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Weathering the storms: Workplace wellbeing, mental health, and the U.S. meteorologist

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Abstract

Mental health is a topic of increasing interest and concern across the weather enterprise amidst a backdrop of funding cuts, extreme storms, and longer, more involved work hours. The present study therefore investigated wellbeing in the meteorological workplace. Participants (N= 389), professional meteorologists (n = 360) and professionally-employed meteorology students (n = 29), voluntarily participated in a Qualtrics-hosted online survey and responded to a number of measures representing a broad range of mental health variables. These individuals fell into three employment sectors: U.S. National Weather Service (NWS), Broadcast (television weather), and Other (a combination of academic, private sector, military, and non-NWS operational meteorologists). Individual differences emerged between meteorological sectors in personality and the subjective wellbeing domains of burnout, job satisfaction, and anxiety. Broadcasters were significantly more burnt-out at work and personally, were higher in extraversion, and were highest in anxiety. NWS meteorologists were most burnt-out in working with partners. The Other category of meteorologists showed more agreeableness and greater job satisfaction than broadcasters and those in the NWS. There was no cross-sector difference, however, in traits that might be relatively uniform among meteorologists: Grit, life satisfaction, self-concept clarity, subjective happiness, stress, and depression. Results are discussed in terms of consequences for meteorologists' mental health and emotional wellbeing as well as the future of the field.



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Weathering the Storms: Workplace Wellbeing, Mental Health, and the U.S. Meteorologist

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Abstract

Mental health is a topic of increasing interest and concern across the weather enterprise amidst a backdrop of funding cuts, extreme storms, and longer, more involved work hours. The present study therefore investigated wellbeing in the meteorological workplace. Participants (N= 389), professional meteorologists (n = 360) and professionally-employed meteorology students (n = 29), voluntarily participated in a Qualtrics-hosted online survey and responded to a number of measures representing a broad range of mental health variables. These individuals fell into three employment sectors: U.S. National Weather Service (NWS), Broadcast (television weather), and Other (a combination of academic, private sector, military, and non-NWS operational meteorologists). Individual differences emerged between meteorological sectors in personality and the subjective wellbeing domains of burnout, job satisfaction, and anxiety. Broadcasters were significantly more burnt-out at work and personally, were higher in extraversion, and were highest in anxiety. NWS meteorologists were most burnt-out in working with partners. The Other category of meteorologists showed more agreeableness and greater job satisfaction than broadcasters and those in the NWS. There was no cross-sector difference, however, in traits that might be relatively uniform among meteorologists: Grit, life satisfaction, self-concept clarity, subjective happiness, stress, and depression. Results are discussed in terms of consequences for meteorologists' mental health and emotional wellbeing as well as the future of the field.

Keywords

Psychology, work place, meteorology, mental health, social psychology

Peer Review

This work has undergone a double-blind review by a minimum of two faculty members from institutions of higher learning from around the world. The faculty reviewers have expertise in

disciplines closely related to those represented by this work. If possible, the work was also reviewed by undergraduates in collaboration with the faculty reviewers.

Acknowledgments

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Mental health is increasingly of interest and concern across America amidst a backdrop of numerous changes and circumstances. Recent budget constraints within the U.S. National Weather Service (NWS), political concerns, and devastating landfalling hurricanes have contributed, as has the meteorological profession shifting to an “always-on” mentality with the emergence of social media and changing of job requirements (Harvey, Irma, and Maria in 2017; Florence and Michael in 2018; Dorian in 2019). Recent research (Bolton, Ault, Greenberg, & Baron-Cohen, 2018; Worley, 2020) and anecdotal discussion have cascaded, bringing about a culture shift from stigmatized views of on-job mental health to an environment that welcomes and encourages such discourse (e.g., panel discussions at the 2019 National Weather Association [NWA] and 2020 American Meteorological Society Annual Meetings; Bolton, 2018; Bolton & DePodwin, 2019, 2020; Gilford, Moser, DePodwin, Moulton, & Watson, 2019; Milrad, 2016; Zee, 2017).

This study on meteorological workplace wellbeing intends to further that positive shift and attempts to further elucidate some results of our previous work on meteorologists. We previously studied connections between meteorologists, autism, and related cognitive style tendencies, with a second hypothesis focused on relationships between personality and mental health (stress, anxiety, and depression) in meteorologists and other physical scientists.¹ While comparisons with engineers and physicists were important to testing cognitive style differences or similarities and a useful first step in opening up this area (meteorologist mental health) for research, neither of those groups is faced with on-the-job circumstances on par with those of meteorologists. Thus, it is not necessarily a meaningful comparison from which to draw

conclusions on meteorologists’ mental health. To better understand meteorological workplace wellbeing, this study examines links between personality, burnout, grit, job satisfaction, life satisfaction, self-concept, subjective happiness, and stress, anxiety, and depression.

Rationale

Given the stressful conditions facing meteorologists today, this study seeks to identify possible differences in wellbeing factors among meteorologists based on their unique job requirements (see the appendix). Given that meteorologists feel uncomfortable talking with supervisors about their mental health, the present study examined psychophysiological health outcomes related to consequences of stressful conditions in the meteorological workplace (Worley, 2020). Specifically, we asked whether or not there exist group (i.e., meteorological employment sector) differences in the various individual differences presented next.

Personality Theory. Personality is an indicator of a person’s psychological and behavioral tendencies over time (Corr & Mathews, 2009). By analogy, personality is not dissimilar to climate as an indicator of long-term weather averages. Mood, on the other hand, is an indicator of a person’s mental state in the present moment, not unlike the atmosphere’s current state. The prevailing theoretical view of personality today, the Five Factor (or “Big Five”) Model, consists of the broad trait dimensions of openness (curious; creative; desiring varied experience), conscientiousness (dependable; organized and self-disciplined), extraversion (sociable; energetic; affectively positive), agreeableness (compassionate; cooperative), and neuroticism (emotionally unstable) (e.g., McCrae & Costa Jr., 1987; McCrae & John, 1990).

¹ Empathizing vs. systemizing, in an attempt to replicate and extend past work linking autism and science; i.e., Baron-Cohen (2008).

These are linked to genetic traits generally stable across different cultures and tend to be stable throughout life, with most fluctuation at younger and older ages (Loehlin & Nichols, 1976; McCrae, 2001; Specht, Egloff, & Schmukle, 2011). Our previous study found meteorologists higher in extraversion, conscientiousness, and agreeableness, and more mentally healthy than the sample's other physical scientists (Bolton et al., 2018). Because personality is relatively stable, we focus here on traits' influences upon self-selection into the meteorological field and its various sectors.

Burnout. Burnout is a psychosocial construct well-recognized within health psychology and social work circles. We operationalized a definition focused on fatigue and exhaustion (Maslach, 1976; Kristensen et al., 2005; Pines & Aronson, 1988; Shirom, 1989; and Schaufeli & Greenglass, 2001). Here we are interested in burnout as it exists within personal and on-the-job contexts, including interactions with others in the course of work (defined as partners in other areas of the weather enterprise; for example, NWS meteorologists coordinating with TV broadcasters and/or emergency managers, and vice versa).

Grit. Grit has been defined as “perseverance and passion for long-term goals” (Duckworth et al., 2007, p. 1087). It involves goal-oriented striving and maintenance of effort in the face of failure, adversity, and apparent plateaus in progress. The present study measures grit on two levels, relating to the consistency of an individual's interests and their perseverance.

Job Satisfaction. While job satisfaction has long been studied by industrial/organizational psychologists, Macdonald and MacIntyre (1997) observe that the concept is often confused and/or conflated with the idea of employee morale e.g., Locke, 1976; Macdonald & MacIntyre, 1997; Yazuk, 1961). We, therefore, wish to clarify the two, as the distinction is important within the context of our study. Job satisfaction, individualistic and

pertaining to single persons across past and present situations, is about one individual's unique job situation (Chen, Sparrow, & Cooper, 2016; Spector, 1997). Employee morale deals with a common, future sense of group purpose within a larger organization and has long been a topic of interest in organizational psychology (e.g., Judge, Weiss, Kammeyer-Mueller, & Hulin, 2017; Leighton, 1949).

Life Satisfaction. Life satisfaction is one of three components generally recognized as related to subjective wellbeing, the others being affect (feelings of positivity and negativity) and emotionality (Andrews & Withey, 1976; Diener, Emmons, Larsen, & Griffin, 1985; Diener, Suh, Lucas, & Smith, 1999; Busseri & Sadava, 2010). Whether or not one is satisfied with life is a cognitive process of judgement and evaluation, which Shin and Johnson define as “a global assessment of a person's quality of life according to his chosen criteria” (1978, p. 478). Judgement and assessment are based on a comparison of one's own circumstances with what is deemed as an appropriate standard that the individual sets for her or himself (Diener et al., 1985).

Self-Concept. Concept of self is a multifaceted and dynamic cognitive schema—an organized knowledge structure that contains traits, values, and episodic and semantic memories about the self, and controls the processing of self-relevant information (Campbell, Trapnell, Heine, Katz, Lavalley, & Lehman, 1996; also see, e.g., Greenwald & Pratkanis, 1984; Kihlstrom & Cantor 1984; Kihlstrom et al., 1988; and Markus, 1977). It is divided into evaluative knowledge subparts, allowing one to ask not only who and what they are (or are not), but also about they feel about themselves (Campbell et al. 1996). Self-concept clarity is “the extent to which the contents of an individual's self-concept (e.g., perceived personal attributes) are clearly and confidently

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Table 1. Demographic Data.

Racial Classification	Caucasian 367	African American 4	Latina/o 5	Hispanic 2	Bi/Multi-racial 4	Asian 1
Employment Sector	NWS 149	Broadcast 143	Private Sector 44	Academia 41	Non-NWS Operational 9	Military 3
Geographic Distribution	Central U.S. 133	Southern U.S. 124	Eastern U.S. 73	Western U.S. 47	Non-Continental 12	
Age	Mean: 38.35	SD: 12.16	Range: 19-75			
Gender	Men 264	Women 123	Non-binary 2			
Student Status	Undergrad 17	Graduate 9				
Leave Meteorology?	Yes 222 (57.1%)	No 155 (39.8%)				
Is Forecaster?	Yes 270 (69.4%)	No 105 (26.7%)				

Note. Age data from 388 out of 389 participants. Geographic distribution data based on 270 responses. Student data from 26 of 29 student participants. Data for those expressing a desire to leave meteorology based on 377 responses. Forecaster data based on 374 responses. Racial, employment, geographic, and gender data based on the full 389 responses. Please note, as well, that statistical comparisons were made on groupings comprising the 149 NWS and 143 broadcast meteorologists and an overall Other grouping consisting of the remaining 97 individuals. Racial classification of “Other” totaled 6.

defined, internally consistent, and temporally stable” (Campbell et al. 1996, p. 141).

Subjective Happiness. Happiness directly relates to, and is closely intertwined, conceptually, with expressions of positive and negative affect (e.g., Myers & Diener, 1995; Lyubomirsky, 2001; Mattei & Schaefer, 2004). Indeed, who doesn’t know *that one person* who is chronically happy, even amidst life’s challenges, while others are conversely consistently unhappy? Where life satisfaction is a global evaluation of quality of life, subjective happiness is a global evaluation of how happy (or unhappy) a person is in her or his life (Lyubomirsky & Lepper, 1999).

Depression, Anxiety, and Stress. Depression and anxiety are well-established as outcomes associated with negative affect,

involving, respectively, a state of repressed and subdued mood and a nervous anticipation of, or worry about, current or future events (e.g., Akiskal, 1985; Clark, 1989; Clark & Watson, 1990; Dobson, 1985; Stavrakaki & Vargo, 1986; Watson, Clark & Carey, 1988). Stress, an uncomfortable emotional experience accompanied by predictable biochemical, physiological, and behavioral changes, has been linked to anxiety (it is a consequence of the anxious response) in the clinical and emotional regulation literature (Baum, 1990; Lazarus, 1993; Lovibond & Lovibond, 1995a, 1995b; Troy & Mauss, 2011).

Method

Participants. Participants were 389 professional meteorologists (n = 360) and professionally employed meteorology students

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(i.e., students working in professional meteorology environments; $n = 29$), with a representative distribution overall relative to the broad American weather community (see Table 1 for demographics).

Procedure. Although we cannot know how many individuals came from each source, as a question relating to this was not asked, volunteer participants were recruited for a Qualtrics-hosted survey by way of social media advertisement and email messages to members of the NWA and American Meteorological Society (AMS). Participants answered standard demographic items, items relating to whether they had ever wanted to leave the meteorological profession, and several individual difference measures. Those who indicated wanting to leave the meteorological field were asked an open-ended question as to why.

The Likert-scale-based individual difference measures included the 15-item Big Five Inventory, Short (BFI-S; Lang, John, Lüdtke, Schupp, & Wagner, 2011; Cronbach's α for this study = 0.41), 19-item Copenhagen Burnout Inventory (CBI; Kristensen et al., 2005; personal burnout $\alpha = 0.88$; work $\alpha = 0.73$; partners $\alpha = 0.89$), 12-item Grit Scale (GS; Duckworth et al., 2007; interest consistency $\alpha = 0.82$; perseverance $\alpha = 0.70$), 10-item Job Satisfaction Scale (JSS; Macdonald & MacIntyre, 1997; $\alpha = 0.84$), 5-item Satisfaction with Life Scale (SWLS; Diener et al., 1985; $\alpha = 0.89$), 12-item Self-concept Clarity Scale (SCCS; Campbell et al., 1996; $\alpha = 0.85$), 4-item Subjective Happiness Scale (SHS; Lyubomirsky & Lepper 1999; $\alpha = 0.88$), and the 21-item version of the Depression,

Anxiety, and Stress Scales (DASS; Lovibond & Lovibond, 1995a; $\alpha = 0.91$).

The BFI-S scores had poor internal reliability (hence why we computed overall and not trait-level reliability), but this is to be expected with such a short scale (Kline, 2000; Nunnally, 1970; Wood & Hampson, 2005) and the construct breadth (as noted by Lang and colleagues in constructing the BFI-S, and by Gosling, Rentfrow, & Swann, 2003, in relation to their 10-item measure). Further details on these measures' construction may be found in their respective articles. Open materials and data for this study, including for variables not analyzed here, are available in SPSS and Excel file format. All survey procedures were approved by our institutional review board.

Data Analysis Plan. We examined group differences and general relationships. Because we were only interested in employment sector comparisons—one independent (grouping) variable, “NWS vs. Broadcast vs. Other”—and not interactions between multiple variables (as would be tested with multiple analysis of variance), we conducted a Kruskal-Wallis (KW) test, the nonparametric counterpart to one-way analysis of variance (ANOVA), with Dunn's post-hoc test (Dinno, 2015), for our main analysis of outcomes.² As noted in Table 1, statistical analyses were carried out on 149 NWS meteorologists, 143 broadcast meteorologists, and the remaining 97 individuals grouped into an overall Other category consisting of academic meteorologists and non-NWS operational and military forecasters.

The dependent variables were the five personality traits and three burnout factors;

² When assessing normality requirements and appropriateness of using ANOVA, the Shapiro-Wilk test revealed no variable was normally distributed (i.e., all null hypothesis tests that the distribution did not differ from normal beyond chance were rejected). To be considered normal, skew should have a value

under 1.0 and less than double the standard error (SE). The variables either skewed > 1.0 or $>$ than double the SE. Dunn's post-hoc test, with a Bonferroni correction to account for Type I error risk, was used to determine which specific groups differed.

Table 2. Descriptive Statistics for Personality Traits in the Meteorology Sectors.

Personality Trait	NWS	Broadcast	Other
	Mean	Mean	Mean
	Rank	Rank	Rank
Openness	162.19	194.22 ^a	174.85
Conscientiousness	186.34	173.34	170.14
Extraversion	164.48 ^b	202.15 ^b	158.36 ^b
Agreeableness	172.04	167.21 ^a	202.86 ^a
Neuroticism	183.59 ^a	175.90 ^a	170.36

Note. Significance levels are denoted by ^a and ^b for $p < 0.05$ and $p < 0.01$, respectively.

two grit factors; job satisfaction; life satisfaction; self-concept clarity; subjective happiness; and the three mental health outcomes: depression, anxiety, and stress. One item each on the subjective happiness and burnout scales was missing data to a point that appeared beyond random chance. (34 participants did not provide an answer on item 4 of happiness and 6 on item 10 of burnout). We excluded those items in our analyses; the SHS and CBI calculations are based upon the remaining items.

Results

The KW test revealed several significant findings. First, the mean ranks of the three group pairs (NWS-Broadcast, NWS-Other, Broadcast-Other) differed significantly for anxiety ($M_{NWS}=166.94$; $M_{Broadcast}=195.44$; $M_{Other}=155.17$), $\chi^2(2) = 9.74$, $p = 0.008$. Dunn's test was significant ($p = 0.012$) for the Broadcast-Other difference, indicating broadcasters were significantly more anxious than meteorologists in academia, operational forecasting outside of the NWS, and the military. Broadcasters were not significantly more anxious than those in the NWS. For job satisfaction, ($M_{NWS}=186.79$; $M_{Broadcast}=146.39$; $M_{Other}=200.01$), $\chi^2(2) = 17.72$, $p < 0.001$. Dunn's test indicated that both NWS ($p = 0.003$) and Other meteorologists ($p < 0.001$) had higher job satisfaction than the sampled broadcasters.

Three personality traits—agreeableness, extraversion, and openness—had significant

mean rank differences among the group pairs: For agreeableness ($M_{NWS}=172.04$; $M_{Broadcast}=167.21$; $M_{Other}=202.86$), $\chi^2(2) = 7.13$, $p = 0.028$. Dunn's test was significant ($p = 0.032$) for the Broadcast-Other difference. For extraversion ($M_{NWS}=164.48$; $M_{Broadcast}=202.15$; $M_{Other}=158.36$), $\chi^2(2) = 13.06$, $p = 0.001$. Dunn's test was significant for both the Broadcast-NWS ($p = 0.007$) and Broadcast-Other pairs ($p = 0.006$), indicating that broadcast meteorologists were the most extraverted. For openness, ($M_{NWS}=162.19$; $M_{Broadcast}=194.22$; $M_{Other}=174.85$), $\chi^2(2) = 6.74$, $p = 0.034$. Dunn's test indicated that broadcasters were significantly more open than NWS, but not Other, meteorologists ($p = 0.03$).

All three burnout factors had significant mean rank differences: For personal, ($M_{NWS}=162.81$; $M_{Broadcast}=182.22$; $M_{Other}=130.85$), $\chi^2(2) = 13.96$, $p = 0.001$. Dunn's test was significant for the Broadcast-Other pair (0.001) and neared significance (0.06) for the NWS-Other pair. For work, ($M_{NWS}=158.38$; $M_{Broadcast}=193.10$; $M_{Other}=120.02$), $\chi^2(2) = 28.81$, $p < 0.001$. Dunn's test was significant for all three pairs (NWS-Other $p = 0.02$; Broadcast-NWS $p = 0.01$; Broadcast-Other $p < 0.001$), indicating that NWS meteorologists were more burnt-out than Other meteorologists but that broadcasters were more burnt-out than both NWS and Other meteorologists. For partners, ($M_{NWS}=179.32$; $M_{Broadcast}=137.23$; $M_{Other}=178.74$), $\chi^2(2) = 15.42$, $p < 0.001$.

Table 3. Group Means for Wellbeing Outcome Variables.

	NWS	Broadcast	Other	Total
Grit (Interests)	18.10 (4.97)	17.67 (4.66)	17.69 (5.08)	17.85 (4.87)
Grit (Perseverance)	24.03 (3.18)	24.57 (2.84)	24.55 (3.22)	24.36 (3.06)
Life Satisfaction	24.69 (6.30)	24.82 (5.74)	25.35 (5.46)	24.90 (5.89)
Self-concept Clarity	44.13 (10.19)	43.81 (10.38)	45.44 (9.91)	44.31 (10.19)
Subjective Happiness	14.15 (3.56)	14.99 (4.01)	14.47 (3.44)	14.55 (3.49)
Stress	14.19 (3.98)	14.49 (4.01)	14.08 (4.11)	14.28 (4.01)
Depression	11.16 (3.49)	11.52 (3.47)	11.09 (3.20)	11.28 (3.41)

Note. Table shows the group means for the two dimensions of grit, life satisfaction, self-concept clarity, subjective happiness, stress, and depression, which did not significantly differ between-groups. Standard deviations are in parentheses.

Dunn's test indicated that Other ($p = 0.007$) and NWS meteorologists ($p = 0.001$) were both more burnt-out than broadcast meteorologists. See Table 2 for the personality most variable rank-sum means, and Table 3 for parametric means associated with the wellbeing variables.

Qualitative Analysis. In response to the open-ended item, 222 out of 377 participants (57.1% of the sample) indicated 12 primary reasons for having wanted to leave the meteorological field at some point (see Figure 1). Two factors most clearly represented the overall considerations for leaving; shift work (22.70%) and negative experiences with co-workers or the broader work environment (15.50%). While lack of sleep was mentioned alone only 3.20% of the time, shift work is notoriously linked to poor and erratic sleep schedules, so it is likely that lack of sleep is a larger issue than reported.

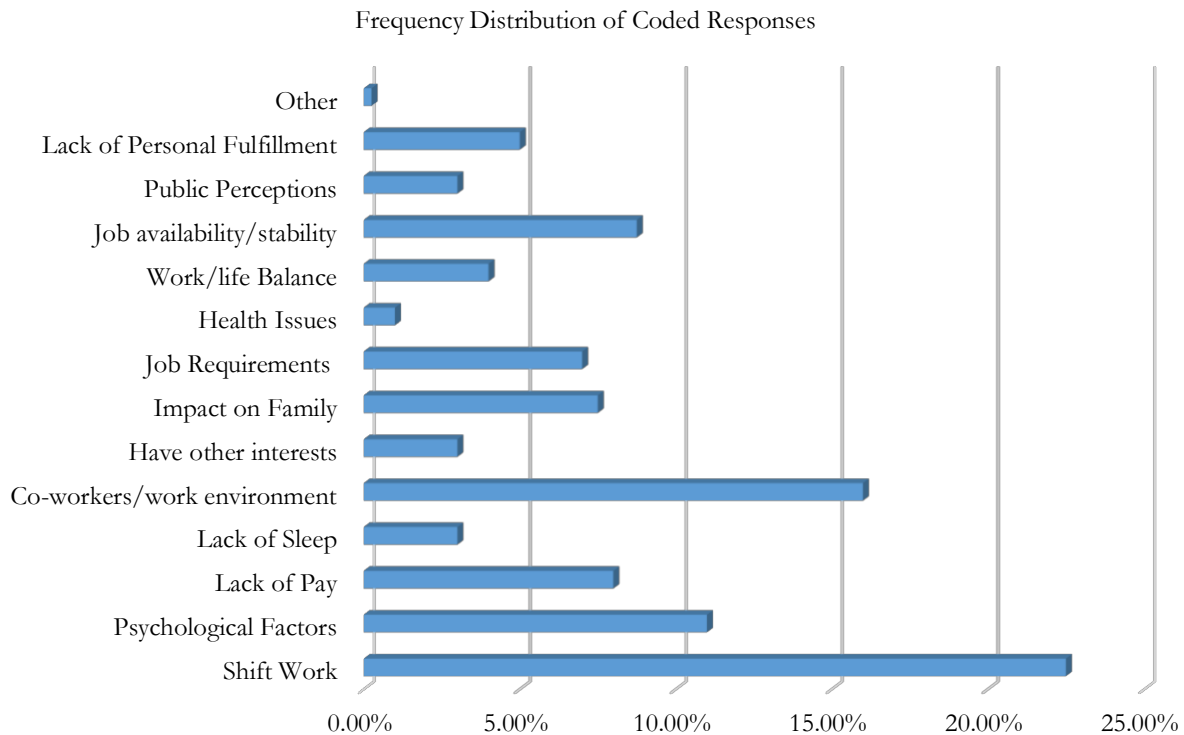
While health issues were only 1.10% of the described reasons for leaving, psychological factors, including stress, depression, and anxiety, made up 10.4% of the reported reasons. Other considerations included dissatisfaction with pay (7.40%), negative impact on family relations (7.20%), and job availability or stability (8.80%). While there are a number of explanations as to why

meteorologists would consider, or actually, leave the profession, primary themes involve the stressful nature of scheduling and workplace-environment, and associated lack of benefits such as pay, time with family, and consistent psychological wellbeing. Combined with 34 participants' leaving unanswered two wellbeing items—related to burnout at the end of the workday and feeling generally unhappy—that may reflect poorly on their work environment or management, these findings shed light on a field involving high stress and job insecurity.

Discussion

Individual differences emerged between meteorological sectors in personality and the subjective wellbeing and mental health domains of burnout, job satisfaction, and anxiety. Broadcasters were significantly more burnt-out at work and personally, were higher in extraversion, and were highest in anxiety. NWS meteorologists were most burnt-out in working with partners. The Other category of meteorologists showed more agreeableness and greater job satisfaction than broadcasters and those in the NWS. There was no cross-sector difference in traits that might be relatively uniform among meteorologists, however, including: Grit, life satisfaction, self-

Figure 1. List and Percentages of Open-ended Reasons for Considering Leaving the Field.



concept clarity, subjective happiness, stress, and depression.

These findings are discussed next. Given that this study was based on a general research question (whether or not there exists differences among meteorological employment sectors with respect to mental health and related variables), we believe it is appropriate to reason through the differences that were found, speculating on their plausibility based on our knowledge of the meteorological field.

With respect to our results, first, it is logical that broadcast meteorologists are the most burnt-out in their personal and work lives: they are likely the first to come to mind when the public thinks of weather reporting and, often, the first criticized. Speaking anecdotally from more than a decade of the lead author’s experiences in professional meteorology, it is almost a certainty that every meteorologist in TV weather has more than one story to share about angry viewers berating them for interrupting a favorite television

program or sporting coverage. Indeed, one broadcast meteorologist told us, “Every time my [desk] phone rings, I get anxious, because I worry it’s going to be someone calling me out on something or saying something extremely rude or hurtful.” Another described situations involving stalking and harassment. It is far more than just backlash from severe weather coverage that tires and worries broadcasters. Both men and women in TV weather face a deluge of sexist perceptions and many struggle to gain separation between their personal and work lives (Lese, 2019; Strong, 2018).

Broadcasters are involved with their station’s public relations campaigns and are typically responsible for managing multiple work-related social media pages. They are often viewed by the public as local scientists who can answer questions and must respond to viewer phone calls and emails not only about weather, but all manner of physical science topics such as astronomy and space weather. They often provide public tours of their work facilities, give school education and other talks,

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engage with the local community while keeping up professional training certifications.

The NWS-partners burnout finding is also convincingly logical, because the National Weather Service is in many ways the backbone of the weather enterprise. As mentioned previously, NWS meteorologists are in constant communication and coordination with the various other meteorological sectors—for example, during severe weather events, meteorologists at local field offices work directly with emergency management officials, and broadcasters and private sector forecasting entities depend on them for up-to-date hazard warning information. Similar communication occurs at the national level, between various partners and the national centers. Moreover, information not only flows from the NWS, but to them as well. The NWS is the center of a multi-directional, multi-channel information current. In addition, while only indirectly related to partner work as we framed it (within a forecasting perspective), the NWS also handles a substantial amount of public weather outreach through talks to school groups, scout troops, and the like, and through their SKYWARN® storm spotter training program.

Considering that meteorologists tend to share personality similarities, it is plausible they are also similar in their expressions of grit, life satisfaction, self-concept clarity, subjective happiness, stress, and depression. The available data between our two studies also suggest possible buffering factors that meteorologists may innately make use of in carrying out their daily work tasks. For example, people low in self-concept clarity tend to be more neurotic, to have lower self-esteem, and to be less agreeable (Campbell et al., 1996; Dunlop, 2017). Higher self-clarity could explain some of the possible buffering effects observed in our work to date. Self-concept clarity has also been implicated as interacting with conscientiousness as a predictor of the interest consistency component of grit (but not of the perseverance component—rather, conscientiousness alone is so predictive; Fite, Lindeman, Rogers, Voyles, & Durik, 2016).

The meteorological workplace is demanding. Given the way its occupants appear psychologically predisposed, it makes sense that resilience, positivity, and self-awareness would be expressed similarly among meteorologists. Perhaps resilience is one factor that attracts meteorologists to, or keeps them in, the field. As for happiness, stress, and depression, we have been unable to identify, through anecdotal discussion and our own subjective experiences within the weather enterprise—as colleagues and observers of meteorologists over the years—reasons any one sector would differ more than another, as born out in this study's findings.

Limitations. Considerations of participant honesty, attention, and accurate question interpretation are in order, along with other limitations of self-report research (e.g., Austin, Gibson, Deary, McGregor, & Dent, 1998). Almost three dozen participants skipped two items directly implicating employment conditions in mental health, indicating either standard impression management concerns or a unique concern for job security among meteorologists. Given recent work (2020) by NWS meteorologist Crystal Worley observing forecasters are often uncomfortable discussing mental health with their supervisors, this warrants further internal investigation within the Weather Service. Overall, findings must be interpreted in the context of a self-reported, online study. As this study was purely correlational, it is unable to explain causal reasons for employment sector differences.

Finally, because we did not assess participant origin and whether individuals learned of the survey from social media or email distribution, the sample perhaps incurred a selection bias. On the one hand, while evidence for social media effects upon well-being are mixed, social media recruitment might have increased feelings of negativity in the sample. On the other hand, recruitment from professional societies may have increased extraversion.

Conclusion

One's ability to psychologically buffer can critically assist in coping with stress (Wills & Filer, 2001). The present study presents some important differences in the types of negativity each meteorological sector experiences, but no differences emerged among those that buffer from stress. While situational factors such as unpredictable hours or harassment may influence stress, participants tended to score highly on measures of constructs which likely protect against these stressors. No hypotheses were specified, but results are in line with what could be expected from the types of workplace conditions associated with the various meteorological sectors. Both self-reported psychological problems and open-ended testimonies indicate a fair amount of workplace dissatisfaction in the field overall.

An important concluding and future research point is the 24-hour news cycle, of which meteorological communication is a part of, is wreaking havoc on employee sleep schedules. Shift work provides ample opportunity for burn-out, exhaustion, anxiety, and decreased life satisfaction, largely due to long hours and unpredictability. Worley (2020) reported that 59% of her respondents indicated shift work had exacerbated their mental health issues. This finding, alongside ours, only underscores the importance of, and need for, further work on this topic. Replication-based

³ In addition to an array of 122 local field offices, 21 Center Weather Service Units co-located with the Federal Aviation Administration's Air Route Traffic Control Centers, 13 River Forecast Centers, research labs, 2 tsunami warning centers, and a Spaceflight Meteorology Group, the NWS is comprised of 8 national offices (the National Centers for Environmental Prediction, collectively, which also have a Central Operations office) that all coordinate amongst each other and at the regional and local Weather Forecast Office (WFO) field levels. These are the Aviation Weather Center,

research is needed to confidently draw conclusions from, and support solutions based on, the study reported here. Given recent discussion within the meteorological field, psychologists and health researchers should also focus on meteorologists' responses to critical incident stress. Finally, work should investigate methods by which to improve job satisfaction and occupational pride, and attempt to ameliorate workplace hardships, among meteorologists.

Appendix: Meteorological Employments Sectors

NWS meteorologists, responsible for providing daily forecasts across a variety of contexts (local, regional, national spatial scales; and all manner of meteorological phenomena), work primarily behind-the-scenes. They issue the severe weather watches, warnings, and advisories across the U.S., working in these round-the-clock endeavors not only within their own agency but with many other sectors of the field. Further, some are involved in research and formal atmospheric study and many foster local weather outreach and safety programs.³

Broadcasters are the public-oriented faces of the field in the same way people are likely to first think of therapists and mental health counselors when talking about psychology; they are on TV transmitting public

Climate Prediction Center, Environmental Modeling Center, National Hurricane Center, Ocean Prediction Center, Space Weather Prediction Center, Storm Prediction Center (SPC), and Weather Prediction Center. An important distinction is that watches are issued by the SPC and advisories and warnings are issued by the local WFOs. Further, an important part of the WFO forecaster's job is communication with partners; this includes direct discussion about impending weather threats with emergency management officials, broadcasters, and those in the private sector.

weather messages and often develop degrees of celebrity when interacting with the general public.

Private sector meteorologists work in many areas: some are forecasters, or work in various support roles, at companies like AccuWeather or The Weather Channel; others are Certified Consulting Meteorologists who consult for legal cases involving weather events; some run independent companies and consult to provide forecasts to businesses or industry entities such as those dealing in oil, energy, or agriculture; other meteorologists are academics involved in university education and research, while there are meteorologists employed by the military; and some who earn a degree in the subject go on to teach grade school science or math topics. Meteorologists in many different areas also work in public and pre-college weather education. Meteorological jobs are many, and the requirements for one may be very different from the next. For statistical comparison purposes, we grouped our academic, non-NWS operational, and military meteorologists with those who selected “Other.”

References

- Akiskal, H. S. (1985). Anxiety: definition, relationship to depression and proposal for an integrative model. In Tuma, A. H. & Maser, J. D. (Eds.), *Anxiety and the anxiety disorders* (787–98). Routledge.
- Andrews, F. M., & Withey, S. B. (1976). *Social indicators of well-being: America's perception of life quality*. Plenum.
- Austin, E. J., Gibson, G. J., Deary, I. J., McGregor, M. J., & Dent, J. B. (1998). Individual response spread in self-report scales: Personality correlations and consequences. *Personality and Individual Differences*, 24, 421–38.
- Baron-Cohen, S. (2008). Autism, hypersystemizing and truth. *Quarterly Journal of Experimental Psychology*, 61, 64–75.
- Baum, A. (1990). Stress, intrusive imagery, and chronic distress. *Health Psychology*, 6, 653–75.
- Bolton, M. J. (2018, August). *How to deal with impostor syndrome—or, how to know when your inner monologue is lying to you*. [Video]. YouTube.
https://youtu.be/_Kgyz63WDPM
- , Ault, L. K., Greenberg, D. M., & Baron-Cohen, S. (2018). Exploring the human side of meteorology: A brief report on the psychology of meteorologists. *Journal of Operational Meteorology*, 6(3), 23–32.
<https://doi.org/10.15191/nwajom.2018.0603>
- , & DePodwin, R. A. (2019). “So what if I’m not OK?” A discussion on meteorologists’ emotional wellbeing and healthy coping mechanisms for weather professionals in the face of mental health challenges. *PsyArxiv* preprint.
<https://doi.org/10.31234/osf.io/zh2va>
- , & DePodwin, R. A. (2020, January). *A psychologist and a meteorologist walk into a bar: A candid discussion of mental health in personal and meteorological contexts*. Annual Meeting of the American Meteorological Society, Boston, MA, United States.
- Boslaugh, S. (2012). *Statistics in a nutshell: A desktop quick reference* (2nd ed.). O’Reilly.
- Busseri, M. A., & Sadava, S. W. (2010). A review of the tripartite structure of subjective well-being: Implications for conceptualization, operationalization, analysis, and synthesis. *Personality and Social Psychology Review*, 15, 290–314.
<https://doi.org/10.1177/1088868310391271>
- Campbell, J. D., Trapnell, P. D., Heine, S. J., Katz, I. M., Lavallee, L. F., & Lehman, D. R. (1996). Self-concept clarity: Measurement, personality correlates, and cultural boundaries. *Journal of*

- Personality and Social Psychology*, 70, 141–56.
- Chen, P., Sparrow, P., & Cooper, C. (2016). The relationship between person-organization fit and job satisfaction. *Journal of Managerial Psychology*, 31(5), 946–59. <https://doi.org/10.1108/JMP-08-2014-0236>
- Clark, L. A. (1989). The anxiety and depressive disorders: Descriptive psychopathology and differential diagnosis. In Kendall, P. C. and Watson, D. (Eds.), *Anxiety and Depression: Distinctive and overlapping features*. Academic Press.
- , & D. Watson. (1990). Theoretical and empirical issues in differentiating depression from anxiety. In Becker, J. and Kleinman, A. (Eds.), *Advances in mood disorders* (Vol. 1, pp. 39–65). Erlbaum.
- Corr, P. J., & Matthews, G. (2009). *The Cambridge handbook of personality psychology*. Cambridge University Press.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49, 71–75.
- , Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, 125, 276–302.
- Dinno, A. (2015). Nonparametric pairwise multiple comparisons in independent groups using Dunn's test. *The Stata Journal*, 15(1), 292–300.
- Dobson, J. S. (1985). The relationship between anxiety and depression. *Clinical Psychology Review*, 5, 307–24.
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92(6), 1087–1101. <https://doi.org/10.1037/0022-3514.92.6.1087>
- Dunlop W.L. (2017). Situating self-concept clarity in the landscape of personality. In J. Lodi-Smith & K. DeMarree (Eds.), *Self-concept clarity* (pp. 19–41). Springer.
- Fite, R. E., Lindeman, M. I. H., Rogers, A. P., Voyles, E., & Durik, A. M. (2017). Knowing oneself and long-term goal pursuit: Relations among self-concept clarity, conscientiousness, and grit. *Personality and Individual Differences*, 108, 191–94. <https://doi.org/10.1016/j.paid.2016.12.008>
- Gable, S. L., & Haidt, J. (2005). What (and why) is positive psychology? *Review of General Psychology*, 9, 103–10. <https://doi.org/10.1037/1089-2680.9.2.103>
- Gilford, D., Moser, S., DePodwin, B., Moulton, R., & Watson, S. (2019). The emotional toll of climate change on science professionals. *Eos*, 100. <https://doi.org/10.1029/2019EO137460>
- Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). A very brief measure of the Big Five personality domains. *Journal of Research in Personality*, 37, 504–28.
- Greenwald, A. G., & Pratkanis, A. R., (1984). The self. In R. S. Wyer and T. K. Srull (Eds.), *Handbook of social cognition* (Vol. 3, pp. 129–78). Erlbaum.
- Judge, T. A., Weiss, H. M., Kammeyer-Mueller, J. D., & Hulin, C. L. (2017). Job attitudes, job satisfaction, and job affect: A century of continuity and of change. *Journal of Applied Psychology*, 102(3), 356–74. <https://doi.org/10.1037/apl0000181>
- Kline, P. (2000). *Handbook of psychological testing*. London, UK: Routledge.
- Kihlstrom, J. F., & Cantor, N. (1984). Mental representations of the self. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 17, pp. 1–47). Academic Press.

- , Cantor, N., Albright, J. S., Chew, B. R., Klein, S. B., & Neidenthal, P. M. (1988). Information processing and the study of the self. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 21, pp. 159–87). Academic Press.
- Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work Stress*, *19*, 192–207. <https://doi.org/10.1080/0267837050297720>
- Lang, F. R., John, D., Lüdtke, O., Schupp, J., & Wagner, G. G. (2011). Short assessment of the Big Five: Robust across survey methods except telephone interviewing. *Behavioral Research Methods*, *43*, 548–67. <https://doi.org/10.3758/s13428-011-0066-z>
- Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*, *44*, 1–21.
- Leighton, A. H. (1949). *Human relations in a changing world: Observations of the uses of the social sciences*. Literary Licensing.
- Lese, A. (2019, September). *Keynote address*. Invited talk at the 44th Annual Meeting of the National Weather Association, Huntsville, AL.
- Levine, T. R., & Hullett, C. R. (2002). Eta squared, partial eta squared, and misreporting of effect size in communication research. *Human Communications Research*, *28*, 612–25. <https://doi.org/10.1111/j.1468-2958.2002.tb00828.x>
- Locke, E. A. (1976). The nature and causes of job satisfaction. In M. D. Donnette (Ed.), *Handbook of industrial and organizational psychology*. Rand McNally.
- Loehlin, J. C., & Nichols, R. C. (1976). *Hereditary, environment, and personality: A study of 850 sets of twins*. University of Texas Press
- Lovibond, S. H., & Lovibond, P. F. (1995a). *Manual for the Depression Anxiety Stress Scales* (2nd ed.). Psychology Foundation.
- . (1995b). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behavioral Research and Therapy*, *33*, 335–43.
- Lyubomirsky, S., & Lepper, H. S. (1999). A measure of subjective happiness: Preliminary reliability and construct validation. *Social Indicators Research*, *46*, 137–55.
- . (2001). Why are some people happier than others? The role of cognitive and motivational processes in well-being. *American Psychologist*, *56*, 239–49.
- Macdonald, S., & MacIntyre, P. (1997). The generic job satisfaction scale: Scale development and its correlates. *Employee Assistance Quarterly*, *13*, 1–16.
- Mattei, D., & Schaefer, C. E. (2004). An investigation of validity of the Subjective Happiness Scale. *Psychological Reports*, *94*, 288–90. <https://doi.org/10.2466/pr0.94.1.288-290>
- Markus, H., (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology*, *35*, 63–78.
- Maslach, C. (1976). Burned-out. *Human Behavior*, *5*, 16–22.
- McCrae, R. R. (2001). Trait psychology and culture: Exploring intercultural comparisons. *Journal of Personality*, *69*(6), 819–46. <https://doi.org/10.1111/1467-6494.696166>
- McCrae, R. R., & Costa, P. T., Jr. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology*, *52*, 81–90. <https://doi.org/10.1037/0022-3514.52.1.81>

- , & John, O. (1992). An introduction to the Five-Factor Model and its applications. *Journal of Personality, 60*, 175–215.
<https://doi.org/10.1111/j.1467-6494.1992.tb00970.x>
- Milrad, S. (2016, December). The mental price of graduate school. <http://shawnmilrad.com/blog>
- Myers, D. G., & Diener, E. (1995). Who is happy? *Psychological Science, 6*, 10–19.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw Hill.
- Pines, A., & Aronson, E. (1988). *Career burnout: Causes and cures*. The Free Press.
- Schaufeli, W. B., & Greenglass, E. R. (2001). Introduction to special issue on burnout and health. *Psychology Health, 16*, 501–10.
- Scheier, M. F., & Carver, C. S. (1992). Effects of optimism on psychological and physical wellbeing: Theoretical overview and empirical update. *Cognitive Therapy Research, 16*, 201–28.
- , & Carver, C. S. (1993). On the power of positive thinking: The benefits of being optimistic. *Current Directions in Psychological Science, 2*, 26–30.
- Shin, D. C. & Johnson, D. M. (1978). Avowed happiness as an overall assessment of the quality of life. *Social Indicators Research, 5*, 475–92.
<https://doi.org/10.1007/BF00352944>
- Shirom, A. (1989). Burnout in work organizations. In C. L. Cooper and I. T. Robertson (Eds.), *International review of industrial and organizational psychology* (pp. 25–48). Wiley.
- Specht, J., Egloff, B., & Schmukle, C. S. (2011). Stability and change of personality across the life course: The impact of age and major life events on mean-level and rank-order stability of the big five. *German Institute for Economic Research, 377*, 1–58.
<https://www.econstor.eu/handle/10419/150922>
- Spector, P. E. (1997). *Job satisfaction: Application, assessment, causes and consequences*. Sage.
- Stavrakaki, C. & Vargo, B. (1986). The relationship of anxiety and depression: A review of the literature. *British Journal of Psychiatry, 149*, 7–16.
- Strong, H. (2018). *How diversity affects feedback: Navigating the gender gap from viewer comments to workplace discussions*. Annual Meeting of the National Weather Association, St. Louis, MO, United States.
- Troy, A. S., & Mauss, I. B. (2011). Resilience in the face of stress: Emotion regulation as a protective factor. In S. M. Southwick, B. T. Litz, D. Charney, & M. J. Friedman (Eds.), *Resilience and mental health: Challenges across the lifespan* (pp. 30–44). Cambridge University Press.
- Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology, 97*, 346–53.
- Wills, T. A., & Filer, M. (2001). Social networks and social support. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 209–34). Erlbaum.
- Worley, C. (2020, January). *Boiling point: NWS workers and mental illness*. Annual Meeting of the American Meteorological Society, Boston, MA, United States.
- Wood, S. A., & Hampson, S. E. (2005). Measuring the Big Five with single items using a bipolar response scale. *European Journal of Personality, 19*, 373–90.
- Yuzuk, R. P. (1961). *The assessment of employee morale: A comparison of two measures*. Ohio State University
- Zee, G. (2017). *Natural disaster: I cover them. I am one*. Kingswell.