanation of the results. There was also a good spread of scores in the safety measure, suggesting that employees felt able to admit that they did not always comply with procedures. The fact that not all the variables were highly intercorrelated further suggests that common method variance is not responsible for the relationships found.

Nevertheless, there would be value in replicating this study using alternative outcome measures of safe working. One obvious recommendation is to use objective measures of safe working, although there are difficulties associated with obtaining and interpreting such assessments. For instance, many accidents are not reported or recorded, and observational methods used to collect compliance data can pick up only obvious or observable unsafe practice. An alternative approach is to extend the type of safe working measures to include more proactive and citizenship safety behaviors, such as participation in safety audits and active involvement in developing safe procedures (e.g., Griffin & Neal, 2000; Marchand et al., 1998). There is research from the performance literature that shows that such citizenship behaviors are more strongly associated with OC than in-role behaviors (Organ & Ryan 1995), hence it is plausible to expect that proactive and citizenship-type safety behaviors might be more strongly associated with commitment than the compliance-type behaviors considered in the present study. Evidence from elsewhere (e.g. Frese, Kring, Soose, & Zempel, 1996; Parker, 2000) also suggests that work characteristics such as autonomy might be particularly important in promoting more proactive safety behaviors.

More detailed investigation of OC as a partial mediator is also warranted. We argued that employees who are committed to their organization align their behavior with organizational goals such as safe working. However, this assumes that there is indeed a clear organizational goal to work safely or, in other words, a strong set of safe working norms. In the present organization, this assumption was reasonable given the company's strong drive to enhance safe working and their considerable investment in initiatives to reduce injuries and accidents. In other organizations in which safety is not an explicit company goal, there is less reason to expect that OC will enhance safe working. The extent to which the organization has a clear goal for safety (e.g., operationalized as employees' perceptions of managerial commitment to safety) is therefore a potential moderator of the relationship between OC and safe working.²

Mechanisms other than commitment could also

explain how work factors affect safety. Related research has identified constructs such as organizational climate (including safety climate) and safety knowledge as plausible antecedents to safe working (e.g., Griffin & Neal, 2000; Neal et al., 2000). Similarly, Barling and Zacharatos (1999) proposed additional mediators of the relationship between high-performance work factors and safety, such as trust in management and perceptions of fairness. It will therefore be important to see how OC integrates with these other potential mediators in influencing organizational safety.

Finally, with the exception of supportive supervision, there were no lagged effects in the present study. The lack of lagged effects could be because there are no causal relations, because we did not capture the true causal lag, or because our use of single rather than multiple indexes of key constructs overestimates stability coefficients and hence could lead to underestimation of lagged effects. Thus, although the present study is superior in method to a cross-sectional inquiry, our data are still inconclusive about whether management and organizational practices *cause* employees to work more or less safely. To ensure lagged effects are not underestimated, longitudinal research is needed that investigates change over different time periods (e.g., 2 months, 6 months), ideally using multiple waves to control for time-varying third factors and using latent variables with multiple indicators.

² We thank an anonymous reviewer for making this suggestion.

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