LEUPHANA
UNIVERSITÄT LÜNEBURG

Rain, rain go away! A diary study on morning weather and affective well-being at work
Venz, Laura; Pundt, Alexander

Rain, Rain Go Away! A Diary Study on Morning Weather and Affective Well-Being at Work

Laura Venz* (iD)

Leuphana University Lüneburg, Germany

Alexander Pundt

Medical School Berlin, Germany

Weather determines a number of affective experiences in everyday life. Although affective events theory positions environmental features such as the weather as important in determining affective well-being also at work, research in this regard has mainly focused on predictors within the person or work context. Addressing this gap, we studied how daily morning weather relates to day-specific affective well-being at work. Specifically, we examined vigor and job satisfaction as positive well-being states, and negative affect and burnout as negative well-being states. Additionally, we examined individual weather sensitivity and positive/negative affectivity as person-level moderators of the daily weather–well-being relationship. Using data gathered in a diary study with 115 employees reporting on 457 workdays, we found morning weather to be related to state vigor and job satisfaction, but not to negative affect and burnout. Positive affectivity moderated the relationships between morning weather and job satisfaction as well as burnout. Weather sensitivity moderated the relationship between morning weather and vigor, while negative affectivity did not moderate any relationship between morning weather and well-being at work. Our results contribute to the understanding of affective well-being at work by pointing at the role environmental factors such as weather conditions can play.

INTRODUCTION

Affective well-being predicts employees' attitudes, health, and performance (Lyubomirsky, King, & Diener, 2005). Hence, research that identifies its

antecedents is important. In our study, we aim to contribute to such research by including a presumably important, yet understudied, determinant of affective well-being at work: the weather. Weather is a ubiquitous environmental factor for humans (Gifford, 2002) and, particularly given climate change, an increase of extreme weather conditions, and global warming, it is important to understand the impact of weather on people at work. Specifically, if weather shapes affective states, every work-related judgement or behavior that depends on employees' current affect (e.g., helping, performance appraisals, group functioning, and productivity; see Barsade & Gibson, 2007; Forgas & George, 2001) might be at least partly weather-dependent.

While there are hints that weather might affect individuals' ability to work via its effect on well-being states (e.g., lethargy, fatigue; Mackensen, Höppe, Maarouf, Tourigny, & Nowak, 2005), few studies have examined weather in relation to work outcomes. In one of those studies, surprisingly, "good" weather was found to be negatively related to productivity (Lee, Gino, & Staats, 2014). Subjectively, though, the majority of respondents believed good weather to increase productivity—via fostering positive feeling states. We explicitly address the latter issue and examine if weather is relevant to affective well-being at work.

Despite some principal evidence for weather's role in well-being, some studies did not find an effect of weather (e.g., Yap, Wortman, Anusic, Baker, Scherer, Donnellan, & Lucas, 2017), indicating that moderators might exist. Hence, we also included moderators, namely weather sensitivity (Mackensen et al., 2005) and positive and negative affectivity (Watson, Clark, & Tellegen, 1988), which, by definition, are propensities to be reactive to specific (weather) conditions. This look at individual differences in reactions to weather is crucial as it may help explain why employees who share the same weather (e.g., coworkers in one office) still experience different well-being (Lee et al., 2014).

In sum, integrating environmental and organizational psychology literatures, we aim to stimulate research on the role of environmental factors in organizational behavior. Specifically, we contribute to research on affective well-being at work by taking weather as an explanatory factor into account. Our study goes beyond existing research by focusing on well-being rather than performance, helping to draw a more complete picture of the role of weather for work-related outcomes. Importantly, the knowledge obtained with this diary study is of high practical relevance as it may help draw attention to seemingly irrelevant, and thus, overlooked factors in employee well-being, attitudes, and, ultimately, behavior.

Two more points are worth noting: First, using the approach of holistic environmental perception (see Gifford, 2002), we based our study on weather as a *whole entity* rather than on single weather parameters. This approach reflects the definition of weather as the momentary state of the atmosphere
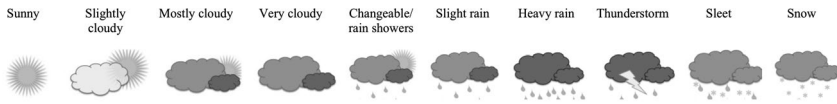
FIGURE 1.   One-item measure to assess subjectively perceived weather. In our analyses, we excluded thunderstorm, sleet, and snow resulting in a seven-point scale ranging from "good" weather (sunny) to "bad" weather (heavy rain). The sun and the lightning symbols are yellow colored in the original scale.

at a particular location (Ackerman & Knox, 2003) and optimally fits the colloquial understanding of weather as ranging from good (i.e., sunny, clear) to bad (i.e., cloudy, rainy). Hence, we assessed weather perceptions combining single weather conditions (see Figure 1). Second, we focused on weather in the morning before work, because research suggests a so-called meteorotropic lag, that is, a time lag between weather conditions and psychological reactions (see Rosen, 1979). Further, when indoors (e.g., at the office), people may not be exposed enough to the weather to be affected by it (Keller, Fredrickson, Ybarra, Côté, Johnson, Mikels, Conway, & Wager, 2005). Before work, though, most people are, at least shortly, exposed to the weather (Ettema, Friman, Olsson, & Gärling, 2017), making an effect of morning weather conceivable.

WEATHER AND AFFECTIVE WELL-BEING

Meteorologists define weather as the state of the atmosphere, described in parameters such as sunlight and precipitation, at a particular location and moment (Ackerman & Knox, 2003). Colloquial phrases such as "to feel under the weather" underscore the common belief that the weather matters for people's well-being (Rosen, 1979). We examined this "classic" notion (Schmiedeberg & Schröder, 2014) in relation to four different well-being states at work: vigor, job satisfaction, negative affect, and burnout. Vigor is a positive affective state of high activation (Shirom, 2004), job satisfaction is a positive well-being state of low activation (Bakker & Oerlemans, 2012), negative affect is a negative affective state of high activation (Watson et al., 1988), and burnout is a negative well-being state of low activation, comprising exhaustion and disengagement (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001).

Empirical evidence has shown that weather relates to different indicators of well-being. For instance, Schwarz and Clore (1983) related "good" weather to happiness and life satisfaction. Similarly, Kämpfer and Mütz (2013) found sunshine positively related to life satisfaction, and Alimoglu and Donmetz (2005) and Leather, Pyrgas, Beale, and Lawrence (1998) showed daylight

exposure at work to positively relate to job satisfaction. Cunningham (1979) found good weather related to waitresses' positive mood. Tsutsui (2012) showed cloud cover negatively related to happiness, Parrott and Sabini (1990) found positive mood to be higher on sunny days, and Kööts et al. (2011) related luminance to positive affect.

Although Rosen (1979) listed "bad moods" among the most common reactions to weather, negative affective states have been studied (or reported) less frequently in relation to weather. The few studies that have included negative affect variables, though, suggest weather as a predictor: Sunlight has been found to negatively relate to feeling "worn out" and "uptight and tense" (Leather et al., 1998) as well as to negative affect and tiredness (Denissen, Butalid, Penke, & van Aken, 2008). Mackensen et al. (2005) found depression, fatigue, and lethargy to be among the most frequent weather-related symptoms in a German sample. Van Tilburg, Sedikides, and Wildschut (2018) related perceived weather adversity to feeling distressed, while Connolly (2013) found women more tired on rainy days. Most recently, Ettema et al. (2017) found rain during people's morning commute related to feeling depressed and displeased after the commute.

All of these findings might be due to weather's influence on neurobiological systems: Sunlight predicts daily serotonin levels (Lambert, Reid, Kaye, Jennings, & Esler, 2002) and cloud cover relates to higher melatonin levels (Cummings, 2002), with serotonin and melatonin both being related to positive affective energy. Further, bad weather relates to salivary cortisol levels (Milas, Šupe-Domić, Drmić-Hofman, Rumora, & Martinović Klarić, 2018), which indicate employee psychological ill-being (Ganster & Rosen, 2013).

In sum, weather puts people in a certain mood (Schwarz & Clore, 1983; Weiss & Cropanzano, 1996), which is an (often not realized) experience of feeling good or bad (Barsade & Gibson, 2007). Affect-based theories (used by environmental psychologists to explain weather effects; Rotton & Cohn, 2002) and mood-as-information approaches (Clore, Gasper, & Garvin, 2001; Schwarz, 2012) suggest that people unconsciously use this weather-induced mood as information about the goodness or badness of their current situation. In turn, we hypothesize weather to predict well-being at work:

Hypothesis 1   Within persons, weather in the morning is related to day-specific affective well-being: the worse the weather, (a) the lower the vigor, (b) the lower the job satisfaction, (c) the higher the negative affect, and (d) the higher the burnout.

WEATHER SENSITIVITY AND TRAIT AFFECTIVITY AS MODERATORS

Despite the evidence for a general relationship between weather and well-being, some studies did not obtain an effect of weather on satisfaction ratings

(e.g., Lucas & Lawless, 2013; Yap et al., 2017), activated positive and negative affect (e.g., Lee et al., 2014; Watson, 2000), or deactivated negative affect (e.g., Huibers, de Graaf, Peeters, & Arntz, 2010). That said, people seem to differ in their reactivity to weather. Indeed, Klimstra et al. (2011) found about half of their participants to be unaffected by weather and the other half to be divided into summer lovers (17%), summer haters (27%), and rain haters (9%). Aiming to explain such individual differences in weather reactivity, Kööts et al. (2011) studied the Big Five, but did not find any significant moderation effect. In our search for moderators, we applied the match principle to enhance the fit with studied relationships (Daniels & de Jonge, 2010). That is, we looked for moderators that, from a theoretical viewpoint, may explain who will be more prone to use weather, and the thereby induced mood, as information to judge their well-being.

First, we studied weather sensitivity, which represents how likely someone is to react to the weather with affective or health-related symptoms (Mackensen et al., 2005). We argue that employees who think of themselves as weather sensitive will depend more on the current weather as an external cue for their well-being, enhancing the likelihood that for them the weather is related to well-being judgements. Conversely, those who do not deem themselves as weather sensitive will be less likely to use the weather as an indicator of their well-being.

> **Hypothesis 2**   Weather sensitivity moderates the day-level relationship between morning weather and (a) vigor, (b) job satisfaction, (c) negative affect, and (d) burnout. The relationships are stronger for employees high in weather sensitivity in that they both benefit more from "good" morning weather and suffer more from "bad" morning weather.

Second, we studied trait affect in terms of positive and negative affectivity (PA and NA, respectively). PA is an affective predisposition to experience feelings of enthusiasm and alertness while NA is a stable tendency to experience aversive feeling states (Watson et al., 1988). PA and NA are dispositional variables typically discussed as influencing affective processes (e.g., Weiss & Cropanzano, 1996). This is because both momentary affect (e.g., weather-induced mood; Schwarz & Clore, 1983) and trait affect provide information that people use to judge their current situation. Hence, it is the interaction between states and traits that influences affective processes (Tamir, Robinson, & Clore, 2002). Specifically, people high in PA are more sensitive to positive stimuli (e.g., Tamir et al., 2002) and will thus be more inclined to use good morning weather as information about their well-being. NA individuals, in contrast, show higher negative emotional reactivity (Watson et al., 1988), indicating that they will react more strongly to bad morning weather.

Hypothesis 3   Positive affectivity moderates the day-level relationship between morning weather and (a) vigor, (b) job satisfaction, (c) negative affect, and (d) burnout. Employees high in positive affectivity benefit more from "good" morning weather.

Hypothesis 4   Negative affectivity moderates the day-level relationship between morning weather and (a) vigor, (b) job satisfaction, (c) negative affect, and (d) burnout. Employees high in negative affectivity suffer more from "bad" morning weather.

METHOD

Sample and Procedure

We recruited participants from Germany for this online study via several channels, such as social media and among student recruiters' personal networks. This strategy allowed for a diverse sample. To ensure data validity, all further communication with participants was the first author's responsibility (see Wheeler, Shanine, Leon, & Whitman, 2014). The present study[1] comprised a general one-time survey followed by a one-week diary with two daily surveys, one in the morning and one after work.

Initially, 182 employees registered for voluntary study participation. We included data from all participants who provided their zip code (allowing us to match their survey data with objective weather data for further analyses) and filled in both daily surveys at the intended time points on a minimum of two survey days. The resultant final sample consisted of 115 employees (47.8% female) from diverse industrial sectors who provided valid data on 457 days. Participants reported a mean age of 32.8 years ($SD = 11.35$), an average job tenure of 8.8 years ($SD = 10.4$), and a mean weekly working time of 41.2 hours ($SD = 6.5$).

Measures

If not stated otherwise, all items were answered on 5-point Likert scales ranging from 1 (*not true at all*) to 5 (*very true*). Table 1 shows descriptive statistics of study variables.

---

[1] The study was part of a larger research project (Pundt & Venz, 2017; Venz, Pundt, & Sonnentag, 2018) that was conducted in Germany in April 2013. This time was well suited for this study because, in Germany, April is the month with the most changeable weather (Steinlein, 2012) and because previous research found weather to influence affect only in spring (Denissen et al., 2008; Keller et al., 2005).

TABLE 1
Means, Standard Deviations, and Correlations Between Study Variables and Additional Control Variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Morning positive affect	2.78	0.45		-.16	.62**	.51**	.09	-.53**	-.16	-.11	-.04	.25	.06	.07	-.13	.47**	-.11
2 Perceived morning weather	2.28	1.13	-.12*		.13	-.17	.07	-.02	.32	-.22	.21	.25	.04	.06	-.01	.38	.02
3 Day-specific vigor	3.02	0.49	.25**	-.13*		.74**	.02	-.76**	-.35	-.16	-.04	.13	.04	-.01	-.05	.56**	-.18*
4 Day-specific job satisfaction	3.69	0.62	.08	-.14**	.57**		-.19*	-.70**	-.69	-.08	-.04	.03	.02	-.08	-.02	.53**	-.22*
5 End-of-work negative affect	1.27	0.24	.00	.08	-.34**	-.32**		.14	.45	-.09	.24	.13	.09	-.26	.11	-.20	.63**
6 Day-specific burnout	2.45	0.37	-.04	.09	-.51**	-.48**	.34**		.22	.08	.08	-.14	-.02	-.15	-.00	-.50**	.24*
7 Perceived daily weather	2.19	1.18	-.06	.43**	-.06	-.03	.09	.09		-.14	.24	.05	.17	-.26	.01	-.21	.36
8 Day-specific temperature[a]	15.02	2.27	.02	-.44**	.02	-.03	.06	.01	-.42**		-.90**	-.80**	-.97**	.65	.11	-.20	-.03
9 Day-specific precipitation[a]	1.80	5.31	-.04	-.05	-.01	.03	.07	.00	.45**	.01		.82*	.85**	-.71	-.28	-.05	.32
10 Day-specific sunshine[a]	1.29	1.22	.08	-.37**	.08	-.01	-.06	-.01	-.51**	.33**	-.37**		.71**	-.27	-.27*	.04	.18
11 Day-specific humidity[a]	62.47	6.70	-.02	.13*	-.03	-.02	.10	.00	.49**	-.13**	.48**	-.45**		-.66*	-.03	.15	.05
12 Day-specific cloud cover[a]	5.09	1.89	-.06	.58**	-.05	-.03	.03	.02	.61**	-.54**	.21**	-.69**	.39**		.10	.08	-.45**
13 Weather sensitivity	2.46	1.96														-.06	.01
14 Positive affectivity	3.42	0.60															-.34**
15 Negative affectivity	1.67	0.50															

Note. Standard deviations relate to the day level for variables 1 to 12 and to the person level for variables 13 and 14. Correlations above the diagonal are person-level correlations (N = 115). Correlations below the diagonal are day-level correlations (N = 457). Displayed correlations are standardized within (below the diagonal) and between (above the diagonal) correlations calculated with Mplus, Version 7.4; two-tailed p-values for the estimated correlations stem from the TECH4 output.
[a]Objective day-specific weather data: Mean temperature in °C, total precipitation in mm, sunshine duration in hours, relative humidity in %, and mean degree of cloud cover in eighth.
*p < .05; **p < .01.

General Survey.   We assessed *weather sensitivity* using the single item "I am sensitive to weather."[2] We assessed *trait affectivity* using the PANAS (Watson et al., 1988). Participants indicated how they "usually feel" rating ten positive emotions (e.g., "excited") to measure PA (α = .87), and ten negative emotions (e.g., "nervous") to measure NA (α = .83).

Daily Morning Survey.   We measured *perceived morning weather* in the morning survey asking participants to indicate "how the weather is at the moment" on a 10-point picture scale (Figure 1). We self-developed the scale[3] based on weather icons typically used in the German weather forecast. The original scale includes thunderstorms, sleet, and snow. However, study participants did not report these three weather conditions. Thus, our analyses are based on a 7-point scale ranging from "good" (*sunny*) to "bad" weather (*heavy rain*). The intraclass correlation coefficient (ICC) was .05.

Daily Afternoon Survey.   We assessed affective well-being at work in the after-work survey. We measured *end-of-work negative affect* using the PANAS (Watson et al., 1988), asking participants to indicate how they feel "at the moment" in relation to ten adjectives (e.g., "upset"). Cronbach's α, averaged across the five measurement days, was .82. The ICC was .58. We assessed *day-specific vigor* using the physical strength subscale of the Shirom-Melamed Vigor Measure (Shirom, 2004). Participants rated five items (e.g., "Today, I felt vigorous") in terms of how they "felt today, during work". Mean Cronbach's α was .91; ICC was .62. We measured *day-specific job satisfaction* with a one-item measure comprising five faces going from unhappy to happy (Kunin, 1955). Participants rated how satisfied they were with their work "today". The ICC was .44. We assessed *day-specific burnout* in terms of both exhaustion (e.g., "Today at work, I felt emotionally

---

[2] Weather sensitivity is a term widely used in German language, thus being face valid. Of the participants, 58 (50.4%) reported to be weather sensitive to at least a medium extent (as compared to 54.5% in the German sample in the study by Mackensen et al., 2005).

[3] To assess the reliability of the weather scale, we conducted an additional study in April 2014. Every morning over the course of two weeks, 17 students enrolled in a German university indicated the current weather using the one-item perceived weather scale. None of the participants reported thunderstorms, sleet, or snow. We computed inter-rater reliability (i.e., ICC(1), Shrout & Fleiss, 1979) by comparing the ratings of three raters each, who reported to be at the same place and completed the survey in close temporal proximity (44 comparisons in total). ICC(1) was .71 for single measures and .88 for average measures. To assess the validity of the weather scale, we used objective weather data, which we obtained from the German Weather Institute (http://www.dwd.de) using participants' zip codes. We tested if perceived morning weather and perceived daily weather (measured in the after-work survey) are related to objective weather (see Table 1 for correlations; full results can be requested from the first author). Results support the validity of the subjective weather scale.

drained.") and disengagement ("Today at work, I thought less and did my job almost mechanically."), using six items of the OLBI (Demerouti et al., 2001), adapted to the day level. Mean Cronbach's α was .62; ICC was .56.

To test discriminant validity among the concurrently assessed well-being outcomes, we conducted a two-level confirmatory factor analysis, in which we modeled vigor, burnout, and negative affect as three distinct factors[4] at the within- and between-person level. As for the burnout facets, we allowed the three items measuring exhaustion and disengagement each to correlate. The resulting model showed an acceptable fit, χ^2 = 860.401, df =360, p < .001, RMSEA = .055. This three-factor model was superior to alternative conceivable models.

RESULTS[5]

To test our hypotheses, we used two-level analyses in which we regressed all four day-specific well-being outcomes simultaneously on perceived morning weather at the day level. To test for cross-level moderation, we specified the to-be-moderated paths as random slopes. To avoid multicollinearity issues, we tested the cross-level moderations independently from each other, that is, we specified three models. We person-mean centered morning weather and grand-mean centered the person-level moderators. We report unstandardized estimates (est.).

Hypothesis 1 stated that, within persons, morning weather is related to well-being. Perceived morning weather was negatively related to day-specific vigor (est. = −.06, p < .05) and job satisfaction (est. = −.07, p < .05), but unrelated to end-of-work negative affect (est. = .02, p = .11) and day-specific burnout (est. = .02, p = .25). In sum, Hypothesis 1 was supported for the positive well-being states, but not for the negative ones (Table 2).

Hypotheses 2, 3, and 4 relate to person-level moderators of the effects of morning weather on well-being at work. Hypothesis 2 stated that highly weather sensitive individuals benefit more from good and suffer more from bad morning weather. Weather sensitivity moderated the relationship of morning weather with vigor (est. = −.03, p < .05).[6] To interpret this interaction effect, we plotted it (Dawson, 2014; Figure 2): Morning weather was unrelated to vigor for those low on weather sensitivity, supporting Hypothesis 2a. Hypothesis 3 stated that high PA employees benefit more from good

---

[4] We did not include job satisfaction, because we assessed it with a one-item measure.

[5] We report results without control variables. Results including morning positive affect, daily perceived weather, and daily objective weather conditions as control variables can be obtained from the first author on request. The results do not meaningfully differ.

[5] The interaction effect between morning weather and weather sensitivity on vigor was not significant when control variables were included. Hence, it has to be interpreted with caution.

TABLE 2
Multilevel Estimates for Predicting Day-Specific Affective Well-Being without Control Variables

	Day-specific vigor			Day-specific job satisfaction			End-of-work negative affect			Day-specific burnout		
	est.	SE	z	est.	SE	z	est.	SE	z	est.	SE	z
Model 1: Main effects												
Day-level predictor variable												
Perceived morning weather[a]	−.06	.03	−2.49*	−.07	.03	−2.17*	.02	.01	1.62	.02	.03	1.15
Person-level moderator variables												
Weather sensitivity (WS)[b]	−.01	.02	−0.26	.00	.02	0.11	.02	.01	2.16*	−.01	.02	−0.37
Positive affectivity (PA)[b]	.58	.10	6.10**	.47	.10	4.57**	.01	.04	0.27	−.33	.08	−4.21**
Negative affectivity (NA)[b]	.01	.12	0.11	−.04	.11	−0.39	.35	.07	5.06**	.06	.09	0.68
Model 2: Cross-level moderation[c]												
2a: Morning weather × WS	−.03	.02	−2.13*	−.03	.02	−1.52	.00	.01	0.65	.01	.01	0.58
2b: Morning weather × PA	−.04	.04	−1.08	−.14	.04	−3.61**	.00	.02	0.02	.07	.03	2.50*
2c: Morning weather × NA	.10	.05	1.87†	−.02	.06	−0.28	.02	.02	0.84	−.05	.03	−1.49

Note. $N_{persons}$ =115. N_{days} =457. est. = unstandardized multilevel estimate. SE =standard error. Displayed estimates for Model 1 (Hypothesis 1) result from one overall model test including perceived morning weather and person-level moderators to predict all four affective well-being outcomes simultaneously. Day-level perceived morning weathers is person-mean centered. Person-level moderators are grand-mean centered.
[a]Random slope.
[b]Effect at the person level.
[c]Estimates for cross-level moderation (Hypotheses 2, 3, and 4) are from three separately specified models.
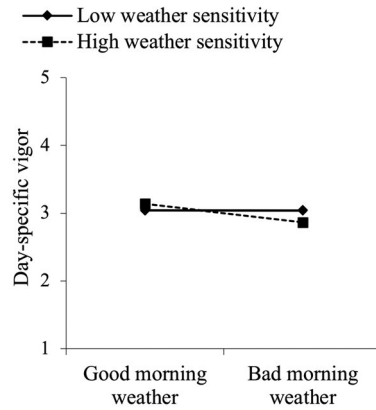†p < .10; *p < .05; **p < .01.

FIGURE 2.   Interactive effect of morning weather and weather sensitivity (WS) on day-specific vigor. Low and high WS lines represent one standard deviation below and above the grand mean, respectively.
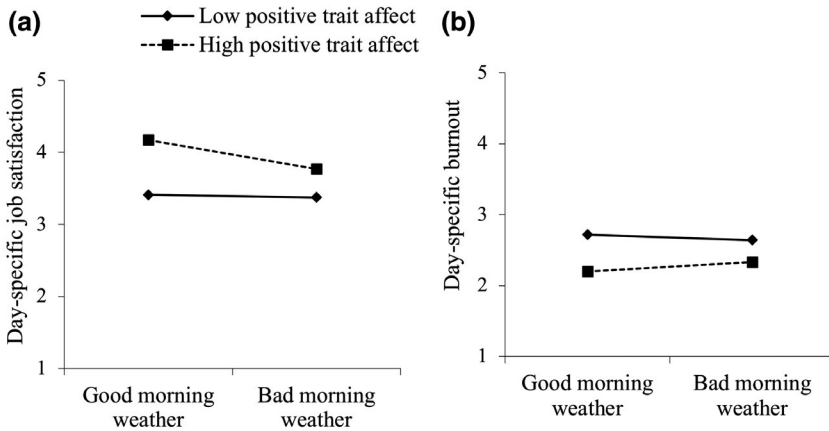

FIGURE 3.   Interactive effect of morning weather and positive affectivity (PA) on (a) day-specific job satisfaction, and (b) day-specific burnout. Low and high PA lines represent one standard deviation below and above the grand mean, respectively.

weather. PA did not moderate the effects of morning weather on vigor and negative affect, but on job satisfaction (est. $= -.14$, $p < .01$) and burnout (est. $= .07$, $p < .05$). The plots (Figure 3) show that high PA employees reacted stronger to weather, showing lower burnout and higher job satisfaction the better the morning weather was. Thus, Hypotheses 3b and 3d were supported.

Hypothesis 4 stated that high NA employees suffer more from bad morning weather. NA did not moderate any of the effects of morning weather. Hence, Hypothesis 4 was not supported.

DISCUSSION

Weather surrounds us every day and in every context. Yet, research on the role of weather in work life is rare. Our results suggest morning weather plays a role in affective well-being at work. Bad morning weather was negatively related to vigor and job satisfaction, but unrelated to negative affect and burnout. PA moderated the effects of morning weather on job satisfaction and burnout such that employees high in PA benefited more from good morning weather. Weather sensitivity moderated the effect of morning weather on vigor such that morning weather was unrelated to vigor for lowly weather sensitive employees. In sum, our results provide possible explanations for previous inconclusive findings on the role of weather for well-being: The intra-individual weather effect differs for the well-being construct under study and depends on interindividual differences in PA and weather sensitivity.

Theoretical, Empirical, and Practical Implications

With this diary study, we break new ground by testing weather as an environmental predictor of well-being at work. Showing morning weather to predict day-specific well-being, our initial results bring along vital implications for theory, research, and practice. While studies are needed to replicate our results, the findings indicate that weather might be a source of bias or a confounding factor. Hence, research on employees' daily experiences (e.g., on the stressor-strain relationship, on commuting) might want to control for day- or even moment-specific weather (see Ettema et al., 2017). Our one-item measure offers a viable way to do so.

We found significant direct weather effects for vigor and job satisfaction, but not for negative affect and burnout. Given many peoples' subjective experience to feel worse on bad-weather days (Watson, 2000), these findings seem surprising. However, they mirror previous findings, suggesting that weather has more reliably been related to positive than negative well-being states. Schwarz and Clore (1983) offered a potential explanation: While the role of weather-induced mood is stable for positive well-being states (i.e., "informational function" of weather-induced positive mood), people in a negative mood (i.e., on bad weather days) likely seek an explanation for feeling bad, with the resulting information likely replacing weather-induced mood as information. This "directive function" of negative weather-induced mood (Schwarz & Clore, 1983) raises the question of whether employees are more

prone to perceive, encounter, or even unconsciously provoke negative work events (e.g., Rothbard & Wilk, 2011) on bad weather days, which is in turn related to well-being.

Unexpectedly, NA did not moderate the effects of weather. One plausible explanation for this nonsignificant direct effect is that high NA persons may constantly search for reasons for their persistent negative feelings (i.e., directive function of negative affect; Schwarz & Clore, 1983). As such, NA might rather shape reactivity to more manifest cues (e.g., job stressors; Hochwarter, Perrewé, Hall, & Ferris, 2005) than to the weather. We found only weak support for a moderating role of weather sensitivity. It is plausible that people who do not deem themselves as weather sensitive might actually react to the weather in a way comparable to self-declared weather-sensitive persons, but subjectively do not attribute their well-being to the weather (Rosen, 1979).

Although the weather is beyond the scope of managerial action, it is vital to realize that aspects beyond job design affect employees at work. We thus advise practitioners to keep in mind background factors that shape employees' daily experiences. For example, weather might be considered when conducting employee surveys as it might bias employee responses. Knowledge about the role of weather may also be used to actively improve well-being (e.g., by encouraging employees to ride a bike or walk to work in good weather). Further, the physical work environment, particularly aspects that facilitate weather-related well-being (e.g., window distance, light; Aries, Veitch, & Newsham, 2010), may be considered.

Limitations and Future Directions

Our study has limitations. In particular, we covered only five workdays in April in Germany. This week may be highly selective for the effects of weather, so our findings could be due to a seasonal effect (Keller et al., 2005). In addition, day-specific weather effects might be different for different places depending on the "normal" weather (e.g., a sunny morning might have a larger effect in "rainy England" than on the sunshine coast in Australia). To replicate our results and enhance generalizability, future studies should try to replicate our findings in several countries and places, use longer time periods, and cover all seasons.

Our study has implications for research on weather effects. In particular, to aid theorizing, future studies might address the mechanisms underlying weather effects. As such, studies that explicitly test the role of weather in inducing mood, the informative and directive functions of weather-induced mood (Schwarz & Clore, 1983), and neurobiological and (potentially opposing; Lee et al., 2014) cognitive pathways are needed.

REFERENCES

Ackerman, S.A., & Knox, J.A. (2003). *Meteorology: Understanding the atmosphere*. Pacific Grove, CA: Brooks/Cole.

Alimoglu, M.K., & Donmez, L. (2005). Daylight exposure and the other predictors of burnout among nurses in a university hospital. *International Journal of Nursing Studies*, *42*, 549–555.

Aries, M.B., Veitch, J.A., & Newsham, G.R. (2010). Windows, view, and office characteristics predict physical and psychological discomfort. *Journal of Environmental Psychology*, *30*, 533–541.

Bakker, A.B., & Oerlemans, W.G.M. (2012). Subjective well-being in organizations. In K.S. Cameron, & G. M. Spreitzer (Eds.), *The Oxford handbook of positive organizational scholarship* (Vol. *1*, pp. 178–187). New York, NY: Oxford University Press.

Barsade, S.G., & Gibson, D.E. (2007). Why does affect matter in organizations? *Academy of Management Perspectives*, *21*, 36–59.

Clore, G.L., Gasper, K., & Garvin, E. (2001). Affect as information. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (Vol. *1*, pp. 121–144). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Connolly, M. (2013). Some like it mild and not too wet: The influence of weather on subjective well-being. *Journal of Happiness Studies*, *14*, 457–473.

Cummings, D.R. (2002). The seasonality of human births, melatonin and cloud cover. *Biological Rhythm Research*, *33*, 521–559.

Cunningham, M.R. (1979). Weather, mood, and helping behavior: Quasi experiments with the sunshine Samaritan. *Journal of Personality and Social Psychology*, *37*, 1947–1956.

Daniels, K., & de Jonge, J. (2010). Match making and match breaking: The nature of match within and around job design. *Journal of Occupational and Organizational Psychology*, *83*, 1–16.

Dawson, J.F. (2014). Moderation in management research: What, why, when, and how. *Journal of Business and Psychology*, *29*, 1–19. https://doi.org/10.1007/s10869-013-9308-7

Demerouti, E., Bakker, A.B., Nachreiner, F., & Schaufeli, W.B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology*, *86*, 499–512.

Denissen, J.J.A., Butalid, L., Penke, L., & van Aken, M.A.G. (2008). The effects of weather on daily mood: A multilevel approach. *Emotion*, *8*, 662–667.

Ettema, D., Friman, M., Olsson, L.E., & Gärling, T. (2017). Season and weather effects on travel-related mood and travel satisfaction. *Frontiers in Psychology*, *8*, 140.

Forgas, J.P. & George, J.M. (2001). Affective influences on judgments and behavior in organizations: An information processing perspective. *Organizational Behavior and Human Decision Processes*, *86*, 3–34. https://doi.org/10.1006/obhd.2001.2971

Ganster, D.C., & Rosen, C.C. (2013). Work stress and employee health: A multidisciplinary review. *Journal of Management*, *39*, 1085–1122.

Gifford, R. (2002). *Environmental psychology: Principles and practices*. Colville: Optimal Books.

Hochwarter, W.A., Perrewé, P.L., Hall, A.T., & Ferris, G.R. (2005). Negative affectivity as a moderator of the form and magnitude of the relationship between felt accountability and job tension. *Journal of Organizational Behavior*, *26*, 517–534.

Huibers, M.J.H., de Graaf, L.E., Peeters, F.P.M.L., & Arntz, A. (2010). Does the weather make us sad? Meteorological determinants of mood and depression in the general population. *Psychiatry Research*, *180*, 143–146.

Kämpfer, S., & Mutz, M. (2013). On the sunny side of life: Sunshine effects on life satisfaction. *Social Indicators Research*, *110*, 579–595.

Keller, M.C., Fredrickson, B.L., Ybarra, O., Côté, S., Johnson, K., Mikels, J., Conway, A., & Wager, T. (2005). A warm heart and a clear head: The contingent effects of weather on mood and cognition. *Psychological Science*, *16*, 724–731.

Klimstra, T.A., Frijns, T., Keijsers, L., Denissen, J.J.A., Raaijmakers, Q.A.W., van Aken, M.A.G., Koot, H.M., van Lier, P.A.C., & Meeus, W.H.J. (2011). Come rain or come shine: Individual differences in how weather affects mood. *Emotion*, *11*, 1495–1499. https://doi.org/10.1037/a0024649

Kööts, L., Realo, A., & Allik, J. (2011). The influence of the weather on affective experience: An experience sampling study. *Journal of Individual Differences*, *32*, 74–84.

Kunin, T. (1955). The construction of a new type of attitude measure. *Personnel Psychology*, *8*, 65–77.

Lambert, G.W., Reid, C., Kaye, D.M., Jennings, G.L., & Esler, M.D. (2002). Effect of sunlight and season on serotonin turnover in the brain. *The Lancet*, *360*, 1840–1842.

Leather, P., Pyrgas, M., Beale, D., & Lawrence, C. (1998). Windows in the workplace: Sunlight, view, and occupational stress. *Environment and Behavior*, *30*, 739–762.

Lee, J.J., Gino, F., & Staats, B.R. (2014). Rainmakers: Why bad weather means good productivity. *Journal of Applied Psychology*, *99*, 504–513.

Lucas, R.E., & Lawless, N.M. (2013). Does life seem better on a sunny day? Examining the association between daily weather conditions and life satisfaction judgments. *Journal of Personality and Social Psychology*, *104*, 872–884.

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, *131*, 803–855.

Mackensen, S., Höppe, P., Maarouf, A., Tourigny, P., & Nowak, D. (2005). Prevalence of weather sensitivity in Germany and Canada. *International Journal of Biometeorology*, *49*, 156–166.

Milas, G., Šupe-Domić, D., Drmić-Hofman, I., Rumora, L., & Martinović Klarić, I. (2018) Weather conditions: A neglected factor in human salivary cortisol research? *International Journal of Biometereology*, *62*, 165–175.

Parrott, W.G., & Sabini, J. (1990). Mood and memory under natural conditions: Evidence for mood incongruent recall. *Journal of Personality and Social Psychology*, *59*, 321–336.

Pundt, A., & Venz, L. (2017). Personal need for structure as a boundary condition for humor in leadership. *Journal of Organizational Behavior*, *38*, 87–107.

Rosen, S. (1979). *Weathering. How the atmosphere conditions your body, your mind, your moods and your health*. New York: M. Evans and Company.

Rothbard, N.P., & Wilk, S.L. (2011). Waking up on the right or wrong side of the bed: Start-of-workday mood, work events, employee affect, and performance. *Academy of Management Journal*, *54*, 959–980.

Rotton, J., & Cohn, E.G. (2002). Climate, weather, and crime. In: R. B. Bechtel& A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 481–491). New York, NY: John Wiley & Sons, Inc.

Schmiedeberg, C., & Schröder, J. (2014). Does weather really influence the measurement of life satisfaction? *Social Indicators Research*, *117*, 387–399.

Schwarz, N. (2012). Feelings-as-information theory. InP. M. Van Lange, A. W. Kruglanski, & E. Higgins (Eds.), *Handbook of theories of social psychology* (Vol. *1*, pp. 289–308). Thousand Oaks, CA: Sage.

Schwarz, N., & Clore, G.L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology*, *45*, 513–523.

Shirom, A. (2004). Feeling vigorous at work? The construct of vigor and the study of positive affect in organizations. InP. L. Perrewé& D. C. Ganster (Eds.), *Emotional and physiological processes and positive intervention strategies* (Vol. *3*, pp. 135–164). Bingley, UK: Elsevier Science/JAI Press.

Shrout, P.E., & Fleiss, J.L. (1979). Intraclass correlation: Uses in assessing rater reliability. *Psychological Bulletin*, *86*, 420–428.

Steinlein, C. (2012, April 26). Zwischen Schneefall und Hochsommerhitze [Between snowfall and midsommer heat], *Focus Online*. Retrieved from www.focus.de/wissen/natur/meteorologie/wetterextreme-mehr-als-32-grad-im-april_aid_736749.html

Tamir, M., Robinson, M.D., & Clore, G.L. (2002). The epistemic benefits of trait-consistent mood states: An analysis of extraversion and mood. *Journal of Personality and Social Psychology*, *83*, 663–677.

Tsutsui, Y. (2012). Weather and individual happiness. *Weather, Climate, & Society*, *5*, 70–82.

van Tilburg, W.A.P., Sedikides, C., & Wildschut, T. (2018). Adverse weather evokes nostalgia. *Personality and Social Psychology Bulletin*, *44*, 984–995.

Venz, L., Pundt, A., & Sonnentag, S. (2018). What matters for work engagement? A diary study on resources and the benefits of selective optimization with compensation for state work engagement. *Journal of Organizational Behavior*, *39*, 26–38.

Watson, D. (2000). *Mood and temperament*. New York: Guilford Press.

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Weiss, H.M., & Cropanzano, R. (1996). Affective events theory: A theoretical discussion of the structure, causes and consequences of affective experiences at work. InB.M. Staw& L.L. Cummings (Eds.), *Research in organizational behavior* (Vol. *18*, pp. 1–74). Greenwich, CT: Elsevier Science/JAI Press.

Wheeler, A.R., Shanine, K.K., Leon, M.R., & Whitman, M.V. (2014). Student-recruited samples in organizational research: A review, analysis, and guidelines for future research. *Journal of Occupational and Organizational Psychology*, *87*, 1–26.

Yap, S.C., Wortman, J., Anusic, I., Baker, S.G., Scherer, L.D., Donnellan, M.B., & Lucas, R.E. (2017). The effect of mood on judgments of subjective well-being: Nine tests of the judgment model. *Journal of Personality and Social Psychology*, *113*, 939–961.