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Psychosocial safety climate moderating the effects of daily job demands and recovery on fatigue and work engagement

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This study examined the role of schools' psychosocial safety climate (PSC) in teachers' psychological outcomes. We proposed that PSC would moderate the effects of teachers' daily job demands on their fatigue and work engagement, and also the effects of teachers' daily recovery on fatigue and engagement. Sixty-one Australian school teachers completed a diary that was repeated three times over the course of approximately 8 months. Each diary ran for five consecutive days, measuring daily self-reports of job demands, recovery, fatigue, and engagement (N = 915 data points), while perceived PSC was measured once per diary. Multilevel analyses indicated that PSC moderated the relationships between job demands and fatigue, as well as job demands and engagement. This suggests that perceived PSC could act as a buffer against deleterious impacts of daily job demands. PSC also moderated the relationships between recovery and fatigue, and recovery and engagement. This indicates that higher levels of perceived PSC in schools could amplify the benefits of daily recovery for teachers. PSC also exerted a main effect on both fatigue and engagement. These results offer insight into the mechanisms by which PSC may act as a buffer to protect worker mental health, and highlight the importance for school management to promote PSC within their organization.

Practitioner points

- Psychosocial safety climate in organizations may buffer workers from the negative psychological outcomes associated with job demands.
- Psychosocial safety climate in organizations may boost the psychological benefits that workers gain from achieving good daily recovery outside of work.

Psychosocial safety climate (PSC) measures the climate of an organization as specifically related to the psychological well-being of employees (Dollard & Bakker, 2010). It has previously been investigated as a moderator of the impacts of work stressors upon worker psychological health, as well as a precursor to job demands and resources in the

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workplace (Dollard & Bakker, 2010). However, to date there has been little or no research exploring the impact of PSC on worker stress recovery at a daily level.

Psychosocial safety climate

Psychosocial safety climate can be defined as 'policies, practices, and procedures for the protection of worker psychological health and safety' (Dollard & Bakker, 2010, p. 580). It is concerned with the prevention and management of psychological injury at work and is characterized by a climate of trust and respect where employees perceive that management values them and their welfare sufficiently to make their psychological well-being a priority (Dollard & Bakker, 2010). PSC also has a safety signal function, indicating to workers that it is safe to utilize available resources should high demands be encountered (Law, Dollard, Tuckey, & Dormann, 2011). PSC has been modelled as augmenting the job demands–resources (JDR) model of work stress (Idris, Dollard, Coward, & Dormann, 2012). Although the current study does not explicitly test the JDR model, it serves as a framework through which PSC can be conceptualized as related to job demands and resources.

The JDR model identifies two processes through which work and health outcomes are linked with job demands and resources. Through the health erosion process, sustained effort to meet job demands (aspects of the job that require physical, psychological, cognitive, or emotional exertion) contributes to strain through the exhaustion of energy reserves (Bakker & Demerouti, 2007). The motivational process describes the potential for job resources, which include elements of the job that motivate workers intrinsically or extrinsically, to stimulate positive work-related outcomes such as engagement and performance (Bakker & Demerouti, 2007). As a precursor to the levels of job demands and resources experienced by workers, PSC extends both of these pathways (Dollard & McTernan, 2011). In organizations with high PSC, employees report lower levels of job demands, as administration creates manageable demands and puts in place communication systems to monitor and manage risks (Schaufeli, Bakker, & Van Rhenen, 2009). Adequate investment in resourcing is also given to allow workers to meet goals successfully and derive meaning from their work, encouraging engagement and enhanced performance (Schaufeli *et al.*, 2009). By comparison, low-PSC organizations allow excessive demand scenarios and invest little in resources (Idris & Dollard, 2011). PSC itself can be considered a job resource that stems from management, by providing instrumental support to workers or by maintaining an environment where workers are comfortable utilizing available resources (Dollard & McTernan, 2011). Hence, PSC has also been conceptualized as having a moderating function on the impacts of job demands and resources on worker psychological health and engagement (Law *et al.*, 2011).

Organizational climates originate in individual perceptions (Kuenzi & Schminke, 2009), but have been proposed as a shared perception among employees, which is a collective phenomenon (Schneider & Reichers, 1983). Thus, they may be best analysed by aggregating measurements of individual perceptions within a work unit, which requires sampling multiple participants who work in the same unit. However, workplace climates can also be measured at the individual level (i.e., without aggregation) and in these cases can be referred to as psychological climates (Kuenzi & Schminke, 2009). This method does not necessitate sampling multiple workers within the same work unit, and this is how we measured PSC for this study. When measured this way, researchers capture the

individual's perceptions of the psychological impact of the work environment on his or her own well-being.

Daily recovery from work stress

To further explore the effects of PSC at the daily level, a highly relevant construct is daily recovery from work-related stress. The stress response process is a neurophysiological mechanism that facilitates the concentration of available physical and mental resources to resolve challenges (McEwen & Lasley, 2007). Recovery from work stress requires a period free from further job-related demands and associated stress experiences (Sonnentag & Fritz, 2007). A worker who has achieved adequate recovery from a previous shift's demands may have more energy and be more able to engage fully with work in a subsequent shift (Sonnentag, 2003). However, many high-demand occupations may activate the stress response frequently and for substantial parts of the day, as one challenge is followed by another within a relatively short time. Such prolonged activation increases the risk of consistent failure to recover adequately from work-related stress, leading to progressively unrepaired cellular-level changes within the central nervous system (McEwen & Lasley, 2007). For a worker so affected, the changes are commonly characterized by progressive decrements in motivation, and disengagement from activities formerly found to be rewarding, including work participation itself with accompanying loss of productivity (McEwen, 2003).

Both intershift recovery and PSC have been found to indirectly affect employee engagement and fatigue (Dollard & Bakker, 2010; Winwood, Bakker, & Winefield, 2007), suggesting a possible moderating role of PSC in the effects of recovery on employee psychological outcomes. Workers require mental resources to be engaged in their job (Bakker, Schaufeli, Leiter, & Taris, 2008), and this process is facilitated by intershift recovery, as workers who achieve good recovery will have accrued adequate mental resources prior to starting a new shift (Sonnentag, 2003; Winwood *et al.*, 2007). These resources may be augmented by a workplace with high PSC, which signals to employees that additional resources are available when needed (Law *et al.*, 2011). The combination of worker personal resources achieved via recovery and awareness of additional workplace resources as signalled by PSC may result in lower fatigue levels and increased potential for work engagement. However, recovery between shifts may be undermined in a low-PSC work environment, because more of the individual's mental resources accrued through recovery will need to be used to meet demands in lieu of PSC-related support (Dollard, Tuckey, & Dormann, 2012). It is possible that for workers experiencing consistently poor recovery (with associated reduced personal resources prior to beginning a shift), entering a low-PSC workplace may further compromise the capacity for engagement and exacerbate the levels of acute fatigue.

PSC and acute fatigue

Work-related acute fatigue refers to the feelings of fatigue a worker experiences following exposure to job demands during a work shift and can be characterized by states of physical exhaustion and temporary impoverishment in cognitive function, mood, and motivation (Querstret & Cropley, 2012; Winwood, Lushington, & Winefield, 2006). Job demands may not be as psychologically distressing for workers within a context of high PSC, where sufficient job resources are provided. According to the conservation of resources theory (Hobfoll, 2001; Hobfoll & Shirom, 2001), individuals strive to obtain, retain, protect, and

foster resources; stress and associated fatigue occur when these resources are threatened. Given that PSC signals to workers that further organizational-level resources are available if needed (Dollard *et al.*, 2012; Law *et al.*, 2011), threat of resource loss and associated acute fatigue is reduced. This suggests a possible interaction in which PSC moderates the impacts of job demands to reduce consequent worker fatigue. Previous studies have found that the detrimental effects of demands on worker psychological health are ameliorated in the context of high PSC (Dollard & Bakker, 2010; Law *et al.*, 2011). For example, Dollard and Bakker (2010) conducted a repeated-measures study with school staff and found that higher levels of PSC reduced the positive relationship between job demands and emotional exhaustion. Conceivably, perceived PSC may also contribute to reduced levels of worker fatigue, including in conjunction with worker daily recovery, whereby the signalled safety to utilize available workplace resources interacts with a worker's personal resources to further reduce fatigue.

PSC and work engagement

Work engagement, a cognitive-affective state characterized by vigour, dedication, and absorption (Schaufeli & Bakker, 2010), is an important work-related psychological outcome that may be linked to perceived PSC in the workplace. It is strongly related to employee well-being, job performance levels, and intention to stay with one's current employer and is considered a key outcome in interventions aimed at promoting worker well-being (Bakker, 2009; Rich, Lepine, & Crawford, 2010; Sonnentag, 2003). Engagement is frequently conceptualized as a stable trait between individuals, but there is also significant intra-individual variation on a daily level, an aspect referred to as state work engagement (Sonnentag, Dormann, & Demerouti, 2010). This is consistent with research highlighting the dynamic nature of work-related personal resources, which involve continuous interactions between a worker's perceptions of the work environment and his or her behaviour (Shirom, 2010). The relationship between PSC and engagement can be explained with social exchange theory (SET); that is, if employers display concern for and prioritize employee well-being, employees will invest their efforts towards the job (Cropanzano & Mitchell, 2005). Through the norm of reciprocity, employees who recognize managerial commitment to worker mental health may be more motivated to invest and engage in their work, even in the face of high demands (Elstad, Christophersen, & Turmo, 2011). Law *et al.* (2011) also found that PSC supports worker engagement by reducing exposure to workplace psychosocial hazards, such as bullying and harassment.

However, levels of job demands and worker engagement do not share a simple negative relationship. Timms, Graham, and Cottrell's (2007) investigation of workload and engagement in Australian school teachers found that high workload predicted lower levels of vigour, but higher levels of absorption, suggesting that teachers find their work so intrinsically interesting that even when workload is excessive, they still lose track of time. Similarly, Schaufeli and Salanova (2011) highlight that work engagement is not simply the opposite of burnout, but rather an independent construct with different consequences and antecedents. Therefore, efforts to minimize job demands and reduce negative outcomes including fatigue may not necessarily lead to increased work engagement. PSC has been conceptualized as a type of workplace resource that moderates workers' psychological outcomes, including engagement (Law *et al.*, 2011), which may occur via minimizing the negative effects of job demands and supporting the positive effects of

recovery. Hence, it is important to identify whether maintaining a high level of PSC provides significant benefits for worker engagement on a daily level as they face varying amounts of job demands.

Occupational health of school teachers

School teachers are an ideal occupational group for research on work-related stress and coping resources, as this type of work is accepted as high stress and associated with job demands intruding into non-work time, including marking, lesson design, resource preparation, staff meetings, and contact with parents (Rudow, 1999; Yong & Yue, 2007). The high level of non-paid work at home often expected of school teachers is of particular significance, as these demands may restrict opportunities for recovery outside of work as well as maintaining heightened stress levels (Sonnentag & Kruel, 2006). It is therefore important to understand how PSC impacts the efficacy of recovery in teachers, as this may be something that school managements can leverage to improve teacher mental well-being. Furthermore, recent research investigating teacher retention in Australia, the United States, and the United Kingdom has identified teaching as having a relatively high turnover rate compared with other employee groups, which has been linked to the high strain associated with the role (Mayer, 2006; Ministerial Council on Education Employment Training and Youth Affairs, 2004). Hence, research into ways for promoting psychological well-being in teachers is relevant and timely.

The present study

Based on the above discussion, we conducted a diary study with a sample of Australian school teachers to investigate PSC as a moderator of the effects of daily job demands on fatigue and engagement, and also of the effects of daily recovery on each of those worker outcomes. Previous studies have examined PSC and other organizational variables in relation to worker psychological health (Dollard & Bakker, 2010), although the focus has mostly been on organizational factors that are relatively outside of the control of individual workers. To our knowledge, this is the first published study to examine the relationship between daily recovery and workplace PSC, which is significant because recovery is achieved outside of the workplace and so is largely under the control of individual workers. This study explores the relationships between individual-level and perceived workplace factors and so can inform interventions targeting worker well-being or performance in which workers have a degree of agency.

Participants completed a week-long diary, reporting responses to items daily. Participants then completed a second, similar diary approximately 4 months later, and again 4 months after that, for a total of three waves. PSC has been conceptualized as a relatively stable variable (Idris *et al.*, 2012) and so was measured only once per diary to allow for subtle variations across the school year. Our design is thus suitable for analysing a combination of factors conceived as varying at differing frequencies. A theoretical model was constructed (Figure 1):

Hypothesis 1: Psychosocial safety climate moderates the positive relationship between daily job demands and acute fatigue, such that under the conditions of higher PSC, the relationship will decrease. That is, the relationship of high demands predicting high fatigue will be weaker for employees working at schools with higher perceived PSC, than at schools with lower perceived PSC.

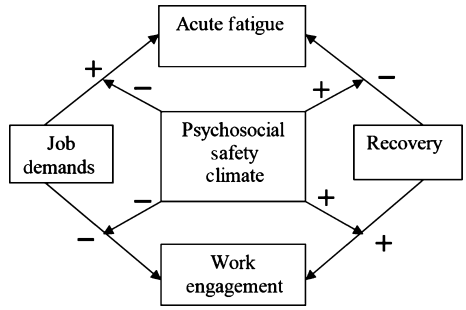

Figure 1. Moderation model of psychosocial safety climate (PSC) in the job demands, daily recovery, acute fatigue, and work engagement relationships.

Hypothesis 2: Psychosocial safety climate moderates the negative relationship between daily recovery and acute fatigue, such that under the conditions of higher PSC, the relationship will increase. That is, the relationship of high recovery predicting low fatigue will be stronger for employees working at schools with higher perceived PSC, than at schools with lower perceived PSC.

Hypothesis 3: Psychosocial safety climate moderates the negative relationship between daily job demands and work engagement, such that under the conditions of higher PSC, the relationship will decrease. That is, the relationship of high demands predicting low engagement will be weaker for employees working at schools with higher perceived PSC, than at schools with lower perceived PSC.

Hypothesis 4: Psychosocial safety climate moderates the positive relationship between daily recovery and work engagement, such that under the conditions of higher PSC, the relationship will increase. That is, the relationship of high recovery predicting high engagement will be stronger for employees working at schools with higher perceived PSC, than at schools with lower perceived PSC.

Method

Design

School teacher participants completed three identical diaries that ran for five consecutive days each (weekend days were not included). The diaries were distributed over the course of a school year, separated by approximately 4 months each. Independent variables included PSC (measured once per diary), daily job demands, and recovery; dependent variables were daily acute fatigue and work engagement. We performed the study with relevant university ethics approval. We requested permission from school principals to present the study to staff. We contacted 30 schools, of which 15 agreed to participate. We presented the research during staff meetings and left diaries in each staff room for

interested (participating) teachers to collect. The diaries instructed participants to complete sleep quality items in the morning upon waking, and remaining items at night, just before going to bed. Participants returned completed diaries via reply-paid envelopes. To protect anonymity and confidentiality, no personally identifiable information was requested in the diaries other than a postal address, which was stored separately from the diaries upon collection. Two follow-up diaries were posted to participants at approximately 4 and 8 months after the first diary. Data were entered into a PASW Statistics v18 database for initial analysis (SPSS Inc., Chicago, IL, USA).

Participants

The sample consisted of 61 participants drawn from teachers and school principals working in primary and secondary schools. The sample comprised 29 men and 32 women with mean age 43.0 years (range 22–63 years, *SD* = 12.9). Of these, 44 (72%) worked at government schools and 17 (28%) worked at non-government schools; 32 (53%) worked in metropolitan areas, and 29 (48%) worked in regional areas. Job roles included 7 (12%) principals/assistant principals, 13 (21%) subject-area coordinators, and 41 (67%) with regular teacher duties. The mean duration of service as a teacher was 18.8 years (range 0.25–45 years), with mean duration of service at the participants' current school being 7.9 years (range 0.2–27.2 years). The inclusion criterion was a minimum of 16 paid working hours per week.

Measures

Background variables

Control variables included gender, age, number of paid work hours per day (this may have increased daily job demands and limited time available for recovery), time spent performing work-related activity at home (homework) per day (such demands may have caused the stress response to persist beyond formal work hours and hence prevented recovery) (Yong & Yue, 2007), and sleep quality (a strong predictor of recovery and fatigue outcomes) (Rook & Zijlstra, 2006; Sonnentag, 2003). Sleep quality was measured using four items selected and adapted from the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), an example being, 'It took 30 min or more for me to get to sleep'. Scores were summed and converted to a value out of 100 (actual scores ranged from 0 to 100), with higher values representing better sleep quality. Internal consistency reliability across all measurement points was high (Cronbach's $\alpha = .87$).

Psychosocial safety climate

We measured PSC once per diary, using 11 items from the PSC-12, reworded for school employees (we used an early version of the questionnaire, which did not include the item, 'Information about workplace psychological well-being is always brought to my attention by my manager/supervisor'; Hall, Dollard, & Coward, 2010). This is considered to be a relatively stable construct, and so only one measurement of PSC was taken per diary (for a total of three measurements). An example item is, 'Psychological well-being of staff is a priority for this school'. The PSC-12 uses a 5-point scale (0 = *Strongly Disagree*; 4 = *Strongly Agree*). The scores were summed and converted to a value out of 100 (actual scores ranged from 15.9 to 100), with higher values representing higher levels of

perceived PSC. Internal consistency reliability across all measurement points was high (Cronbach's α = .86).

Job demands

Daily job demands (physical, cognitive, and emotional) were measured with 11 items selected from the DISC questionnaire (De Jonge *et al.*, 2007), adapted for school teachers and to reflect the daily timescale. These items were measured on a 5-point scale (0 = *Strongly Disagree*; 4 = *Strongly Agree*), with an example item being, 'I was under a lot of time pressure today'. The scores were summed and converted to a value out of 100 (actual scores ranged from 15.9 to 88.5), with higher values representing higher levels of job demands. Internal consistency reliability across all measurement points was high (Cronbach's α = .85).

Recovery and acute fatigue

The Occupational Fatigue Exhaustion Recovery (OFER) scale is a previously validated measure of work-related fatigue and recovery (Winwood *et al.*, 2006). We employed two subscales from the OFER: intershift recovery and acute fatigue, each comprising five items. Intershift recovery refers to recovery from acute fatigue between work periods. Acute fatigue refers to feelings of fatigue and disinclination/inability to engage in other activities after finishing a work shift.

We reworded items from the OFER to measure momentary states of each construct. For example, an item from the original acute fatigue scale was changed from 'After a typical work period I have little energy left' to 'After work today I had little energy left'. An example from the state recovery scale is, 'I still felt fatigued from my previous work before I started today's shift' (reverse coded). The OFER uses a 7-point scale (0 = *Completely Disagree*; 6 = *Completely Agree*). For each subscale, the scores were summed and converted to a value out of 100 (actual scores for both subscales ranged from 0 to 100), with higher values representing higher levels of each construct. Internal consistency reliability across all measurement points was high for both fatigue (Cronbach's α = .94) and recovery (Cronbach's α = .91).

Work engagement

State work engagement was measured using the 9-item version of the Utrecht Work Engagement Scale (UWES; Schaufeli, Bakker, & Salanova, 2006), with items reworded to measure momentary states of engagement. An example item is, 'At work today I felt full of energy'. The UWES uses a 7-point scale (0 = *Completely Disagree*; 6 = *Completely Agree*). The scores were summed and converted to a value out of 100 (actual scores ranged from 0 to 100), with higher values representing higher levels of engagement. Internal consistency reliability across all measurement points was high (Cronbach's α = .89).

Statistical analyses framework

Repeated-measures data can be considered multilevel data (Van Der Leeden, 1998). In this study, daily measures (Level 1) were nested within each of the three diaries (Level 2), nested within the individual (Level 3). For such cases, multilevel analysis is superior to

ordinary regression analysis, because multilevel models are designed to analyse variables from different levels simultaneously, using a statistical model that properly includes various dependencies (Hox, 2002). To account for the nested data structure, we conducted hierarchical linear modelling using MLwiN 2.10 software (Centre for Multilevel Modelling, Bristol, UK). Gender, age, hours spent at work, hours spent in work-related activity at home, and sleep quality were controlled for in all multilevel analyses.

All Level 1 (day-level) and Level 2 (diary-level, i.e., PSC) variables were centred around the group (person) mean, while Level 3 (person-level) variables were centred around the grand mean (Hofmann & Gavin, 1998). Centring day- and diary-level variables at the person mean removes between-persons variance in these variables, allowing for interpretations of results without referring to stable differences between persons. We computed effect sizes by standardizing all predictors and obtaining the parameter estimates, with the resultant coefficients being similar to standardized regression coefficients (Yeates, Taylor, Walz, & Stancin, 2010). These can be scaled to correlations, and so we used conventional definitions of effect size for correlations to characterize the magnitude of the parameter estimates (i.e., .1 is small, .3 is medium, and .5 is large) (Cohen, 1988). We obtained significance levels of parameter estimates by dividing the estimate by its standard error and comparing this ratio with the critical *t*-value. To compare model fit between nested models, we tested the difference in the deviance statistic (−2log likelihood) over the difference in degrees of freedom (Rasbash, Steele, Browne, & Goldstein, 2009).

To examine the cross-level moderations in predicting fatigue and engagement, we calculated the following models in sequence, beginning with lower-level predictors and then adding higher-level variables (Tuckey, Bakker, & Dollard, 2012): (Model 1) the intercept-only model; (Model 2) adding Level 1 predictors (sleep quality, work hours, homework, job demands, and recovery); (Model 3) allowing variation in slopes (at Levels 2 and 3) of job demands and recovery (the Level 1 predictors to be included in interactions); (Model 4) adding the Level 2 predictor (PSC); (Model 5) adding the Level 3 predictors (age and gender); and (Model 6) adding cross-level interactions of PSC with job demands and recovery. Allowing the slopes of job demands and recovery to vary (Model 3) means that the relationships between these predictors and the dependent variable can differ between persons and diary waves. We interpreted interactions following Aiken and West (1991); where a significant interaction term was indicated, we plotted values on the dependent variable for high and low values of the independent and moderator variable. The nature of the interaction was interpreted from the plots.

Results

Assumptions testing showed that scores of PSC, daily job demands, recovery, fatigue, and engagement were normally distributed and linear. Table 1 displays the means, standard deviations, and bivariate correlations between variables. Results showed that PSC had significant positive relationships with recovery and engagement, and significant negative relationships with job demands and fatigue (although the relationship with fatigue was only significant at the day-level). Fatigue was significantly negatively related to engagement at the day-level, but not significant at the person-level. Multicollinearity was not a problem, because no variables displayed variance inflation factors higher than 10 or tolerance values lower than .20 (O'Brien, 2007; Schroeder, 1990).

Table 1. Means, standard deviations, and bivariate correlations of study variables

	M	*SD*	1	2	3	4	5	6	7	8	9	10
1. Age	43.03	12.90	–	.30**	−.24**	.10**	.20**	−.18**	.20**	−.36**	.22**	−.06
2. Gender[a]	–	–	.30*	–	−.12**	−.09**	.05	.27**	−.01	−.12*	.17**	.19**
3. Sleep quality	69.44	14.56	−.34**	−.17	–	−.02	−.16**	.26**	−.13**	.30**	−.15**	.18**
4. Work hours	8.56	1.98	.16	−.15	−.04	–	.12**	−.04	.09**	−.18**	.13**	−.10**
5. Homework	1.77	1.83	.31*	.08	−.36**	.07	–	.33**	.30**	−.49**	.43**	−.22**
6. PSC	56.77	19.12	−.20	.29*	.37**	−.07	−.47**	–	−.18**	.36**	−.19**	.42**
7. Demands	46.32	12.52	.26*	−.01	−.19	.17	.49**	−.30*	–	−.40**	.26**	.13**
8. Recovery	49.34	23.67	−.43**	−.14	.40**	−.18	−.63**	.47**	−.56**	–	−.45**	.31**
9. Acute fatigue	59.04	20.68	.34**	.26*	−.14	.07	.38**	−.14	.32*	−.55**	–	−.32**
10. Engagement	49.28	18.21	−.08	.28*	.18	−.09	−.15	.59**	.10	.20	−.19	–

Note. PSC, psychosocial safety climate.
Correlations below the diagonal are person-level correlations ($N = 61$). Correlations above the diagonal are day-level correlations ($N = 915$).
[a]1 = Male.
*$p < .05$; **$p < .01$.

Table 2. Multilevel models of acute fatigue

DV = acute fatigue	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables			β			
Intercept	.00	.00	.00	.00	.00	.01
Day-level main effects						
Sleep Quality		−.06**	−.05**	−.05**	−.05**	−.05**
Work Hours		.08***	.06**	.06**	.06**	.06**
Homework		.22***	.19***	.19***	.19***	.18***
Demands		.30***	.32***	.33***	.33***	.33***
Recovery		−.24***	−.28***	−.30***	−.30***	−.31***
Diary-level main effects						
PSC				−.73***	−.72***	−.74***
Person-level main effects						
Age					.19*	.18*
Gender[a]					.12	.12
Interaction effects						
PSC × Demands						−.22*
PSC × Recovery						−.20**
Model fit indices						
−2 × log likelihood	1914.16	1535.45	1465.55	1433.25	1423.93	1407.65
Δ −2 × log likelihood		378.71***	69.90***	32.30***	9.32**	16.28***
df		4	10	1	2	2
Level 3 intercept variance (SE)	.26 (.08)	.28 (.08)	.27 (.08)	.32 (.08)	.26 (.07)	.25 (.07)
Level 2 intercept variance (SE)	.46 (.07)	.39 (.05)	.43 (.06)	.30 (.04)	.30 (.04)	.30 (.04)
Level 1 intercept variance (SE)	.29 (.02)	.18 (.01)	.14 (.01)	.14 (.01)	.14 (.01)	.14 (.01)

PSC, psychosocial safety climate.
[a]1 = male.
*$p < .05$; **$p < .01$; ***$p < .001$.

Multilevel analyses of acute fatigue

Table 2 displays the results of testing predictors of acute fatigue. The variance components of Model 1 indicated that 25% of the variance in fatigue could be attributed to differences between individuals, 46% between diaries, and 29% between days. Thus, there was sufficient variation across the levels to continue with multilevel modelling. Each subsequent model led to a significant decrease in the −2log likelihood, indicating a better model fit for the data. Model 6 indicates that the control variable sleep quality had a significant negative relationship with fatigue, while work hours, homework, and age had significant positive relationships with fatigue.

There was a significant negative relationship between PSC and fatigue, while job demands had a significant positive relationship with fatigue. There was a significant negative interaction between job demands and PSC, which we plotted. Figure 2a shows that teachers' fatigue increased as job demands rose. For teachers working in schools with lower perceived PSC, fatigue increased more rapidly than in schools with higher perceived PSC, supporting Hypothesis 1.

Recovery had a significant negative relationship with fatigue, and there was a significant negative interaction between PSC and recovery, which we plotted. Figure 2b shows that teachers who achieved higher levels of recovery experienced a reduction in subsequent acute fatigue, and the reduction was larger for those working in schools with higher perceived PSC. Thus, Hypothesis 2 was supported.

Multilevel analyses of work engagement

Table 3 displays the results of testing predictors of work engagement. The variance components of Model 1 indicated that 30% of the variance in engagement could be

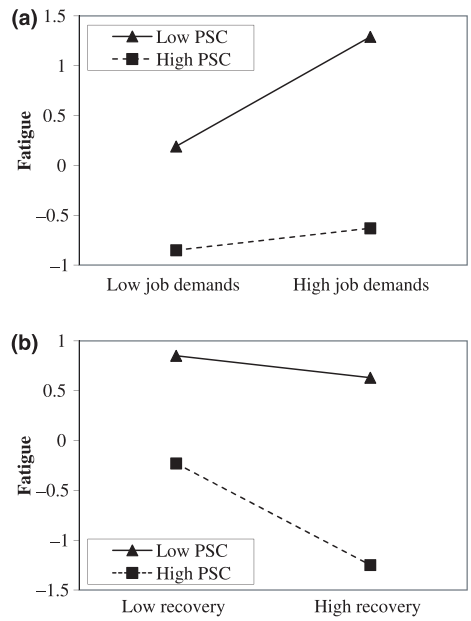

Figure 2. (a, b) Psychosocial safety climate (PSC) interactions with job demands and daily recovery for acute fatigue.

Table 3. Multilevel models of work engagement

DV = engagement	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables			β			
Intercept	.00	.00	.00	.00	.00	.00
Day-level main effects						
Sleep Quality		.05*	.04*	.04*	.04*	.04*
Work Hours		.01	.00	.00	.00	.00
Homework		−.04	−.02	−.02	−.02	−.01
Demands		.19***	.23***	.22***	.22***	.22***
Recovery		.62***	.67***	.68***	.68***	.69***
Diary-level main effects						
PSC				.39***	.39***	.35**
Person-level main effects						
Age					−.12	−.12
Gender[a]					.22***	.22*
Interaction effects						
PSC × Demands						.15**
PSC × Recovery						.28**
Model fit indices						
−2 × log likelihood	1942.78	1593.00	1358.01	1346.66	1340.52	1325.10
Δ −2 × log likelihood		349.78***	234.99***	11.35***	6.14*	15.42***
df		4	10	1	2	2
Level 3 intercept variance (SE)	.30 (.08)	.34 (.08)	.34 (.08)	.35 (.08)	.29 (.07)	.30 (.07)
Level 2 intercept variance (SE)	.39 (.06)	.29 (.04)	.32 (.05)	.29 (.04)	.29 (.04)	.29 (.04)
Level 1 intercept variance (SE)	.30 (.02)	.20 (.01)	.11 (.01)	.11 (.01)	.11 (.01)	.11 (.01)

PSC, psychosocial safety climate.
[a]1 = male.
*$p < .05$; **$p < .01$; ***$p < .001$.

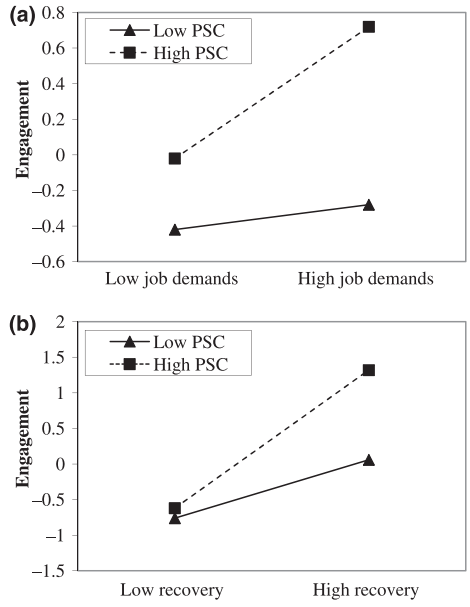

Figure 3. (a, b) Psychosocial safety climate (PSC) interactions with job demands and daily recovery for work engagement.

attributed to differences between individuals, 39% between diaries, and 30% between days. Thus, there was sufficient variation across the levels to continue with multilevel modelling. Each subsequent model led to a significant decrease in the −2log likelihood, indicating a better model fit for the data. Model 6 indicated that of the control variables, sleep quality and gender had significant positive relationships with engagement (i.e., men reported higher engagement than women).

Both PSC and job demands had significant positive relationships with engagement, and there was a significant positive interaction between PSC and job demands, which we plotted. Figure 3a shows that in schools with higher perceived PSC, teacher engagement increased as job demands rose, while in schools with lower perceived PSC, engagement levels remained relatively stable. Hypothesis 3 predicted a negative relationship between job demands and engagement, with PSC acting as a moderator. Our results found a positive relationship between job demands and engagement, although PSC did act as a moderator. Hence, Hypothesis 3 was partially supported.

Recovery and PSC had significant positive relationships with engagement, and there was a significant interaction between PSC and recovery, which we plotted. Figure 3b shows that teachers who achieved relatively high recovery experienced higher subsequent engagement, and the rate of this increase was larger for those in schools with higher perceived PSC. These findings supported Hypothesis 4.

Discussion

We used multilevel modelling to examine the impact of perceived school PSC, measured at the individual level, on daily levels of teacher engagement and fatigue. Two other key variables analysed were daily job demands and daily recovery. We proposed that teachers who perceived their school to have relatively higher levels of PSC would report fewer

negative impacts of job demands and increased restorative outcomes of daily recovery. Conversely, teachers at schools with lower perceived PSC would report increased negative consequences of job demands and reduced benefits from recovery. Our results supported these hypotheses. In accordance with previous research (Dollard & Bakker, 2010), PSC was negatively related to daily job demands and fatigue levels and positively related to work engagement. In addition to the analyses described in the Results section, we also assessed the subscales of engagement separately (vigour, dedication, and absorption) and found similar relationships for all three subscales. It should be noted that PSC had significant main effects on fatigue and engagement even after controlling for job demands. This finding differed from previous research, such as that of Dollard and Bakker (2010), who found that the main effect of PSC on psychological health problems became non-significant after controlling for job demands. Our results suggested a direct effect of perceived PSC on staff fatigue and engagement, over and above its role as a moderator of job demands. One possible explanation is that worker affect was impacted by perceptions of management care towards staff mental well-being, with flow-on effects to mental health (Shirom, 2011), although affect was not measured in this study.

Importantly, our results demonstrated perceived PSC as having moderator effects on both positive and negative worker psychological health outcomes, by buffering against the negative effects of daily job demands and boosting the beneficial effects of daily recovery. These moderator properties were consistent with previous theory and research (Dollard & Bakker, 2010; Idris & Dollard, 2011), although this was the first study to investigate the relationship between PSC and recovery, as well as the effects of PSC at a daily level. We also assessed for a possible three-way interaction effect between job demands, recovery, and PSC, but this was found to be not significant.

PSC moderating relationships involving fatigue

We found a moderator effect of perceived PSC on the relationship between daily job demands and fatigue. A significant interaction in the multilevel model between PSC and job demands demonstrated that teachers in schools with lower perceived PSC became more fatigued than teachers from schools with higher perceived PSC, when job demands increased. Potentially, workers in lower-PSC schools may have had access to fewer psychological resources to meet challenges, and so when job demands increased (and required further resource expenditure from an already smaller reserve), subsequent fatigue increased. Schools with higher perceived PSC may have signalled to workers that they could call upon additional workplace-derived psychological resources, resulting in relatively lower levels of fatigue when faced with high demands.

We also found that in schools with higher perceived PSC, teachers who achieved good daily recovery experienced lower levels of fatigue at work the next day compared with teachers in schools with lower perceived PSC. This likely reflected a consolidation of the personal resources provided by recovery and the resources that are made available (when needed) by the higher-PSC work environment itself, which enabled a worker to meet the next day's job demands with reduced fatigue. In schools with lower perceived PSC, levels of acute fatigue tended to remain relatively stable during the subsequent work shift, even if the individual teacher achieved good recovery. This suggests that work environments that failed to demonstrate adequate psychological care to employees weakened the benefits of daily recovery. This is a significant finding, as it is the first demonstration of PSC's contribution to the recovery – fatigue process in workers. Chronic fatigue and burnout can result when workers consistently fail to recover adequately from daily

work-related fatigue (Winwood *et al.*, 2006), and so efforts from management to help reduce fatigue in workers is crucial for avoiding serious long-term psychological injury. These results demonstrate an interaction between a worker's self-care during non-work time and the perceived workplace PSC, highlighting the important role of management in maximizing positive outcomes from employee recovery.

Job demands and work engagement

Surprisingly, job demands were positively related to work engagement, which was opposite to the direction we predicted. Positive relationships between job demands and engagement have been found in previous research, with a suggested explanation that job demands can be divided between job hindrances and job challenges (Crawford, Lepine, & Rich, 2010; Van den Broeck, De Cuyper, De Witte, & Vansteenkiste, 2010). Job hindrances are demands that are considered threatening obstacles; they are positively related to exhaustion and negatively related to engagement (Van den Broeck *et al.*, 2010). Job challenges are demands that still require energy expenditure, but are stimulating; they present opportunities for achieving mastery, personal growth, or future goals and so are positively correlated with both fatigue and engagement (Crawford *et al.*, 2010; Van den Broeck *et al.*, 2010). It is possible that our sample perceived the majority of job demands as stimulating challenges and so maintained engagement despite the impacts on fatigue. This cannot be determined, however, as we did not measure the quality of daily job demands encountered.

PSC moderating relationships involving work engagement

We found that perceived PSC moderated the relationship between job demands and engagement. The significant interaction in the multilevel model demonstrated that for teachers working in schools with higher perceived PSC, engagement increased at a greater rate in response to high job demands compared with teachers from schools with lower perceived PSC. Following from SET, our results suggested that PSC may have motivated teachers to invest additional personal resources to engage with increasing demands, in order to maintain reciprocity with an organization perceived as providing good psychological care (Cropanzano & Mitchell, 2005). Conversely, teachers in schools with lower PSC may have perceived relatively less access to psychological resources, and so engagement levels tended not to increase with higher job demands.

Our results showed that perceived PSC also moderated the relationship between daily recovery and work engagement. Teachers who achieved more recovery experienced more subsequent engagement, which is in accordance with previous research (Sonnentag, 2003; Winwood *et al.*, 2007). The finding unique to this study is that the positive relationship between recovery and engagement was stronger for teachers who reported higher PSC in their school. Work environments that failed to provide adequate psychological care to employees weakened the benefits of recovery; that is, adequate recovery from one shift resulted in only a small increase in engagement in the subsequent shift. In schools with higher perceived PSC, however, workers who achieved good recovery experienced a larger increase in engagement during the subsequent work shift. Work engagement is associated with both job resources and worker personal resources (Bakker, 2011). The interaction effect found in our results suggested that teacher personal resources accumulated via recovery

were consolidated in schools with higher perceived PSC, resulting in better engagement. Conversely, such resources were undermined in schools with lower perceived PSC, where workers reported a relatively smaller boost to engagement as a result of recovery. This finding supports PSC's importance in the motivation pathway of the JD-R model and introduces to this relationship the role of daily worker recovery, a variable external to the workplace that is nonetheless impacted by PSC when predicting performance-related outcomes.

Promoting PSC in the workplace

Our results suggest that strong PSC in schools minimizes the detrimental impact of job demands on fatigue and increases the benefits of worker recovery on fatigue and engagement. We also found that higher perceived PSC enhanced the positive relationship between job demands and work engagement. As PSC is a condition of the workplace determined by management, these results highlight a potentially rewarding avenue for school management and education departments to pursue towards improving teacher mental health. Dollard and McTernan (2011) note inconsistency between the work-stress literature and actual interventions; the former often focuses on identifying stressors related to the work environment, while the latter focuses on individual factors. Targeting PSC as a workplace intervention will tackle both elements – employees will have access to more psychological resources to meet daily job demands, and the recovery they achieve outside of work may yield boosted engagement, with likely flow-on effects to job performance (Rich *et al.*, 2010). Interventions that target worker healthy lifestyles as a means of coping with work-related stress should acknowledge the likely impact of workplace PSC on recovery-related outcomes. Recent research has suggested that matching specific types of job resources, demands, and off-job recovery (i.e., cognitive, emotional, and physical) may be important in predicting employee outcomes (De Jonge, Spoor, Sonnentag, Dormann, & Van Den Tooren, 2012). Hence, future studies investigating PSC interventions may benefit from more detailed measures of the types of job demands and resources targeted for change, to help tailor for particular occupations.

Strengths and limitations

This research has several strengths. Few studies have examined the role of PSC in employee well-being, while none have yet investigated its relationship with recovery. Most measurements were collected for five consecutive days at a time, reducing the problem of retrospective data. Another strength was the sample; teaching is a recognized high-stress occupation, and so this investigation is pertinent not only for teachers but potentially for other high-stress occupational groups.

Limitations of the present study included a potential self-selection bias, as well as the relatively small sample size, but this was compensated for by the 5-day design (resulting in 915 data points). Our data relied on self-report measures, and so there is a potential for common method bias. We also did not measure specific types of job demands encountered by participants (e.g., administrative, student behaviour management, etc.), which may have impacted the effects of PSC. Future investigations could shed further light on the role of PSC by differentiating between various forms of job demands. Due to the somewhat small sample derived from a relatively large number of schools, we did not aggregate PSC scores by school. This means that we were unable to measure

school-level factors, which may have influenced some of the between-individual-level effects. However, similar approaches to ours have been used in the past and derived significant results (Idris & Dollard, 2011). As PSC is based on individual worker appraisals of their organization and management, individual-level measurements of PSC were also justified. The structure of our analyses did not allow for causal inferences to be made, as the relatively small sample size restricted our ability to measure changes over time. However, while this study did not examine longitudinal changes, repeating measures over three separate weeks spread across the school year provided high-resolution data. This allowed for more representative fluctuations in variables across both daily and longer-term time periods, which was captured by the multilevel data analysis. Finally, the interaction terms testing perceived PSC's role as a moderator had generally small to medium effect sizes. However, this did not necessarily diminish the practical importance of the effects; efforts to improve PSC within schools could be a relatively low-cost endeavour with potentially large benefits, considering that the impacts on workers of inadequate recovery are likely to be cumulative over time (Coe, 2002; Glass, McGaw, & Smith, 1981).

Conclusions

The current study contributed to a better understanding of the significance of PSC in the workplace to workers' acute fatigue and work engagement on a daily level. This is one of relatively few studies investigating PSC and the only research as yet to explore the effects of its interaction with recovery, the restorative potential of which remains an under-researched area of work-stress experience. Theoretical contributions of this study included the support of PSC as a significant moderator within the broad JD-R framework, partially protecting workers from the negative outcomes of job demands. We also found that perceived PSC moderates work-stress recovery, such that the beneficial effects of daily recovery on fatigue and engagement are boosted when PSC is perceived to be high. Work conditions in any organization reflect the prioritized outcomes of senior management, as they are in charge of allocating resources and distributing tasks to employees (Idris & Dollard, 2011). Previous research indicates a lack of attention to workplace psychological health, as PSC is consistently lower in organizations than physical safety climate (Idris *et al.*, 2012). Our report emphasized the importance for management to promote strong PSC within their organization, as it presents an opportunity for changes to be made that will benefit employee mental well-being (Dollard & Karasek, 2010).

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