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The stressor–strain relationship in diary studies: A meta-analysis of the within and between levels

Shani Pindek[a], Maryana L. Arvan[b] and Paul E. Spector[b]

[a]Department of Human Services, University of Haifa, Haifa, Israel; [b]Department of Psychology, University of South Florida, Tampa, Florida

ABSTRACT

Daily diary studies use the same set of measures repeatedly for several days. Within the work stress domain, these studies are able to isolate the effects of daily exposure to stressors within people from the general level of stressors between people. This meta-analysis investigated both content-related and methodological aspects of workplace stressor–strain relationships in diary studies. Results from 55 unique samples (a combined sample size of 5409) indicated that the magnitude of the stressor–strain relationship was stronger at the between-person level than the within-person level. Further, when the stressor was measured prior to the strain (within the same day), the relationship was somewhat stronger than when stressor and strain were measured concurrently. This suggests that stressor–strain effects might take some time to fully manifest. Differences were also detected among types of strains: affective strains had stronger relationship with stressors than behavioural strains. There were also differences in the stressor–strain relationship depending on both the type of strain and the timing of their respective measurement (concurrent versus predictive), suggesting that certain strain responses require more time to manifest. Overall, this meta-analysis elucidates important considerations in the design and interpretation of diary studies on occupational stress.

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Meta-analysis; diary-study; work stress; stressor; strain

The study of job stress has long been dominated by research designs that compare people on relatively stable job stressors and strains. Although many of these studies introduce a temporal element through the use of longitudinal designs, their focus still remains on overall stressor–strain relationships. This trend has finally shifted in recent years, with occupational stress scholars increasingly employing daily diary designs that explore more episodic stress by assessing people's stressors and strains over successive days. Indeed, nearly 10% of studies published recently in top outlets for such research utilised daily diary or experience sampling designs (Spector & Pindek, 2016). These kinds of studies are well-suited to examine various theoretical explanations of the link between stressful workplace conditions (i.e. stressors) and proximal strain outcomes (i.e. psychological and physical decrements to well-being) that are expected to occur within the same work day. They can, therefore, help elucidate potential short-term stress responses

CONTACT Shani Pindek pshani@gmail.com

that underlie the stressor–strain relationships we observe in more traditional cross-sectional and longitudinal studies. Further, their focus on the relatively immediate impact of workplace stressors can help inform the optimal time frame for interventions. Finally, a key advantage of diary studies is that they allow for the separation of relationships between variables to their between-person and within-person components. These components are independent of each other and have different theoretical meanings, as within-person indicates if high stressor days are associated with high strain days, whereas between-person indicates if people high on stressors are also high on strains. Despite their implications for theory building and interventions, however, there has presently been no systematic investigation of the multilevel relationships found in diary studies within the job stress literature. Consequently, many questions regarding the magnitude of various stressor–strain relationships have not yet been answered, and the extent to which relationships found in diary studies converge with those found in traditional between-person designs remains uncertain.

In the current paper, we discuss a meta-analysis that provides a comparison of the magnitude of the stressor–strain relationship (1) when it is inter-individual versus when it is intra-individual, (2) when stressor and strain are measured at the same time in the day (i.e. a concurrent relationship) versus when the stressor is measured prior to the strain (i.e. a predictive relationship), and (3) across separate categories of stressors and strains, which allows us to discuss differential effects for stressors and strain responses. Combined, the results of this meta-analysis provide a deeper understanding of workplace stressor–strain relationships as they unfold in diary studies, particularly regarding how stressors and strains are associated within each day, and for individuals as a whole.

Within-person and between-person levels of the stressor–strain relationship

Diary studies require participants to complete the same set of measures regarding a limited timeframe (e.g. the workday) over the course of several days, creating daily scores that are nested within individuals. Assuming no missing data, for each variable in a given diary study, there are j observations for each of the n participants, making a total of j times n observations. The total variability among the observations can be partitioned into a within-person component reflecting variance across days within individuals, and a between-person component that reflects variability across people in their aggregated (averaged) daily scores (Enders & Tofighi, 2007). The within-person variance can be computed by group-mean centring, thus calculating the variance and covariance for computing correlations around each person's own mean. This removes variability due to differences among people, because only variance among days for each person's own scores is assessed. The variances and covariances are then pooled across people. The between-person variance can be computed by first averaging across days for each person, and then computing the variance and covariance among the average scores. In this case, the variability across days is ignored because only a single average is used for each person. The two components of the variance and covariance address different questions and reflect different things. Within-person addresses whether individuals experience more strain on days of more stressors. It thus indicates the more episodic effects of stressors on strains. Between-person addresses whether people who generally have more stressors experience more strains. By itself, it is unable to disentangle whether relationships among people are due to differences in the objective

work environment or to individual differences. The within-person component controls for individual differences by group-mean centring. The between-person component removes the effects of daily fluctuations which get averaged away in the total scores. The two components are therefore mathematically orthogonal (Enders & Tofighi, 2007).

Although it is possible that relationships among stressors and strains are similar for the between and within components, this is not a foregone conclusion, as they reflect different things. In fact, relationships across levels can even be opposite. For example, consider the case of the relationship between typing speed and typing accuracy (i.e. fewer typing errors). At the within-person level, we can expect a negative relationship between typing speed and accuracy, because individuals who type faster than usual are likely to be less accurate than usual (i.e. make more typing errors). However, at the between-person level, we can expect a positive relationship between typing speed and accuracy, because individuals with higher levels of typing skill are likely both faster and more accurate in their typing than individuals with lower levels of typing skill (Hamaker, 2012).

Given that stressor–strain relationships can differ in magnitude when examined within or between individuals, it is important for theorising and empirical research to explicitly consider the level of analysis. From a theoretical perspective, we argue that the stressor–strain relationship has a different meaning at each level. At the within-person level, the relationship represents an episodic strain response to a specific stressful event. Many of these events represent exposure to acute episodes; that is, events that might occur occasionally, but are not necessarily enduring aspects of the job. The between-person level represents more stable conditions that are endemic to the work environment, as well as individual differences in perceiving the stressfulness of one's overall experiences on the job: for some individuals, the levels of both stressors and strains are higher than for other individuals. Some interplay between the within and between levels is to be expected, as chronic exposure is in many ways the accumulation of individual acute events. However, some stable conditions are more or less constant. For example, having inadequate resources can be a more-or-less constant issue that employees encounter each day.

Many influential occupational stress theories focus on one level of analysis, and thus implicitly account for the conceptual differences between the two levels of analysis in the stressor–strain relationship. However, the levels issue is often not considered in the testing of these stress models and theories. Furthermore, most empirical findings are conducted entirely at the between-person level and are essentially summary judgments of one's job, and not the aggregation of daily experiences, with a number of meta-analyses summarising results of the general stressor–strain relationship (e.g. Ford et al., 2014; LePine, Podsakoff, & LePine, 2005) and the relationships between specific stressors and strains (e.g. Bowling, Alarcon, Bragg, & Hartman, 2015; Nixon, Mazzola, Bauer, Krueger, & Spector, 2011; Pindek & Spector, 2016b). One example of an influential theory that has been tested across multiple levels of analysis is the job demands-control-support (JDCS) model (Karasek & Theorell, 1990), which specifies job demands, control, and support as the key determinants of strain. The original framework suggests a between-person approach, as it stipulates that jobs characterised by high demands and low levels of control are "high strain" jobs (Karasek, 1979). A vast majority of studies utilising the JDCS model have been conducted at the between-person level of analysis (Morrison, Payne, & Wall, 2003). However, several studies have found that the JDCS is best conceptualised at the intra-individual level (e.g. Beal, 2012), arguing that a

strain is often affected by a person's experience of a higher or lower level of stressors than usual, more than by their average stressor level. This model has been tested with the within-person approach on other occasions (e.g. Daniels, Boocock, Glover, Hartley, & Holland, 2009). Another theory commonly used in the job stress literature, the transactional model of stress (Lazarus & Folkman, 1984), focuses on episodic stress and therefore focuses its predictions on the within-person level of analysis. This model argues that the relationship between job stressors and strains is a dynamic process shaped by individuals' specific appraisals of an event as stressful, and ongoing attempts to cope with the stressor. However, the transactional model of stress has often been applied at the between-person level of analysis (e.g. Zhang, LePine, Buckman, & Wei, 2014).

Overall, stress theories often focus on the within or between level of analysis when explaining the effects of stressors. However, they generally lack a conceptual multilevel framework, and have therefore been applied to both levels interchangeably in existing research. Furthermore, although previous findings indicate that a positive stressor–strain relationship should occur at both the within and between levels of analysis, the question of the comparable magnitude of those relationships remains largely unanswered. As no current theory deals directly with the two components of the stressor–strain relationship in a comparative manner, we base our arguments on separate conceptualisations of these levels rather than on one overarching theory.

There is a theoretical reason to expect stronger between-person than within-person stressor–strain relationships. Specifically, work conditions that are more stable impact the between level and conditions that are less stable impact the within level. However, personal characteristics only affect the between-person level, and the between-person level therefore has more sources of systematic variance than the within-person level. For example, trait negative affectivity (NA) or neuroticism might strengthen between-person stressor–strain relationships. Job stress researchers have long recognised the role of NA in reports and experiences of job stressors and strains (e.g. Chen & Spector, 1991; Spector, Zapf, Chen, & Frese, 2000; Watson, Pennebaker, & Folger, 1987). There are a number of substantive explanations for why high-NA individuals report higher (average or between-person) levels of stressors and strains. These include a perception mechanism in which high-NA individuals are more likely to interpret work events as stressful, a hyperresponsivity mechanism in which high-NA individuals experience exaggerated strain responses to stressors, and a selection mechanism in which high-NA individuals hold more stressful jobs than low-NA individuals (Spector et al., 2000). Since NA is a stable individual difference, we would expect that its effects on the stressor–strain relationship (as well as the effects of other relevant personality variables in the job stress process, such as locus of control; Wang, Bowling, & Eschleman, 2010) would occur only at the between-person level, as the within-person level controls for individuals' average or typical levels of stressors and strains. Accordingly, we present the following hypothesis:

Hypothesis 1: Between level stressor–strain correlations are stronger than the corresponding within level correlations.

Stressor–strain time precedence within the day

Some diary study designs ask their participants to answer questionnaires more than once per day, which creates the opportunity to predict an outcome measured several hours after

the predictor within each day. This design feature provides the opportunity to compare the stressor–strain relationship in diary studies when the stressor and strain are measured concurrently (in the same questionnaire) versus when they are measured predictively (the stressor is measured prior to the strain). A number of stress theories discuss the deterioration of effects over time (e.g. Frese & Zapf, 1988). In support of this general idea, a recent meta-analysis of longitudinal studies on stressors and strains (Ford et al., 2014) found that while synchronous (i.e. concurrent) effects that are assessed more than once increased over time (indicating that there is an effect for cumulative exposure to chronic stressors), lagged (i.e. predictive) effects were generally small. Although its results provide important insight into how stressor–strain relationships unfold over time in longitudinal studies, Ford et al.s' (2014) meta-analysis was not designed to address how concurrent versus predictive effects might vary within persons over a shorter time frame. Furthermore, the question of how time influences the within-person effects observed in diary studies is infrequently considered in diary research itself (Bolger, Davis, & Rafaeli, 2003).

Frese and Zapf's (1988) theoretical models provide some insight into this question by describing various within-person trajectories of how stressors may result in strains, with some strains taking as long as a few years to fully manifest (e.g. the sleeper effect model), and other strains occurring immediately (the initial impact model). The initial impact model is the most relevant to diary research because the time span of participation in diary studies is typically short, and both stressor and strain are measured during the same day. This model argues that upon experiencing a stressor, a physiological strain response (e.g. hormonal response) occurs that activates the internal resources needed to cope with the situation. After some initial exposure to the stressor, however, there is a decline in strain simply because the human body is depleted of its physiological strain drivers (Dormann & van de Ven, 2014). The strain response, therefore, deteriorates over time due to the process of physiological adaptation. Another of Frese and Zapf's (1988) models, the stress reaction model, holds that compromised health in response to a stressor begins to improve as soon as the stressor is removed (Dormann & van de Ven, 2014). Within the context of a daily diary study, this model entails that impaired health from a stressor experienced during the work day might return to normal levels by the evening or the following morning, with health increasing to equilibrium as the distance (in time) from the experienced stressor increases. Whether through physiological adaptation or the removal of a stressor, both of these models can be used to argue that within level stressors and strains measured concurrently within a diary study will demonstrate stronger relationships than when measured predictively. Since each variable is aggregated to the person level in order to calculate between level correlations, there is no reason to expect this pattern to emerge at the between level.

Hypothesis 2: Concurrent stressor–strain correlations are stronger than predictive correlations at the within level.

Magnitude of the Stressor–strain relationship by type of stressor and strain

In the work stress literature, emotions are thought to play a critical mediating role in the stress process. In fact, scholars have argued that the elicitation of negative emotions is the

feature that defines a particular situation or event as a job stressor (Spector & Goh, 2001). Emotional strains (i.e. negative emotions) are a direct response to stressors that are thought to create cognitive, motivational, and/or physical pathways to distal outcomes such as behavioural strains, poorer job attitudes, and physiological stress reactions (Fox, Spector, & Miles, 2001). While the emotional response is considered immediate, the linkages between negative emotions and more distal strains may take time to develop. Therefore, at the daily level, emotional strains should relate more strongly to job stressors than other forms of strains. Previous meta-analyses have presented inconsistent evidence that emotional strains correlate more strongly with stressors than other kinds of strains (Bowling et al., 2015; Pindek & Spector, 2016b). However, these meta-analyses synthesised results from mostly single survey cross-sectional designs, in which retrospective bias is a concern and it is not possible to tease apart which effects are more immediate than others. Diary studies, in contrast, are more sensitive to the relatively immediate and transient nature of emotional reactions to job stressors over time (Ganster & Rosen, 2013). It is also important to note that because affect is highly variable within individuals and sensitive to everyday events that occur on the job, it does not lend itself as meaningfully to analyses at the between-person level (Beal, Weiss, Barros, & MacDermid, 2005; Weiss & Cropanzano, 1996). Therefore, we expect that at the within level, stressors will have stronger correlations with emotional strains than with other strains that may take longer to fully manifest.

Hypothesis 3: Stressor–strain correlations are stronger for emotional strains than other strains at the within level.

As previously noted, the type of strain may play an important role in determining the magnitude of relationships observed in diary studies. Similarly, the type of stressor may also affect the nature of the relationships observed. We, therefore, consider an additional content aspect of diary studies: the types of stressors and strains in our analysis. We investigate whether specific stressors, specific strains, and broader categories of stressors and strains reveal significantly different relationships from the overall stressor–strain relationship. One such categorisation of stressors is the challenge-hindrance framework, which argues that stressors belong to one of two broad categories: challenge stressors, which have the potential to promote personal growth and mastery, and hindrance stressors, which have the potential to impede personal or work-related accomplishment (Cavanaugh, Boswell, Roehling, & Boudreau, 2000). Examples of challenge stressors include workload and time pressure, whereas hindrance stressors include mistreatment and organisational constraints. Consistent with the general predictions of the model, meta-analytical findings (based primarily on cross-sectional studies) have indicated that hindrance stressors have stronger relationships with strains than challenge stressors (LePine et al., 2005). Apart from the challenge-hindrance framework, however, most theories of occupational stress treat stressors interchangeably and fail to distinguish how the stress process might differ across distinct stressors. We, therefore, explore differences in the stressor–strain relationships of different individual stressors, as well as these broader categories of stressors.

Since we are constrained by the number of studies and variables included in eligible primary studies, we do not make predictions about the relationship between specific stressors and specific strain variables apart from Hypothesis 3 regarding emotional strains. We therefore conduct exploratory analyses of the relationships between specific stressors and

strains across both the within and between levels, allowing us to investigate whether patterns are consistent across various stressors and strains, or whether specific variables demonstrate distinct patterns.

Research Question 1: Are there differences in the stressor–strain relationship depending on the type of stressors and strains?

Another issue is the combination of separating the time precedence in the measurement of stressors and strains (i.e. concurrent vs. predictive), and separating the type of strain (i.e. affective versus behavioural/physical). One possibility is that the effects of time precedence and the effects of type of strain are merely additive. Alternatively, a combination of these two features (time precedence and type of strain) may reveal new information. It is possible, for example, that time precedence within the day will be more meaningful for affective strains, which take a relatively short time to develop, as opposed to when the strain takes longer to manifest, as is the case with behavioural and physical strains. This follows the same theoretical grounding as Hypothesis 3, whereby physical/behavioural strains may take more than a few hours to manifest, rendering the separation of stressor and strain measurement within a day less relevant.

Research Question 2: Do the specific time precedence and type of strain interact in determining effect sizes between stressors and strains?

Method

Literature search

Our literature search was conducted in the PsycInfo and Web of Science databases, and included results through 17 July 2016. We used the following Boolean phrase: ("diary stud*" OR "daily diary" OR "within-person" OR "experience sampling") AND (work OR employee* OR organisation). Our search terms produced 840 results in PsycInfo and 197 results in Web of Science. We also searched through the programmes of the AOM, SIOP, and Work, Stress, and Health conferences held over the prior two years.

We defined job stressors as conditions in the environment requiring an adaptive response from the employee (Beehr & Newman, 1978; Jex & Beehr, 1991), such as time pressure and mistreatment. We defined strains as negative reactions to job stressors that could fall into the following broad categories: emotional, attitudinal, physical, and behavioural. We identified 53 articles with 55 unique samples (a combined sample size of 5409, with a median, minimum and maximum sample size of 94, 32 and 234, respectively) that met our criteria. In those 55 samples, we found 266 relevant coefficients (133 for each level, within and between).

In cases where articles reported level 1 correlations that disregarded nesting within individuals, we contacted the authors to request appropriate within-person correlations. We obtained previously unpublished within-person correlations for four of our identified studies.

Inclusion criteria

In order to be included, studies had to use a quantitative diary design where individuals made ratings of stressor and strain levels repeatedly for several days. For example, a

study would be included if it had measures of workload as a stressor and fatigue as a strain which participants rated every day for 5 work days. Additionally, studies had to report both within-person and between-person stressor–strain correlations for the same pairs of stressor–strain variables. We only included studies that had within-person level measures that were assessed daily, and excluded studies that used longer lags between their within-person measures. Therefore all level 1 assessments (i.e. the within-person level) represented days, and level 2 assessments (i.e. the between-person level) represented people.

We excluded correlations on sleep and work–family conflict, as both constructs are not clearly distinguished either as a predictor or an outcome of work stress. We also excluded physiological measures of strain (e.g. cortisol levels), as there were very few samples reporting them ($k < 3$). Finally, we excluded cases where the measurement of strain preceded the measurement of stressor because there was an insufficient number of studies ($k = 3$) to analyse separately.

Coding procedure

When calculating each meta-analytic effect size, if more than one relevant stressor–strain correlation was reported for each level (within and between) in a sample, the relevant correlations were averaged prior to the meta-analytic calculation. This ensured that only one study-wise correlation was used to calculate each meta-analytic effect size. For example, if a study measured two different types of emotional strain, the two correlations were averaged before calculating the meta-analytic effect size between stressors and emotional strains. Further, if a study included correlations that belong to different categories, those would be coded separately. For example, if a study reported both concurrent and predictive relationships, the different correlation estimates from that study would appear in the concurrent and predictive analyses, respectively. Their average would appear in the overall analysis.

We coded the sample size at the between level as the number of individuals who participated in the study. The median sample size at the between level was 94. The sample size at the within level is the total number of daily measurement points across all individuals (with a theoretical maximum that is the product of the number of participants and number of data points in the diary study). The median sample size at the within level was 691, and the median number of days in the diary studies was 10 (the number of days ranged from 3 to 30).

Our hypotheses and research questions required us to create categories of stressors and strains. The following stressors were categorised as challenge stressors: challenge stressors, cognitive/ mental/ physical/problem-solving demands, work/job demands, control/autonomy, job complexity, and workload/time pressure. Hindrance stressors included: hindrance stressors, abusive supervision, bullying/social exclusion, interpersonal conflict, constraints/interruptions, customer injustice/mistreatment, surface acting/emotional dissonance/self-control demands, illegitimate tasks, incivility, interactional justice/supervisor injustice, job insecurity, role/task conflict, negative events, social stressors, unpleasant work conditions, unfinished tasks, and task ambiguity.

The following strains were categorised into the affective strain category: negative affect, mood, anger, anxiety, embarrassment, irritation, affective distress (these are also the

strains used in the narrower "emotional" category used to test Hypothesis 3), mental health complaints, rumination, worries, affective well-being, emotional exhaustion, burnout, fatigue, ego depletion, job satisfaction, and need for recovery. Behavioural/physical strains included: counterproductive work behaviours (CWB), and health/physical distress/physical fatigue/physical symptoms.

Meta-analytic procedures

We followed Hunter and Schmidt's (2004) random effects meta-analytic approach to calculate the main stressor–strain effect size for each subset of studies described above. We implemented the meta-analytic formulas (Borenstein, Hedges, Higgins, & Rothstein, 2009; Brannick, 2005) in R ourselves, and added an automated creation of the table of results to minimise the chances of any human error at that stage.

We calculated the number of samples included in the analysis (k), the combined sample size (N), the estimated sample-size-weighted average correlation ($\bar{r}$), the population estimate corrected for unreliability in the criterion (ρ), the standard deviation of the corrected population estimate (SD_ρ), and the 95% confidence interval (CI) and 80% credibility interval (CR) around the corrected population estimate (ρ). Note that the combined sample size has a different meaning at the between and within levels: at the between level it reflects the number of participants, but at the within level it reflects the number of data points (i.e. the number of participants multiplied by the number of days the diary study was carried out, when there are no missing data). The 95% CI reflects the range of possible values that has a .95 probability of including the population parameter in question. Furthermore, when the CI does not contain zero, ρ is said to be significant. The 80% CR indicates whether ρ has possible moderators (i.e. when the CR is wide), or whether ρ is unlikely to be moderated by other variables (i.e. when the CR is narrow).

Results

The results of the meta-analysis are presented for the corresponding within and between relationships in Table 1. We conclude that correlation A is significantly different from correlation B when correlation A is outside the CI for correlation B. In some cases when using this method, it is possible to find that correlation A is outside the CI for correlation B, but correlation B is not outside the CI for correlation A. When significance is not evident in both directions, we cannot be sure if the difference between correlations A and B is significant or not. As can be seen in Table 1, the overall stressor–strain relationship was significantly stronger for the between level (ρ = .35, CI = [0.30, 0.40]) than the within level (ρ = .23, CI = [0.20, 0.26]), thus supporting Hypothesis 1. Furthermore, 12 of the remaining 16 effect sizes calculated based on subsets of the data in this meta-analysis supported this pattern, despite the fact that they were based on smaller ks and Ns, with lower power to detect differences.

We next examined our hypothesised differences between subsets of the data: measurement precedence and type of stressor and strain. At the within-person level, concurrent relationships were not significantly different from predictive relationships, but the pattern was opposite to that in hypothesis 2, which predicted that at the within-person

Table 1. Meta-analytic results of the stressor–strain relationship for different subsets of the data.

		Within level						Between level					
	k	*N*	$\bar{r}$	ρ	SD_ρ	CI	CR	*N*	$\bar{r}$	ρ	SD_ρ	CI	CR
Overall	55	51,218	0.21	0.23	0.11	[0.20, 0.26]	[0.08, 0.37]	5409	0.32	0.35	0.15	[0.30, 0.40]	[0.15, 0.55]
By Precedence													
Concurrent	38	37,321	0.20	0.22	0.12	[0.18, 0.26]	[0.07, 0.37]	3773	0.32	0.35	0.10	[0.30, 0.39]	[0.21, 0.48]
Predictive	26	18,533	0.24	0.26	0.11	[0.21, 0.30]	[0.11, 0.40]	2455	0.32	0.34	0.20	[0.26, 0.43]	[0.09, 0.60]
By Stressors													
Challenge	22	19,658	0.19	0.21	0.1	[0.17, 0.25]	[0.09, 0.33]	2203	0.28	0.31	0.17	[0.23, 0.39]	[0.09, 0.52]
Hindrance	39	35,430	0.21	0.22	0.12	[0.18, 0.26]	[0.06, 0.38]	3793	0.34	0.35	0.16	[0.29, 0.41]	[0.15, 0.55]
Workload	13	5892	0.20	0.21	0.12	[0.14, 0.29]	[0.06, 0.37]	1162	0.24	0.26	0.09	[0.19, 0.34]	[0.15, 0.37]
Mistreatment	13	17,043	0.18	0.2	0.13	[0.12, 0.27]	[0.03, 0.36]	1366	0.29	0.31	0.15	[0.21, 0.41]	[0.11, 0.50]
Surface Acting	7	6382	0.24	0.26	0.12	[0.17, 0.35]	[0.11, 0.41]	573	0.43	0.46	0.18	[0.31, 0.61]	[0.23, 0.69]
By Strains													
Affective	53	50,817	0.24	0.26	0.10	[0.23, 0.29]	[0.13, 0.39]	5134	0.34	0.37	0.15	[0.32, 0.42]	[0.18, 0.56]
Behavioural/Physical	18	22,174	0.10	0.11	0.12	[0.06, 0.17]	[−0.04, 0.26]	1740	0.24	0.26	0.18	[0.16, 0.36]	[0.03, 0.49]
Physical	10	6350	0.17	0.19	0.16	[0.09, 0.29]	[−0.01, 0.39]	797	0.24	0.27	0.19	[0.13, 0.41]	[0.02, 0.52]
Job Satisfaction	9	6726	0.21	0.23	0.09	[0.16, 0.29]	[0.11, 0.35]	781	0.31	0.33	0.27	[0.14, 0.52]	[−0.01, 0.67]
CWB	5	9229	0.04	0.05	0.05	[0.00, 0.10]	[−0.02, 0.11]	564	0.18	0.2	0.12	[0.06, 0.33]	[0.04, 0.35]
Anxiety	6	5288	0.21	0.22	0	[0.20, 0.25]	[0.22, 0.22]	635	0.27	0.29	0	[0.23, 0.35]	[0.29, 0.29]
Anger	6	4976	0.24	0.26	0	[0.24, 0.28]	[0.26, 0.26]	731	0.35	0.37	0	[0.31, 0.43]	[0.37, 0.37]
Fatigue	18	18,062	0.22	0.23	0.11	[0.18, 0.29]	[0.09, 0.38]	1746	0.38	0.4	0.17	[0.31, 0.49]	[0.19, 0.62]
Emotional	30	32,058	0.24	0.26	0.10	[0.22, 0.29]	[0.13, 0.38]	3027	0.31	0.34	0.08	[0.29, 0.38]	[0.24, 0.43]

Notes: *k* is the number of unique samples, *N* is the total number of observations, $\bar{r}$ is the estimated average correlation, ρ is the corrected population estimate, SD_ρ is the standard deviation of the corrected population estimate, CI is the 95% confidence interval, CR is the 80% credibility interval.

level, concurrent relationships would be stronger than predictive relationships. Hypothesis 2 was therefore not supported.

In terms of the type of strain, we found that at the within level, the category of emotional strains ($\rho = .26$, CI = [0.22, 0.29]) and two discrete emotional strain variables (anxiety and anger) had stronger stressor–strain relationships than the strain outcomes of CWB ($\rho = .05$, CI = [0.00, 0.10]), and the combined behavioural/physical strains category ($\rho = .11$, CI = [0.06, 0.17]), but not significantly stronger than the discrete category of physical strain ($\rho = .19$, CI = [0.09, 0.29]). Furthermore, when expanding the emotional strains subset of the data to include all affective-related strains, the within relationship was still stronger than that of behavioural/physical strains. The stability in this pattern of results across different levels of specificity, from discrete emotions to broader emotional and affective strain categories, provides support for Hypothesis 3 and some insight into Research Question 1.

To further our investigation of Research Question 1, we compared the stressor–strain relationship across challenge and hindrance stressors. At the within level, we found that challenge and hindrance stressors were not significantly different in their correlation with strain (challenge $\rho = .21$, CI = [0.17, 0.25], hindrance $\rho = .22$ CI = [0.18, 0.26]). We also detected no differences at the between level. We next investigated Research Question 2 by testing subsets of the data based on time precedence and type of strain. Specifically, we examined whether the differences found between concurrent and predictive relationships and the differences found between emotional and other strains would hold when combining those restrictions (creating a two by two comparison). As shown in Table 2, we found that the difference between concurrent and predictive relationships at the within level was only significant for emotional strains ($\rho = .24$, CI = [0.20, 0.28] for concurrent relationships and $\rho = .29$, CI = [0.26, 0.33] for predictive relationships). There was no significant difference between concurrent and predictive relationships for behavioural /physical strain ($\rho = .12$, CI = [0.05, 0.19] and $\rho = .08$, CI = [0.01, 0.15], respectively).

Discussion

This study aimed to quantitatively cumulate what we have learned from diary studies about the relationship between stressors and strains. The unique attributes of diary designs allowed us to answer important questions that were previously unexplored, such as how the level of analysis (within or between individuals) and the temporal nature of measurement shape the strength of the relationships between various stressors and strains over a short period of time.

The within and between levels

Our hypothesis that the overall stressor–strain relationship at the between-person level would be stronger than at the within-person level was supported. This difference can be attributed, at least in part, to a psychometric explanation: there is reduced error at the between-person level, compared to the within-person level, which can disattenuate the relationships (Ostroff, 1993). However, there are substantive explanations for the stronger between level relationships. In the occupational stress domain, one conceptualisation is that between level relationships represent the effects of stable job conditions, whereas

Table 2. Meta-analytic results of the stressor–strain relationship for combinations of time precedence with type of strain

		Within level						Between level					
Precedence and type of strain	*k*	*N*	$\bar{r}$	ρ	SD_ρ	CI	CR	*N*	$\bar{r}$	ρ	SD_ρ	CI	CR
Concurrent-Emotion	37	36987	0.22	0.24	0.11	[0.20, 0.28]	[0.10, 0.38]	3669	0.33	0.35	0.12	[0.30, 0.40]	[0.20, 0.50]
Predictive-Emotion	23	16,768	0.27	0.29	0.08	[0.26, 0.33]	[0.20, 0.39]	2160	0.35	0.38	0.19	[0.29, 0.47]	[0.13, 0.63]
Concurrent – Behavioural/Physical	12	17,755	0.11	0.12	0.12	[0.05, 0.19]	[−0.03, 0.27]	1223	0.27	0.30	0.18	[0.18, 0.42]	[0.07, 0.53]
Predictive – Behavioural/Physical	8	5745	0.07	0.08	0.09	[0.01, 0.15]	[−0.04, 0.20]	744	0.18	0.20	0.14	[0.07, 0.32]	[0.01, 0.38]

Notes: *k* is the number of unique samples, *N* is the total number of observations, $\bar{r}$ is the estimated average correlation, ρ is the corrected population estimate, SD_ρ is the standard deviation of the corrected population estimate, CI is the 95% confidence interval, CR is the 80% credibility interval.

within level relationships represents short-term situational effects. As such, stressors and strains are inherently multilevel constructs, consisting of daily stressor episodes and associated strains, plus enduring environmental and individual characteristics. Trait NA, for example, shares variance with both stressors and strains, and is thought to play an important role in the stress process through a variety of mechanisms (Spector et al., 2000). In cross-sectional studies, global judgments of levels and frequency of stressors and strains can be influenced by both daily stressor–strain episodes and more enduring characteristics of people and workplaces, though some have argued this relationship is driven mainly by NA (Watson, Pennebaker, & Folger, 1987). Although smaller in magnitude, the significant within level correlations found in this meta-analysis demonstrate that there are other meaningful aspects to the stressor–strain relationship besides NA, as NA only influences the between level, and within level efffects represent entirely different information.

This meta-analysis highlights that aspects of stressful work situations can be stable (reflected at the between level) or episodic (reflected at the within level), and quantifying the extent to which the stressor–strain relationship reflects stable person-level elements versus transient elements can be very useful for researchers and practitioners. Also useful would be a more nuanced investigation of the relationships between specific stressors and strains in terms of the relative portions of variance explained at the within and between levels: for some stressors and strains, the immediate within-person response might be more important, whereas for others, the aggregated experiences and/or individual traits might account for most of the stressor–strain relationship. For example, employees may habituate to more chronic stressors, but have severe strain responses (and less developed coping strategies) to stressors that are rare and unexpected.

It is also informative to briefly compare our results on the overall stressor–strain relationship to those found in other meta-analyses. A recent meta-analysis of the stressor–strain relationship in longitudinal studies (Ford et al., 2014) also reported the concurrent (synchronous) correlations at two time points (because the meta-analysis only included longitudinal studies, there were two time points in every primary study, and therefore two concurrent correlation estimates). The average concurrent corrected correlation they found was .36, based on 91 studies with a combined sample size of 24,844 individuals. This correlation is a meaningful comparison point for the one obtained in our study, as it combined a similar list of stressor and strains to create a general estimate of the stressor–strain relationships. When we compare this cross-sectional estimate with our between and within corrected estimates of the same relationship (.35 and .23, respectively), it is evident that our between level correlation is closer in magnitude to the Ford et al. cross-sectional correlation. Although cross-sectional correlations are closer conceptually to the between level component, is important to note that some differences are to be expected between cross-sectionally assessed stressors and strains, using one-time summary judgments of one's job experiences and strains, and the diary study approach in which the individual level of stressors and strains is an aggregation of their daily experiences.

Time precedence within the day

Our hypothesis that concurrent correlations would be stronger than predictive correlations (Hypothesis 2) was not supported, and in fact there was a nonsignificant trend

in the opposite direction, such that predictive stressor–strain relationships were *stronger* than concurrent ones. This fits with the dynamic accumulation model of stress, whereby the levels of strain continue to increase after the stressor has been removed (Dormann & van de Ven, 2014; Frese & Zapf, 1988). One possible explanation is that stressors accumulate during the day, and it may take some time for the full strain response to be felt. For example, mechanisms such as rumination have been used in the past to explain how emotional responses to stressors may increase over time (e.g. Wang et al., 2013). Similarly, employees with stressful work environments report experiencing difficulty detaching from work during later, non-working hours (Sonnentag, Binnewies, & Mojza, 2010), which may serve as a mechanism for their heightened experiences of strain at subsequent time points.

Relevant to this discussion is information revealed in relation to Research Question 2, which aimed to explore the interplay between the type of strain and the difference between concurrent and predictive stressor–strain relationships (at the within level). We found that the difference between concurrent and predictive stressor–strain relationships was only significant for emotional strains, and not for behavioural/physical strains. This can be attributed to the same rumination mechanisms previously discussed (e.g. Wang et al., 2013), whereby negative emotions intensify in the interval between the occurrence of the stressor and the measurement of the strain. When it comes to behavioural/ physical strains, however, the effects of stressors may take longer than a single working day to fully manifest, or dissipate quickly during the day, making it less impactful to separate the measurement of stressors and strains.

Type of stressor and strain

Hypothesis 3 was supported, as we found that emotional strains were more strongly related to stressors than behavioural or physical strains at the within level. This finding is in line with theoretical perspectives that view emotional reactions as playing a critical mediating role between stressors and more distal strain reactions. Furthermore, our results reinforce the view advanced by Affective Events Theory (Weiss & Cropanzano, 1996) that the link between stressors and emotions is most meaningfully investigated at the intra-individual level. Given their immediacy and sensitivity to fluctuations in stressors, we see value in continuing research that utilises emotional strains as a mediator between job stressors and more distal strains within the context of daily diary research.

We found mixed results pertaining to Research Question 1 regarding whether specific stressors and strains influenced the magnitude of the stressor–strain relationship. Our findings were consistent regarding the type of strain. In terms of stressors, however, we did not replicate the different stressor–strain relationships for challenge stressors and hindrance stressors that were found in previous meta-analyses (Crawford, LePine, & Rich, 2010; LePine et al., 2005; Podsakoff, LePine, & LePine, 2007) at either the within-person or between-person levels. Considering a more recent meta-analytic attempt to replicate the results which largely found no differences between the effects of challenge and hindrance stressors on strains (Mazzola & Disselhorst, 2017), it may be that the individual appraisal of a stressor as a challenge or a threat is what explains differences in the relationship with strains (Pindek & Spector, 2016a). Indeed, a recent diary study found that these distinct appraisals of stressors differentially related to strains (Tuckey, Searle,

Boyd, Winefield, & Winefield, 2015), providing further support for the idea that stressors are not inherently a challenge or a hindrance in terms of their overall effects on strain. Instead, the appraisal of a specific stressor event as a challenge or hindrance in a given context may be key to observing different patterns with strains. It would be informative for future research to explicitly test the predictions of the challenge-hindrance stressor framework, as well as the individual appraisal of stressors as a challenge or hindrance, across both levels of analysis in order to confirm and explain these patterns.

In addition to comparing stressors across challenge and hindrance categories, we also examined individual stressors. Although no significant differences were detected between specific stressors at the within level, one significant difference occurred at the between level. Specifically, surface acting had a significantly stronger relationship with strains than workload at the between level (with ρ values of .46 and .26, respectively), which is in line with the challenge-hindrance perspective. Alternatively, it also supports the idea that social stressors have stronger relationships with strains than task stressors (see Dormann & Zapf, 2002).

In terms of specific strains, our findings were generally consistent with our prediction that emotional/affective strains would have stronger relationships with stressors compared to physical/behavioural strains. One particularly interesting finding pertains to the within level stressor–strain relationship for CWB. Out of all the effect sizes calculated in this meta-analysis, within level CWB was the only strain that was not significantly related to stressors. The stressor–CWB relationship was significant, however, at the between level. This result is in line with previous research finding a low base-rate of engaging in CWB (e.g. Meier & Spector, 2013), suggesting the variance at the within-person level is small and may attenuate relationships. Alternatively, there may be very minimal within-person variance in CWB because some individuals engage in CWB and others do not, regardless of their daily stressors.

Limitations

Our study is not without limitations. First, the relatively small number of samples prevented us from comparing the relationships between specific pairs of stressor and strain variables. For example, it is possible that social/interpersonal stressors (e.g. mistreatment and surface acting) yield stronger relationships with emotional and attitudinal strains, whereas stressors such as workload yield stronger relationships with physical strains such as muscular tension. Such patterns would yield important insight into the pathways through which the stress process occurs and are important avenues for future research.

Second, certain topics were excluded from this meta-analysis due to the small number of primary studies. Specifically, all physiological measures of strain (e.g. cortisol level) were present in fewer than three samples and therefore excluded. There were also too few studies to allow an examination of the stressor–strain relationship when the strain preceded the stressor, despite a growing body of literature (e.g. Lang, Bliese, Lang, & Adler, 2011; Meier & Spector, 2013) suggesting that this pathway is important in understanding the dynamics of work stress.

Finally, the design of diary studies allows us to tease apart daily fluctuations from more stable effects only within the period of the included primary studies. Therefore, if the diary study lasted for two work weeks (the median length in this meta-analysis), any conclusions

about the stable elements are limited to what is stable within two weeks. Different designs are needed in order to examine elements of the stressor–strain relationship that are stable over longer periods.

Future directions, implications, and conclusion

Our study helps direct future occupational stress research in two important ways. First, it delineates where empirical evidence is still lacking in the burgeoning literature on the multilevel experience of occupational stress. Specifically, future primary studies should attempt to confirm the effects we reported (particularly for relationships with smaller *ks*), incorporate understudied strains (e.g. physiological indicators), and establish potential boundary conditions of the findings observed herein. For instance, although we observed positive stressor–strain relationships across both levels of analysis, future research could examine circumstances in which there might be long-term benefits to exposure to stressors (e.g. learning experiences, creative problem-solving, etc.), which would be reflected in opposite signs in the stressor–strain relationship across levels (see Ostroff, 1993). One such example outside the occupational domain is the relationship between blood pressure and exercise: blood pressure increases while a person is exercising, but people who exercise more tend to have lower blood pressure. Second, our findings on the nuanced patterns observed across both levels of analysis have significant implications for theory building and the appropriate use of existing theories. As previously discussed, many studies have applied popular occupational stress theories to a different level than the theory explicitly considers. This issue likely stems from the fact that many stress theories were not originally developed within a multilevel framework. Scholars should expand these theories to make explicit multilevel predictions. Similarly, researchers should attempt to develop new multilevel theories of occupational stress. This approach may be particularly helpful in explaining the many environmental and individual elements that influence the stress process, including those that are momentary (i.e. episodic/ daily), short-term (e.g. several days), chronic (e.g. weeks or months), and relatively permanent.

To conclude, this meta-analysis summarised and investigated job stressor–strain relationships in diary studies according to the level of analysis, nature of the time lag, and specific kind of stressor and strain. We found that overall, the stressor–strain relationship is stronger at the between-person level than the within-person level, implying that stable elements of individuals and the environment are more influential in the experience of strains than are daily fluctuations in working conditions, though both contribute significantly to the experience of stress. Moreover, we found that measuring stressor and strain in a predictive manner resulted in stronger estimations of the relationship than when they were measured concurrently, implying that it may take several hours for the effects of work stressors to fully manifest in the form of strain, particularly when that strain is emotional or affective in nature.

Additionally, we compared our between-person findings with those in previous meta-analyses based on cross-sectional and/or longitudinal studies. Our results paint a complex picture of stressor–strain relationships in diary studies that highlight, among many things, the importance of emotions in the short-term stress process, the need for careful consideration of the temporal spacing of measurement points based on theory and the type of strain in question, and the potential challenges involved when investigating phenomena

that are low base-rate (e.g. CWB) or may take longer to manifest. With a growing number of studies using a diary design, this meta-analysis underscores the need moving forward to take a multilevel perspective in order to provide a more complete understanding of job stress.

Disclosure statement

No potential conflict of interest was reported by the author.

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