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ARTICLE

# Winter is coming: Wintertime mindset and wellbeing in Norway

**Kari Leibowitz · Joar Vittersø**

**Abstract:** Previous research of the effect of winter on wellbeing has yielded contradictory findings. While there is evidence that the lack of sunlight in wintertime can lead to seasonal depression and negative emotions, many individuals are able to thrive during the winter. What might determine whether the darkness of winter leads to poor psychological outcomes? To investigate whether or not mindset contributes to wintertime wellbeing, we assessed wintertime mindset via a Wintertime Mindset Scale measuring attitudes towards winter. A survey of 238 respondents from southern Norway, northern Norway, and the Arctic island of Svalbard identified correlations between positive wintertime mindset and measures of wellbeing, including life satisfaction and positive emotions. Latitude and wintertime mindset were also correlated, with more northern residents, who experience significantly more darkness and somewhat colder temperatures during the winter, holding more positive wintertime mindsets, and wintertime mindset statistically mediating the relationship between location and wellbeing. These results suggest that mindset is a previously overlooked factor of seasonal wellbeing, especially in places where the winter darkness is more extreme. Implications of these findings and suggestions for further research are discussed.

**Keywords:** mindset, wellbeing, seasonal affective disorder, winter, arctic, latitude

## 1. Introduction

Dark is bad and light is good. This assumption is not only documented in metaphor theory (e.g., Lakoff & Johnson, 1999) and what most people believe when it comes to the association between sunshine and happiness (Schkade & Kahneman, 1998; Watson, 2000), but is also reflected in our language. Someone who is cheerful has a "sunny" disposition, while depressing thoughts are described as "dark." As the darkest time of the year, winter is often subject to the negative categorization associated with darkness. When the weather is "bad," which usually means cold, dark, and wet, people are more likely to write negative posts on social media (Coviello et al., 2014), and, across North America, city-wide initiatives are springing up to help citizens battle the winter blues (Theobold, 2015). Based on prevailing negative beliefs about winter and research on wintertime depression, people may assume that those living at extreme latitudes with dark winters must suffer through the winter months (Beecher et al., 2016; Denissen, Butalid, Penke, & van Aken, 2008; Liu, Liu, & Yu, 2015; Schkade & Kahneman, 1998; Young, Meaden, Fogg, Cherin, & Eastman, 1997).

The belief that winter is a dreadful time of year may have been inadvertently strengthened by psychological science on winter. The vast majority of psychological research on winter concerns the ways winter can be particularly harmful to mental health and wellbeing (Rosenthal, Sack,

Kari Leibowitz
Stanford University
kaleibowitz@gmail.com

Gillin, & et al., 1984). The American Psychological Association has asserted that lack of exposure to the sun increases depressive symptoms, especially during the winter season (Beecher et al., 2016). Seasonal Affective Disorder, first described by Rosenthal and colleagues in 1984 (SAD; Rosenthal et al., 1984), is characterized by a recurrent pattern of seasonal depression, which most often occurs in the winter. Since Rosenthal and colleagues first described Seasonal Affective Disorder (SAD; Rosenthal et al., 1984), the idea of wintertime depression has become embedded in the public perception of winter, inspiring pop culture (such as an episode of NBC's *30 Rock*,) and a slew of books and articles about the topic (including a *Seasonal Affective Disorder for Dummies* book).

A critical component of Seasonal Affective Disorder is the idea that the relative lack of sunshine of the winter months contributes to seasonal depression (Rosenthal et al., 1984). In Rosenthal's initial study, patients saw the alleviation of depressive symptoms after undergoing artificial light therapy to supplement the amount of light patients were exposed to during the winter (Rosenthal et al., 1984). Based on this evidence, Rosenthal and his colleagues posited the 'latitude hypothesis': the hypothesis that as latitude increases, so too should rates of SAD, such that populations living far north (or south) of the equator, who experience little to no direct sunlight in the winter, should be more prone to SAD. This hypothesis has been supported by other research on psychological issues in winter in the U.S. (Molin, Mellerup, Bolwig, Scheike, & Dam, 1996; Rosen et al., 1990) as well as other work on the effects of light therapy on depression (Gordijn, 't Mannetje, & Meesters, 2012; Najjar et al., 2014).

Yet other research contradicts the latitude hypothesis. Several studies conducted in the Arctic and sub-Arctic of Norway, at extreme latitudes that receive little to no sunlight in the winter, find that people living in these locations do not have higher rates of seasonal affective disorder than those living at lower latitudes (Brancaleoni, Nikitenkova, Grassi, & Hansen, 2009; Johnsen, Wynn, & Bratlid, 2012). For example, a study comparing students in Tromsø, Norway, located north of the Arctic Circle, with students living in Italy found no evidence to support the hypothesis that the prevalence of seasonal affective disorder was related to the amount of daylight and latitude of living (Brancaleoni et al., 2009). Further, after reviewing 20 retrospective studies examining seasonal mood variation, Magnusson concluded that "the effect of latitude is probably small" (Magnusson, 2000). Finally, an analysis of almost 9000 residents in Tromsø failed to find any significant seasonal variation in levels of self-reported mental distress (Johnsen et al., 2012). Based on this evidence, the authors concluded that, for the majority of adults, winter's negative impact on mental health is more of a popular myth than a scientific fact (Johnsen et al., 2012, p. 5). This seems to be especially true for those living at extreme latitudes in Northern Norway.

This is not to say that people living at these latitudes are unaffected by the extreme shifts in daylight that occur between the winter 'Polar Night' period – in which, in Tromsø, the sun does not rise over the horizon for two full months – and the summer 'Midnight Sun' period, during which time the sun remains above the horizon for two months. There is evidence to suggest that these extreme changes in light influence sleep, energy, and mood (Haggag, Eklund, Linaker, & Götestam, 1990; Hansen, Lund, & Smith-Sivertsen, 1998; Johnsen et al., 2012). These studies have found that residents of Tromsø are more tired in the winter (Haggag et al., 1990) and have more sleep problems (Hansen et al., 1998; Johnsen et al., 2012). However, these disturbances are typically subclinical, and not as extreme as would be supposed by the latitude hypothesis of Seasonal Affective Disorder (Haggag et al., 1990; Rosenthal et al., 1984).

At high latitudes, behavioral changes with the seasons are considered normal and adaptive. In general, residents of the high north sleep more and have less energy during the dark period,

but this is viewed as a normal yearly cycle, rather than pathology associated with depression (Hansen et al., 1998). Many of the studies that discuss the theoretical relationship between Seasonal Affective Disorder and latitude fail to take into account the adaptive ways residents in the high north, and elsewhere, shift their behavior as the seasons change. Somehow, the residents of the high north must find a way to accept and work *with* the extreme winter, rather than against it.

Throughout the world, millions of people each year make it through winters of varying severity without developing Seasonal Affective Disorder. What is it that allows some people to thrive during even the coldest, darkest winters, while others experience debilitating Seasonal Affective Disorder? Research suggests objective weather has little to no effect on well-being (Denissen et al., 2008; Keller et al., 2005; Watson, 2000). Denissen and colleagues found large variability in the effect of weather on individuals' moods, and that this variability was largest for the amount of daily sunlight (Denissen et al., 2008). Indeed, this study found that while the shortening daylight may lead to a strong depression in mood for some people, it can also lead to an equally strong boost in mood for others, indicating that the subjective experience of daylight has a far greater influence on individuals' moods than objective hours of daylight (Denissen et al., 2008). This work suggests that more important than the actual influence of weather on mood is one's psychological interpretation of the weather. Hence, the present study seeks to explain the contradictory findings regarding the effect of winter on wellbeing by investigating how adaptation to long and dark winters may be influenced by a particular mentality that we refer to as wintertime mindset. By examining mindset as a potential factor that captures what people believe about winter and, subsequently, how winter affects them, we hope to understand what can be learned from residents of the high north about how to thrive during the winter.

Mindsets are selective viewpoints that help us simplify and organize complex information, and they include things like our thoughts, beliefs, and expectations. Recent literature on the concept of mindset suggests that mindsets play a role in many aspects of human functioning, including health and wellness (Blackwell, Trzesniewski, & Dweck, 2007; Conner, Boles, Markus, Eberhardt, & Crum, 2019; Crum, Corbin, Brownell, & Salovey, 2011; Crum & Langer, 2007; Crum, Leibowitz, & Verghese, 2017; Crum, Salovey, & Achor, 2013; Dweck, 2006, 2008; Howe et al., 2019; Zahrt & Crum, 2020). Mindsets help individuals quickly make sense of information by orienting an individual toward a specific framework to understand a situation or environment (Crum et al., 2013). This, in turn, helps individuals respond in subjectively appropriate ways. Mindsets influence our lives in a variety of ways, most notably by guiding our behavior. For example, those with a negative mindset towards aging have been shown to take fewer proactive measures towards healthy aging, such as engaging in physical exercise and visiting a physician (Levy & Myers, 2004). And, in a study examining mindsets towards stress, those who held the mindset that stress is performance-enhancing demonstrated a stronger desire to receive potentially helpful feedback to improve their performance in a stressful situation (Crum et al., 2013). An important distinction here is that individuals' experiences were not driven by an objective reality of their circumstances, such as amount or type of stress. Rather, meaningful outcomes were driven by participants' beliefs and expectations about those circumstances. As such, mindsets can powerfully shape outcomes in absence of an objective truth – while stress may, in truth, be a paradox that can be both good or bad for our performance, a critical factor in determining the impact of stress may be people's mindsets about stress (Crum et al., 2013).

Like stress, winter is a paradox, full of opportunities for joy (cozy nights spent with loved ones, the serenity of fresh snowfall) and opportunities for despair (cleaning the ice off your car windshield, trudging home in the sleet). With the concept of mindset, we can begin to imagine

mindset about winter as a factor that might account for conflicting evidence regarding the influence of winter on wellbeing. A long, dark winter may not be objectively good or bad for mental health and wellbeing. Rather, individuals' subjective experiences and interpretations of wintertime may determine winter's influence on wellbeing. The compelling literature regarding mindsets' influence over a wide range of behavioral and physical outcomes inspired us to ask: Is mindset toward winter related to seasonal wellbeing? We suggest that studies concentrating only on mental distress and Seasonal Affective Disorder in the high north have overlooked the many positive aspects of winter that allow people all over the world to enjoy the season. Wintertime mindset may thus be a factor that encourages positive wintertime mental health.

In this context, *wintertime mindset* can be understood as how one thinks about and relates to the winter. Mindsets elicit cognitive schemas, so a wintertime mindset is comprised of what comes to mind when someone thinks about winter: what do you expect winter will be like? Does winter represent a time of year with many things to look forward to (a positive wintertime mindset) or a time of year with many things to dread (a negative wintertime mindset). Of course, like any season, the truth is that winter is both – there are things about winter that can be wonderful, and others that can be miserable. But since mindsets represent a subjective way of viewing the world, they often take the form of mental shortcuts that give an overall impression of a situation or thing. Someone with a positive wintertime mindset might have associations with winter as a beautiful or cozy time of year, full of unique opportunities for activities they enjoy, such as skiing or spending nights in front of a fire. Conversely, someone with a negative wintertime mindset might associate winter with freezing darkness, and see winter as a time of year when they are limited – forced to stay inside to avoid the cold.

We hypothesize that wintertime mindsets influence individuals' interpretation of wintertime events. Individuals with a positive wintertime mindset might attune more to the beauty of the snow and refreshing bite of the air when outside; individuals with a negative wintertime mindset might attune to the fact that snow means shoveling driveways and sidewalks and that the bitter air numbs their faces. In this way, individuals with different wintertime mindsets might view the same objective event – a recent snowfall – in two completely different ways. This selective interpretation of winter is then likely to influence individuals' reported wellbeing during winter.

Importantly, these mindsets are not an assessment of the *true* nature of winter. In truth, winter, like any season, has both positives and negatives. Fewer hours of sunlight a day can be both an opportunity for sitting by the fire and also lead one to feel sluggish. Snow can be both a beautiful opportunity for skiing and necessitate shoveling one's driveway and cleaning off one's car before going to work in the morning. The power of mindset lies in the somewhat selective interpretation and filtering of information that can lead to beneficial outcomes in the face of a paradoxical reality.

We hypothesize that a positive wintertime mindset is at least partly responsible for the ability of people living in the high north in Scandinavia to thrive during the darkness of winter. It is our hope that, by identifying the relationship between these mindsets and wintertime wellbeing, we can add a new element to the current discourse on seasonal wellbeing. This work thus has the potential to spark future research that helps us build a positive psychological framework of seasonal wellbeing.

### *1.1 The present study: wintertime mindset in Norway*

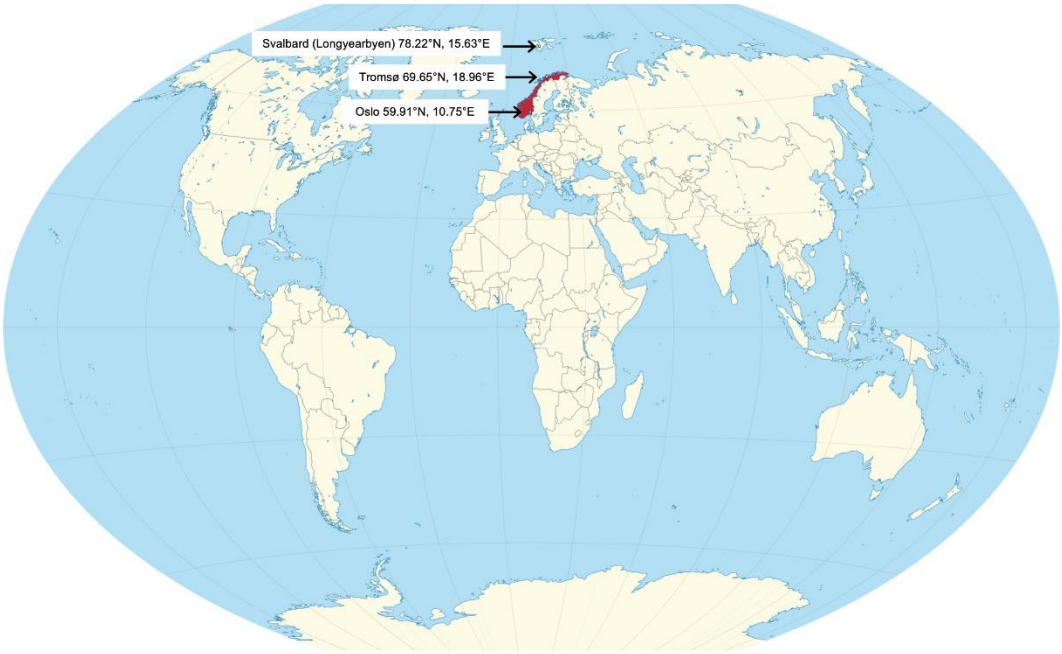
The present study is a first attempt at understanding the relationship between winter darkness, mindset, and wellbeing. Norway provides a unique opportunity for studying the psychological effects of extreme conditions of light and dark. This study sought to examine wellbeing in

relation to the dark period in northern Norway by comparing residents living in the Oslo area in southern Norway (Oslo is located at 59° N), the Tromsø area in northern Norway (69° N), and in Longyearbyen in the Norwegian arctic archipelago of Svalbard (78° N). (See Figure 1).

**Figure 1. (A) Map of Europe with Oslo, Tromsø, and Longyearbyen highlighted (B) World map with Oslo, Tromsø, and Longyearbyen highlighted**

(A)

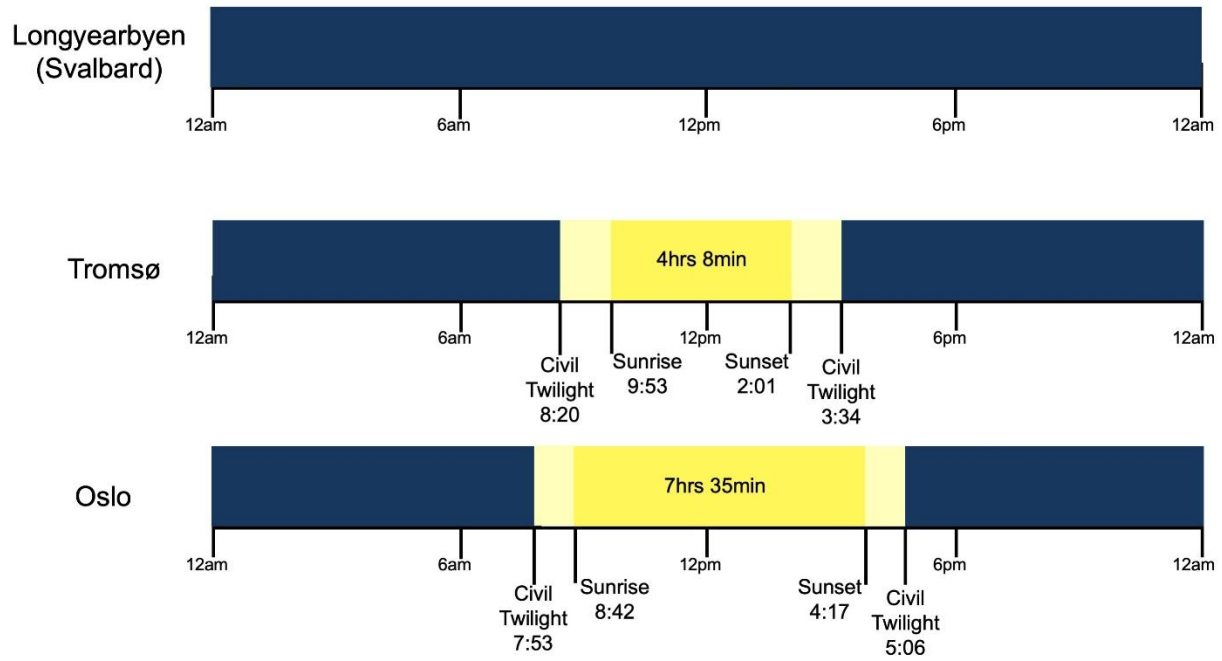

(B)




During the darkest time of the year, from November to January, southern Norway (Oslo) receives about 6 hours of direct sunlight a day. Northern Norway (Tromsø, in Troms county), which experiences the Polar Night period, receives no direct sunlight from mid-November to mid-

January, but has anywhere from 2 to 5 hours of civil twilight each day, as the sun skirts just below the horizon. In Svalbard, the Polar Night period is 4 months and for two months the region experiences no light, including twilight. See Figure 2 for an example of relative daylight between the regions at the end of January.

**Figure 2. Sunrise, sunset, and civil twilight times in Oslo, Tromsø, and Svalbard on 27 January, 2015, the approximate midpoint of the study period**




Tromsø is significantly farther north than Oslo (1148 kilometers): for reference, the distance from Oslo to Tromsø is approximately equal to the distance from Miami to New York in the United States (Figure 1). However, Tromsø is on the Gulf Stream, so the extreme difference in latitude is not matched by a difference in winter temperatures. In fact, the average winter temperature is similar in both Oslo and Tromsø: around -4°C (25°F). Due to the similarity in climate between Tromsø and southern Norway, it is particularly appropriate to conduct wintertime studies of how light, or lack thereof, influences psychological wellbeing by comparing these regions. Southern Norway provides a baseline for comparison with northern Norway, as these areas are similar not only in regards to winter temperature, but also in terms of culture and quality of life. Thus, the average amount of direct daylight in midwinter is one of the most significant environmental differences between these regions. Svalbard experiences a much more extreme winter. In addition to receiving no light whatsoever for two months, average winter temperatures hover around -16°C (3°F). Because of its extreme location, residents of Svalbard tend to live there for only a few years at a time, and are much more self-selecting than those living in Oslo and Tromsø. As such, investigating wintertime mindsets in Svalbard provides insight into a more extreme winter sample differing from the other regions in light, temperature, and population.

### *1.2 Research questions*

The prevailing attitude of adaptability and 'leaning in' to the winter in Tromsø inspired our first research question: Are there certain mindsets that contribute to wintertime wellbeing in northern

Norway? As a first step towards answering this question, we developed and conducted an initial validation of a 'Wintertime Mindset' scale. Our second research question asks: Is wintertime mindset associated with measures of wellbeing?

We approached both research questions by surveying respondents living in southern Norway, northern Norway, and Svalbard about their wellbeing and mindset in the middle of winter (in January, at the end of the Polar Night in Tromsø and during the Polar Night in Svalbard). In doing so, we identified relationships between wintertime mindset and wellbeing. We hope the identification of such relationships will spawn further research in this area, in order to better understand mindsets that may promote wintertime flourishing. This paper describes the Wintertime Mindset Scale and provides evidence for the relationship between wintertime mindset and wintertime wellbeing in the high north.

## 2. Method

### *2.1 Participants*

The gross sample comprised 1,500 randomly selected persons from a register of all physical mail (i.e. letters sent in envelopes) addresses in three geographic areas in in Norway—the capital (Oslo), the county of Troms (which contains the city Tromsø), and Svalbard (primarily the town of Longyearbyen). A total of 238 responses were returned, yielding a response rate of 15.9%. Previous research suggests this response rate is common (e.g., PEW Research Center, 2012). A one-variable chi-square test showed that response rates did not differ between the three locations, $\chi^2 = 0.37$, $p = .833$. The mean age of the sample was 46.18 years ($SD = 12.48$), as calculated from weighed mid-values of eight age categories. Males comprised 45% of the sample, and 93% were born in Norway to Norwegian parents. The sample was almost evenly split between respondents living in Southern Norway (32.9%), respondents living in Northern Norway (31.9%), and respondents living in Svalbard (35.2%).

### *2.2 Recruitment*

Respondents were invited to participate in our survey via letters mailed to a random sample of the population in the three afore-mentioned regions of Norway. We employed the 'Bring' mailing company to send 500 letters to potential subjects in southern Norway, 500 to northern Norway (excluding Svalbard), and 500 to Svalbard. The letter contained a message inviting participants to take part in our survey and the link to our online survey. Letters were sent out on January 5 in 2015, and participants completed surveys between January 16 and February 7. January 16 to February 7 spans the last week of the Polar Night to the first two weeks with the return of the sun in Northern Norway, and is a time in which Svalbard experiences almost no light each day. See Figure 2 for an example of relative daylight between the regions on January 27, 2015, the approximate midpoint of our study period.

As incentive, subjects were told that they would be entered into a lottery to win one of five gift certificates worth 1000 NOK each (~125 U.S. dollars). As an additional incentive, both to attract participants to complete surveys and to keep participants engaged during the course of the survey, feedback on certain measures was provided throughout the survey. Participants were informed of their raw score relative to the total possible score for the Mental Health Continuum, the Wintertime Mindset Scale, and the Satisfaction with Life Scale. These raw scores were referred to as participants' 'Flourishing,' 'Positive Winter Mindset,' and 'Satisfaction with Life' Scores, respectively.

All surveys and accompanying information were delivered in Norwegian, with the option for participants to switch to English located on the website.

### *2.3 Measures*

#### *2.3.1 Subjective wellbeing (SWB)*

We created a composite SWB scale comprising three subscales: life satisfaction, positive emotions, and negative emotions as detailed below.

*The Satisfaction with Life Scale* (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure participants' life satisfaction. Participants rated how much they agreed or disagreed (scale: 1 = *strongly disagree* to 7 = *strongly agree*) with five statements pertaining to life satisfaction. The total score was the mean of all five responses (producing a range of 1-7). Cronbach's alpha ($\alpha$) for the SWLS was .93.

*Positive emotions* were measured with three items from the Basic Emotions Trait Test (BETT; Vittersø, Dyrdal, & Røysamb, 2005). The items were pleasure, satisfaction, and happiness, and the instructions asked how often participants felt each of these emotions in their everyday lives, with response options running from 1 (*never*) to 7 (*all the time*). Cronbach's alpha for the positive emotion subscale was .88.

*Negative emotions* were also measured with three items from the Basic Emotions Trait Test (BETT; Vittersø et al., 2005). The items were anger, sadness, and fear, and the instructions again asked how often participants felt each of these emotions in their everyday lives, with response options running from 1 (*never*) to 7 (*all the time*). Cronbach's alpha for the negative emotion subscale was .60, reflecting low internal stability, and indicating risks of underestimating the effect sizes in subsequent analyses. However, the average inter-item correlation for the composite score was .33, which may be regarded as sufficient (Bollen & Lennox, 1991). Moreover, we also ran separate analyses for each of the three negative emotion items and none of these differed from analyses using the composite score in terms of significance. Since only the reliable part of item variances are utilized in the latent variable models, the Cronbach's alphas are irrelevant for those analyses.

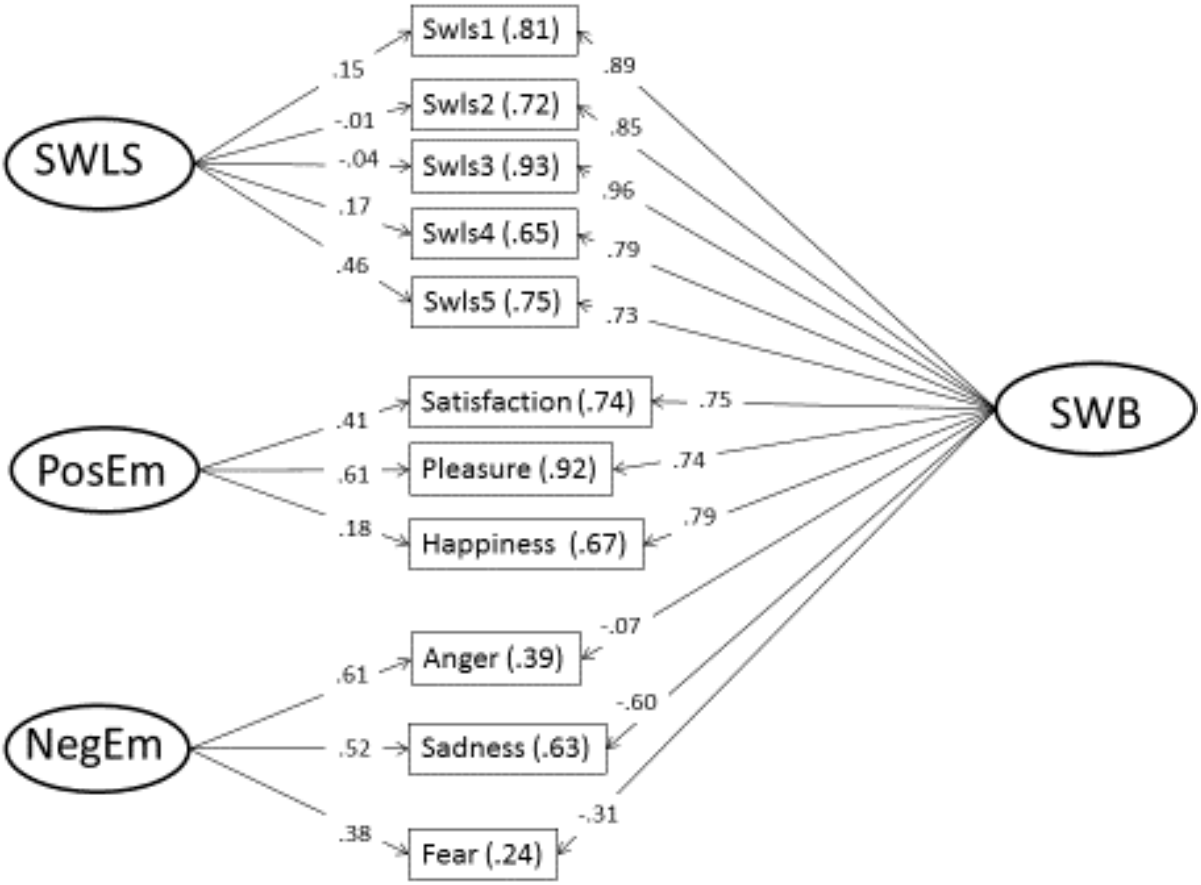
A confirmatory factor analyses with SWB as the common factor and the items from the SWLS, positive emotions and negative emotions additionally loading on three independent, nested factors was estimated. The structure of the model is depicted in Figure 3 (below). The factor model fitted the data well: $\chi^2$ (30, N = 226) = 49.47 (p = .033), CFI = .99, RMSEA = .05 (CI = .01 - .07). For further details about nested factor models like the one fitted for SWB in the present paper, please see Gustafsson and Åberg-Bengtsson (2010).

#### *2.3.2 Wintertime mindset*

To assess how positively or negatively participants viewed and related to the wintertime, we developed the Wintertime Mindset Scale (WMS). Themes for the scale were identified through discussions with Norweigan and foreign residents of Tromsø, including members of the psychology department at the University of Tromsø. These discussions were meant to make explicit some of the implicit associations residents of Tromsø have with winter and to understand how people living in the high north experience, understand, and relate to the winter there. Based on these conversations, the structure of the WMS was then loosely modeled after the Stress Mindset Measure - General (SMM - G; Crum, et al., 2013). The Stress Mindset Measure captures global interpretations about the nature of stress through items such as "The experience of stress is negative and should be avoided," and "The effects of stress are positive and should be utilized"

(Crum, et al., 2013). Likewise, the Wintertime Mindset Scale was developed to capture two different mindsets about winter: the mindset that winter is dreadful ("I find the winter months dark and depressing") and the mindset that winter is delightful ("There are many things to enjoy about the winter"). Unlike the items in other mindset scales such as the Stress Mindset Measure, the items in the WMS also capture mindset through individual's personal relationships to winter ("I love the coziness of the winter months") in addition to broader interpretations about the nature of winter ("Winter is an especially beautiful time of year").

**Figure 3. Factor model of Subjective wellbeing (SWB) with nested factors accounting for unique variance attributed to the subscales of Satisfaction With Life Scale (SWLS), positive Emotions (PosEm) and Negative Emotions (NegEm)**




*Note*. Numbers in parentheses represent the amount of explained variance of each item.

10 items were initially developed for the WMS: 5 positive items and 5 negative items. After review, it was determined that the item 'Winter is my least favorite season' would be changed to 'Winter is my favorite season' to be less cognitively demanding for respondents, resulting in a scale with 6 positive items and 4 negative items. The order of the items was randomized for participants taking the survey. Participants rated how much they agreed or disagreed (scale: 1 = *strongly disagree* to 5 = *strongly agree*) with each item, and the total score was the mean of all ten items ($\alpha$ = .91).

An exploratory factor analysis (EFA) suggested that a one factor model could account for the correlations among the ten WMS items (Eigenvalues for the three largest components were 5.50, 1.05 and 0.74, respectively). The factor loadings from the one-factor EFA are presented in Table 1. A one factor model was submitted to a confirmatory factor analyses (CFA), yielding mediocre

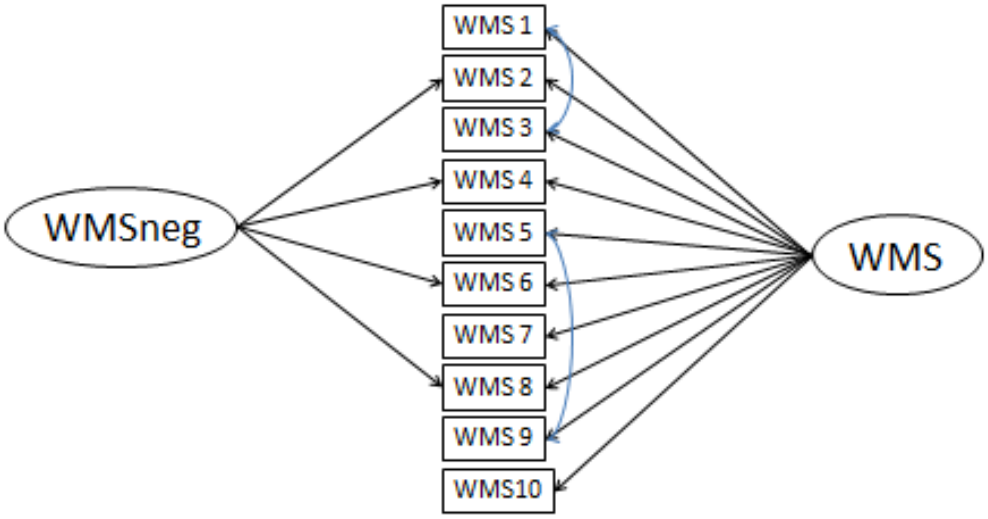
indication of fit (cf. Table 1 for the goodness-of-fit details). After adding a nested factor for the negatively worded items, and freeing up two error terms to correlate, we arrived at the model depicted in Figure 4. This model had acceptable goodness-of fit, $\chi^2$ (29, N = 227) = 68.31, $p < .001$, CFI = .97, RMSEA = .07 (CI = .05 - .10).

**Table 1. Goodness-of-fit measures for the structural equations models**

| Model | $\chi^2$ | df | p | CFI | RMSEA | CI |
|---|---|---|---|---|---|---|
| Subjective Well-Being[1] | 111.05 | 41 | <0.001 | .96 | .09 | .07 - .11 |
| WTM single factor | 163.49 | 35 | <0.001 | .90 | .13 | .11 - .15 |
| WTM with nested factor[2] | 68.31 | 29 | <0.001 | .97 | .07 | .05 - .10 |
| First full SEM | 102.50 | 45 | <0.001 | .95 | .08 | .06 - .10 |
| Second full SEM | 276.02 | 179 | <0.001 | .97 | .05 | .04 - .06 |

*Note.* N = 226; [1]Cf. Figure 1; [2]This model also allowed the errors terms from two pairs of items to correlate as shown in Figure 2; WTM = Wintertime Mindset; $\chi^2$ = Chi Square; df = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; CI = 90% Confidence Interval for the RMSEA.

**Figure 4. Factor model of the Wintertime Mindset Scale, with a nested factor accounting for negatively worded items, and correlated errors**




*2.3.3 Location*

Location was a variable coded 1 for Oslo, 2 for Troms, and 3 for Svalbard. When used in linear regression models, the location variable was dummy-coded with Oslo as the reference category.

*2.4 Statistical analyses*

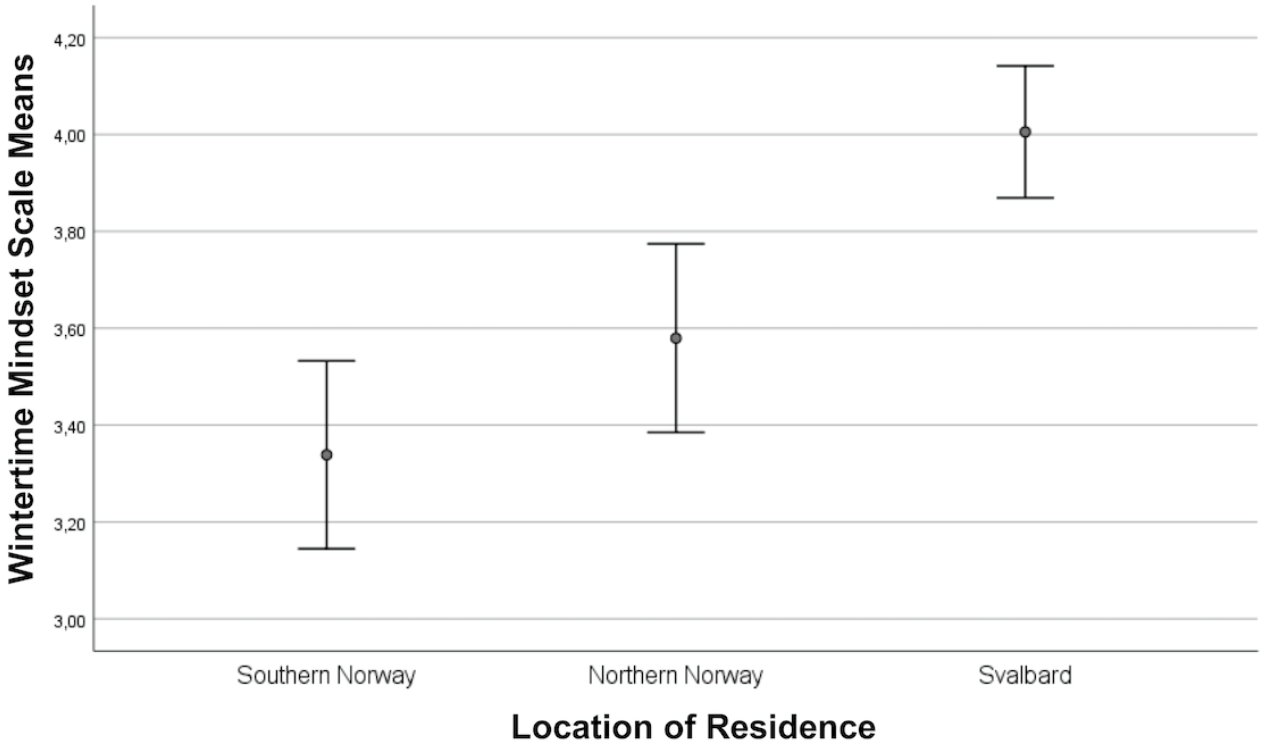
The data was analyzed using IBM SPSS version 25, and Mplus version 8.0 (Muthén & Muthén, 2018). First, using SPSS, the means, standard deviation, skewness, Pearson's product-moment correlations and factor loadings for the study variables were analyzed. Next, four one-way analyses of variance (ANOVA) were conducted, with location (Oslo, Troms and Svalbard) as the independent variable, and wintertime mindset, life satisfaction, positive affect and negative affect as dependent variables. Bonferroni adjusted post-hoc comparisons were made.

The confirmatory factor models (figures 3 and 4) were analyzed in Mplus, as was the structural equation model (SEM) with mediation (Figure 5). We used Model 4 in Hayes (2017) as our mediator template, although with two mediating variables rather than one. Location was taken as the independent variable, although it is conceivable to think that people move to a location as a result of their wellbeing or wintertime mindset. However, given the cross-sectional nature of our data, we did not test that possibility. Model fit was evaluated using chi-square, comparative fit index (CFI), and the root mean square error of approximation (RMSEA). A RMSEA lower than .08 combined with a CFI higher than .95 are considered acceptable (e.g., (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999).

**3. Results**

The items and descriptive statistics for the Wintertime Mindset Scale (WMS) are reported in Table 2. The WMS correlated positively with location, $r(211) = .36$, $p < .001$, indicating that the further north participants lived, the more positive their mindset towards winter. Figure 5 and Table 3 show detailed analyses of the relationships between WMS and living location. These analyses revealed that participants living in Svalbard had the highest WMS score in this sample ($M_{Svalbard} = 4.01$, $SD_{Svalbard} = 0.59$), which was significantly higher than the means for both Oslo ($M_{Oslo} = 3.34$, $SD_{Oslo} = 0.81$), Bonferroni adjusted 95% CI [0.37 — 0.96], and Troms ($M_{Troms} = 3.58$, $SD_{Troms} = 0.80$), Bonferroni adjusted 95% CI [0.13 — -0.73]. This association is further investigated in the mediation analyses reported below. The overall ANOVA model explained 13% of the variance in WMS scores (partial $\eta^2 = .13$), with $F(2, 210) = 15.18$, $p < .001$. None of the wellbeing measures differed across latitudes (all *p*s > .200, cf. Table 3).

**Figure 5. Means for the Wintertime Mindset Scale (WMS) in the three study locations**




*Note.* Error bars represent 95% confidence intervals.

**Table 2. Means, standard deviations (SD), skewness (Sk), and factor loadings from an exploratory principal axes factor analysis for the 10 Wintertime Mindset items**

| Item | Mean | SD | Sk | Factor |
|---|---|---|---|---|
| 1 Winter is an especially beautiful time of year | 3.87 | 0.96 | -0.61 | .81 |
| 2 I dislike the winter time (R) | 1.99 | 1.09 | 0.85 | -.85 |
| 3 I enjoy doing many things I only do during the winter | 3.69 | 1.17 | -0.59 | .76 |
| 4 I find the winter months dark and depressing (R) | 2.11 | 1.04 | 0.63 | -.78 |
| 5 I love the coziness of the winter months | 3.76 | 0.98 | -0.63 | .62 |
| 6 I am much more tired during the winter (R) | 2.99 | 1.17 | -0.05 | -.58 |
| 7 There are many things to enjoy about the winter | 3.97 | 0.97 | -1.01 | .76 |
| 8 In the winter, I often don't feel like doing anything at all (R) | 2.32 | 1.15 | 0.53 | -.57 |
| 9 I like the soft light we have during the winter months | 3.75 | 1.07 | -0.77 | .58 |
| 10 Winter is my favorite season | 2.56 | 1.15 | 0.36 | .75 |

*Note*. (R) Indicates negative items that are reverse coded when taking the mean of the scale overall. N (listwise) = 227.

**Table 3. Means (M), standard deviations (SD), F-values (for the row mean differences), and sample sizes (N) for the Wintertime Mindset Scale (WMS), Satisfaction With Life Scale (SWLS); positive emotion (POSEM), negative emotions (NEGEM)**

| | Oslo (N = 70) | | Troms (N = 68) | | Svalbard (N = 75) | | All (N = 213) | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | M | SD | F |
| WMS | 3.34[a] | 0.81 | 3.58[a] | 0.80 | 4.01[b] | 0.59 | 3.65 | 0.79 | 15.18*** |
| SWLS | 4.44 | 1.49 | 4.63 | 1.48 | 4.79 | 1.19 | 4.62 | 1.39 | 1.14 |
| POSEM | 4.84 | 1.05 | 5.00 | 1.08 | 5.16 | 1.05 | 5.00 | 1.06 | 1.62 |
| NEGEM | 2.91 | 0.82 | 2.96 | 0.92 | 2.80 | 0.87 | 2.89 | 0.87 | 0.57 |

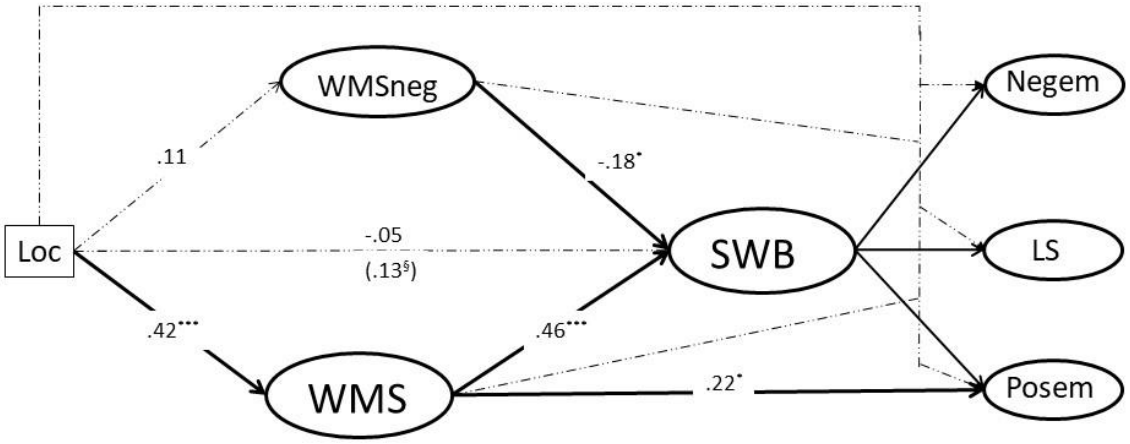
*Note.* *** = p < .001; Row means with different superscripts are significantly different from each other (p < .05, Bonferroni adjusted).

*3.1 Structural equation models*

As suggested in the ANOVA results above, the WMS means for Oslo and Troms were not significantly different from each other. An independent *t*-test checking the difference between Oslo and Troms returned a $t(136) = 1.75$, $p = .082$. However, when the WMS was specified as a latent variable, as depicted in Figure 4, and regressed on two dummy coded location variables, both Troms and Svalbard came out with significantly higher WMS scores than Oslo. The unstandardized regression coefficients (*B*) were: $B_{Troms} = .27$, SE = 0.14, $p(211) = .043$; $B_{Svalbard} = .81$, SE = 0.14, $p$ (211) < .001. These numbers indicate that an average resident in Troms scores .27 points higher on the WMS than an average resident in Oslo. The residents in Svalbard score .80 points higher than those in Oslo. The negative nested WMS was unrelated to location (*p*s > .387).

The next SEM analysis is a regression analysis with location as a manifest, independent variable, WMS and WMSneg as latent mediating variables, and SWB as a latent dependent variable. The structures of the SWB and WMS factor models are illustrated in figures 1 and 2, respectively. The regression model with mediation is depicted in Figure 6 and yielded the following goodness-of-fit measures: $\chi^2$ (179, N = 213) = 276.02 (p < .001), CFI = .97, RMSEA = .05 (CI = .04 - .06).

**Figure 6. The Full Structural Equation Model of the effect of location on Subjective Well-Being (SWB), life satisfaction (SWLS), Positive Emotions (Posem), Negative Emotions (Negem), mediated through Wintertime Mindset (WMS and WMSneg)**




*Note*. Higher values for location represent living further north. Dotted lines are non-significant paths. Full lines are significant paths:§ = p < .10; * = p < .05; *** = p < .001.

The model demonstrates that how far north people live indirectly influenced their level of SWB through their wintertime mindset. Participants living further north showed higher levels of WMS, with a standardized regression coefficient (β) equal to .42, $p(211) < .001$. WMS had, in turn, an effect on SWB, $\beta = .46$, $p(211) < .001$. A Sobel test showed that the indirect effect from location through WMS on SWB was significant, $\beta = .19$, $p(211) < .001$. The model showed no evidence that latitude had an impact on SWB independent of its effect on WMS, $\beta = -.05$, $p(211) = .495$. For further details about the approach used here, please see (Hayes, 2017).

The negative element of WMS did not mediate the relationship between location and SWB, and the direct effect was a nonsignificant $\beta = -.02$, $p(211) = .362$. WMS Negativity had a direct effect on SWB, however $\beta = -.18$, $p(211) = .044$. Finally, a direct effect from WMS on positive emotion was significant $\beta = .22$, $p(211) = .020$. None of the other nested SWB factors were significantly associated with the WMS factors or location.

## 4. Discussion

The present study sought to understand whether wintertime mindset is a variable influencing the relationship between a lack of sunlight in winter and wellbeing, using Norway as a case study. Our first research question asked if there are certain mindsets that contribute to wintertime wellbeing in northern Norway. This question led to the development of the Wintertime Mindset Scale to assess mindsets about winter. By assessing perspectives of winter as a time of year with many things to enjoy, such as winter activities, beauty, soft light, and coziness, this construct highlights some of the associations residents of Norway may have with the winter and provides a way of measuring positive psychological associations with winter for the first time. Our second research question asked whether wintertime mindset is associated with measures of wellbeing. Our results indicate that positive wintertime mindset is associated with subjective wellbeing in Norway, with positive wintertime mindset correlating with life satisfaction and positive emotions and negatively correlating with negative emotions. We also found that wintertime mindset statistically mediated the effect of location on subjective wellbeing. This suggests that wintertime mindset may be a previously overlooked variable influencing the wellbeing of residents living in the high north during the winter, and that

wintertime mindset becomes more important with increases in latitude. For those with a more positive wintertime mindset, living further north is associated with an increase in subjective wellbeing.

There have been no previous studies describing how attitudes or mindsets towards winter influence wintertime wellbeing. Our results reflect the common sentiment in Tromsø that winter has many positive aspects to be enjoyed, rather than a time of year that is dark and depressing. This positive mindset may contribute to the lack of seasonal depression and wintertime mental distress found at this latitude in other studies, although more research is needed to test this directly (Brancaleoni et al., 2009; Johnsen et al., 2012; Rosen et al., 1990).

Additionally, we found that positive wintertime mindset was significantly correlated with latitude, with those living farther north having a more positive wintertime mindset. With its extreme northern location and lifestyle, Svalbard is almost certainly home to a self-selecting sample: people living in Svalbard rarely live there for their entire lives. Instead, residents of Svalbard usually live there for several months or years at a time. However, Tromsø is not necessarily home to a self-selecting sample. While as a mean-score variable the WMS did not discriminate significantly between Oslo and Tromsø, when we used a latent WMS variable the differences in mean scores between the two locations became significant. Due to the increased reliability of the latter analysis, our results suggest that there is indeed a significant difference in how positively residents of Oslo and Tromsø experience the winter. Due to the similarity in temperature between Oslo and Tromsø, amount of wintertime daylight received is one of the main environmental differences between these locations. Located at roughly the same latitude as Anchorage, Alaska, residents of Oslo still experience particularly dark and cold winters by the standards of many parts of the world, but it appears that they do not experience these winters as positively as their compatriots in the north. As such, mindset may be a previously overlooked factor that mediates the relationship between climate or weather and subjective wellbeing.

The concept of wintertime mindset may be particularly useful in explaining the contradictory findings surrounding the effect of weather and climate on emotions. While some studies suggest that the darkness that accompanies winter can lead to depressed mood and seasonal affective disorder (e.g., Connolly, 2013; Feddersen, Metcalfe, & Wooden, 2016; MacKerron & Mourato, 2013), other studies find no such outcomes (e.g., Buscha, 2016; Kämpfer & Mutz, 2013; Lucas & Lawless, 2013). Our results suggest that there may be a psychological variable – mindset – that influences the relationship between climate and wellbeing. By orienting individuals' attention to and interpretation of the positive or negative aspects of winter, our results suggest that this subjective perception of winter may be a greater predictor of winter wellbeing than weather or amount of daylight. Particularly as we move farther north, into more extreme winter weather and darkness, mindset seems to be an important factor in determining wellbeing outcomes.

While our study provides evidence that wintertime mindset and wellbeing are associated, we cannot make claims about the causal direction of this relationship based on our current, cross-sectional study. It is possible that having a positive wintertime mindset causes one to enjoy winter more and spend more time outside enjoying the winter, thus leading to greater life satisfaction and positive emotions. However, it is also possible that being generally satisfied with life could cause one to have a more positive wintertime mindset. Future studies are needed to determine the causal relationship between seasonal mindset and wellbeing. This could be investigated by designing an intervention to promote positive wintertime mindset (see Crum et al., 2013, for an example of mindset intervention) and assessing subsequent outcomes on emotions and life satisfaction to determine whether developing a more positive wintertime mindset directly increases seasonal wellbeing.

Observations in Tromsø also suggest that it is easier to embody a positive wintertime mindset when those around you also have a positive wintertime mindset. Living in an area where everyone is enjoying the winter makes a positive wintertime mindset more easily attainable than living in a community where it is the norm to complain about winter weather. With this in mind, studies examining 'mindset contagion' and wintertime norms should investigate whether or not a group mindset oriented towards positive wintertime feeling can spread among social groups. Research on wintertime mindset could also be combined with anthropological or sociological research on localized culture surrounding winter.

There are many reasons why wintertime mindset might be more positive in northern Norway than elsewhere. Besides having some of the most breathtaking natural landscapes in the world and being home to stunning displays of the Aurora Borealis, spending time outdoors in all seasons is an important part of Norwegian culture. This culture, which includes an appreciation for winter recreation such as cross-country skiing, may be particularly conducive to a positive wintertime mindset. By looking to Norway as an example of a place that does winter well, we hoped to extrapolate insights that could be used to promote wintertime flourishing worldwide. By identifying wintertime mindset as an important factor influencing wellbeing for residents of northern Norway, we have uncovered a psychological approach to winter that may be exported from Norway to improve winter wellbeing elsewhere. To examine whether the relationship between wintertime mindset and wellbeing is unique to Norway, cross-cultural studies on wintertime mindset should be conducted.

This study sought to identify what might contribute to winter wellbeing. In doing so, we hope to move the conversation on the psychology of winter away from focusing only on Seasonal Affective Disorder and how winter can be detrimental to mental health towards a more positive and holistic understanding of the effects of winter on wellbeing. While the items about energy and mood included in the WMS and the negative emotions covered in the BETT do approximate the categories used by Rosenthal et al. (1984) to diagnose Seasonal Affective Disorder, the current study assessed a relatively brief number of constructs, and so future studies may wish to include specific measures pertaining to SAD or mental distress to further confirm the proposed inverse relationship between wintertime mindset and wintertime depression. Furthermore, while the goal of the present study was to provide a counter-perspective to existing psychological research on winter, which focuses largely on Seasonal Affective Disorder, future research may wish to incorporate mindsets about other seasons and seasonal variation to extend this work further.

Our findings suggest that wintertime mindset is a previously overlooked factor in the discussion of the psychological effects of winter, particularly in extreme climates. Yet mindset is not the only factor contributing to wintertime wellbeing and lack of seasonal depression in northern Norway, and future research should examine other individual and social variables that contribute to wintertime wellbeing in Norway. Likewise, we want to be careful not to suggest that clinical Seasonal Affective Disorder is purely a result of poor wintertime mindset and that those suffering from this condition can just 'snap out of it' or cure themselves by adjusting their mindset. Rather, we suggest that this study provides evidence that positive wintertime mindset has a role to play in wintertime wellbeing, and that mindset could be an important addition to the theoretical and practical discussion of seasonal wellness.

This study was made possible by a U.S.-Norway Fulbright grant, during which time we spent ten months (August-May) collaborating on this research at the Arctic University of Tromsø. Given our response rate we cannot be sure that our sample is representative of the populations of the three selected locations. However, a response rate of 15% is common (e.g., PEW Research Center, 2012). Moreover, recent studies suggest that samples reflecting a response rate of 15% or

lower are often remarkably similar to those with greater response rates (e.g., Hellevik, 2015; Singer, 2006). This study would also have been strengthened by a second dissemination of the survey during the summer months so that summer and winter responses could be compared. It is possible that there was a response bias in our survey, as those who were the most willing to respond to a survey given in midwinter might also be more likely to have a positive wintertime mindset. Future research should assess the effect of wintertime mindset longitudinally, and additional measures, such as those measuring optimism or mindfulness, should be examined in comparison to wintertime mindset.

This study is the first to present the concept of wintertime mindset. In doing so, we hope to shift the dialogue around the psychology of winter to include the positive way winter may positively influence mental health and wellbeing. Our research suggests that wintertime mindset may be a previously overlooked factor influencing winter wellbeing, and represents a potential avenue for improving the wintertime wellbeing of people around the world. To residents of northern Norway, our results may not be surprising. Rather than finding the wintertime dark and depressing, those living in the high north often find ways to appreciate the unique joys of winter. Our research indicates that this positive mindset towards winter is strongly associated with wintertime wellbeing, including satisfaction with life and positive emotions. We hope that the introduction of the concept of wintertime mindset, coupled with our data, will add a positive dimension to the discussion of wintertime mental health and illness, encouraging individuals and communities to strive not only to be free of wintertime depression, but to pursue wintertime flourishing as well. Increased understanding of the ways wintertime mindset influences seasonal wellbeing could lead to interventions designed to prevent wintertime depression and promote seasonal wellbeing in a variety of winter climates. This study raises many questions for further investigation, and we hope that our present work will spark future research about wintertime mindset.

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**Conflict of interest statement**

The authors report no conflicts of interest.

**Authors**

Kari Leibowitz
Stanford University
kaleibowitz@gmail.com

Joar Vittersø
University of Tromsø

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**Appendix A**

**Items and Instructions for the Wintertime Mindset Scale (WMS)**
Please rate the extent to which you agree or disagree with the following statements.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. Winter is an especially beautiful time of year.
2. I dislike the winter time. (R)
3. I enjoy doing many things I only do during the winter.
4. I find the winter months dark and depressing. (R)
5. I love the coziness of the winter months.
6. I am much more tired during the winter. (R)
7. There are many things to enjoy about the winter.
8. In the winter, I often don't feel like doing anything at all. (R)
9. I like the soft light we have during the winter months.
10. Winter is my favorite season.

(R) indicates items that should be reverse scored when taking the overall mean for the scale.

To use the Wintertime Mindset Scale, please contact the authors at kaleibowitz@gmail.com and joar.vitterso@uit.no.