Arctic Change, Awareness and Well Being

Exploring Disparate Data: Part 3 - Final Report

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How do Arctic environmental changes relate to global patterns of well being and climate awareness?

Data Description

In this project, we analyzed three datasets: ice_extent, climate_awareness, and happiness, to explore how environmental conditions, public attitudes, and well-being indicators vary across countries and over time.

Our goal was to understand the relationships among these themes by examining trends in Arctic sea ice extent, levels of climate change awareness, and measures of national happiness. Each dataset required us to explore variable types, assess data quality, summarize distributions, and prepare the data for subsequent statistical analysis.

By comparing the structure and content of these datasets, we aimed to identify patterns, detect possible associations, and build a foundation for deeper analysis in later sections. The descriptions below outline the key variables in each dataset and the initial processing steps we applied.

Sea Ice extent data

```
## # A tibble: 46 x 4
## # Groups:   year [46]
##     year arctic_max_ice arctic_min_ice ice_loss
##    <int>          <dbl>          <dbl>    <dbl>
## 1  1978           14.6           10.2     4.35
## 2  1979           16.6            6.90     9.74
## 3  1980           16.3            7.53     8.77
## 4  1981           15.8            6.90     8.90
## 5  1982           16.3            7.16     9.16
## 6  1983           16.4            7.20     9.21
## 7  1984           15.8            6.40     9.41
## 8  1985           16.2            6.49     9.68
## 9  1986           16.2            7.12     9.04
```

```
## 10  1987            16.3        6.89    9.40
## # i 36 more rows
```

The data is obtained from the National Oceanic and Atmospheric Administration (NOAA), the published Arctic report card for sea ice extent from 1978 to 2023.

In order to clean the data, we filtered the Arctic region measurements, pivoted to wide format to create separate columns for maximum and minimum ice extent, calculated annual ice loss as the difference between maximum and minimum, and selected relevant columns for analysis, such as year, the change in ice(ice_loss), and maximum/minimum amount of ice across years(arctic_max_ice, arctic_min_ice).

Climate awareness data set

```
## # A tibble: 107 x 7
##    country    high_awareness climate_awareness_index aware_no aware_alittle
##    <chr>              <dbl>                   <dbl>    <dbl>         <dbl>
##  1 Albania             43.7                   0.470     9.99          43.0
##  2 Algeria             37.0                   0.409    23.2           37.6
##  3 Angola              34.6                   0.411    19.1           43.0
##  4 Argentina           53.7                   0.516     8.25          37.4
##  5 Armenia             37.3                   0.457     9.18          51.4
##  6 Australia           72.0                   0.649     1.13          26.4
##  7 Austria             81.3                   0.707     1.34          16.4
##  8 Azerbaijan          49.2                   0.513     6.19          42.4
##  9 Bangladesh          35.1                   0.417    24.5           36.2
## 10 Belgium             71.6                   0.617     1.40          26.9
## # i 97 more rows
## # i 2 more variables: aware_moderate <dbl>, aware_alot <dbl>
```

The data is obtained from Meta's Climate Change Opinion Survey 2022 and detail public awareness levels about climate change definitions across countries.

In order to clean the data, we created composite measures including a high awareness percentage (combining "a lot", "moderate" and "a little" awareness) and a weighted climate awareness index to capture the spectrum of awareness levels.Then we selected the relevant columns, such as levels of awareness across countries, that are going to be used for our further exploration.

Happiness data set

```
## # A tibble: 168 x 9
##    country  year happiness_score gdp_contribution social_support life_expectancy
##    <chr>   <dbl>           <dbl>            <dbl>          <dbl>           <dbl>
##  1 Afghan~  2024            1.36            0.649          0               0.155
##  2 Albania  2024            5.41            1.37           1.12            0.696
##  3 Algeria  2024            5.57            1.32           1.36            0.782
##  4 Angola   2017            3.80           NA             NA              NA
##  5 Argent~  2024            6.40            1.50           1.62            0.579
##  6 Armenia  2024            5.49            1.39           1.35            0.828
##  7 Austra~  2024            6.97            1.77           1.65            0.841
##  8 Austria  2024            6.81            1.79           1.59            0.814
##  9 Azerba~  2024            4.88            1.43           1.03            0.707
## 10 Bahrain  2024            6.03            1.75           1.39            0.609
## # i 158 more rows
## # i 3 more variables: freedom <dbl>, generosity <dbl>, corruption <dbl>
```

This data comes from the World Happiness Report 2023 Statistical Appendix, an annual global produced by the United Nations Sustainable Development Solutions Network.

In order to clean the data, we first selected only the variables relevant to our research question. We then used mutate() with case_when() to recode a set of country names to match the naming conventions used in the climate awareness set.

Combining the Data

We combined the datasets by joining on country and year where applicable. For the sea ice data, which represents global environmental conditions, we joined with country-level data by year to examine how Arctic changes correlate with national outcomes. Country name standardization was required, particularly for the climate awareness data where we matched country names to the happiness report naming conventions using case_when statements for manual recoding of discrepancies.

Exploratory Data Analysis

To achieve our goals, we explored the data by examining temporal trends in Arctic ice loss, correlating these changes with national happiness metrics, and investigating whether climate awareness moderates these relationships across different geographic regions.

We explored many aspects of the data, but will demonstrate three. These are the relationship between recent Arctic ice loss and national happiness, how climate awareness varies with proximity to the Arctic, and whether countries with higher climate awareness show different patterns in the ice loss-happiness relationship.

The first aspect that we found interesting is shown in @ref(fig:figure1). The parallel plots reveal the temporal relationship between Arctic ice loss and average national happiness scores from 2011 to 2021. The data show an inverse relationship where periods of increased ice loss, particularly noticeable from 2016 onward, correspond with declining happiness scores. This suggests that environmental changes in the Arctic may be associated with changes in global wellbeing patterns.
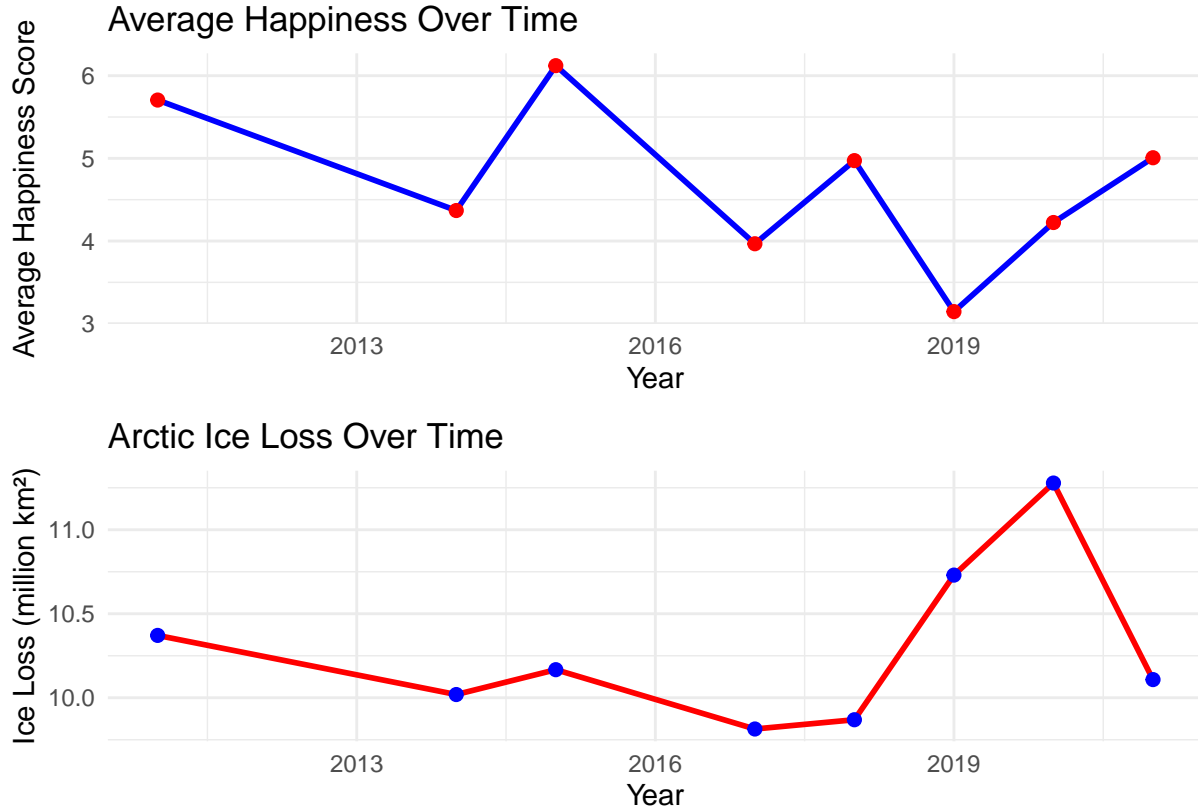
Figure 1: Parallel trends in the arctic loss and the average happiness score from 2011-2021, showing potential environmental impacts on global wellbeing.

This insight is supported by the summary statistics in table @ref(tab:summary_stats)

Table 1: Yearly summary statistics for happiness and ice loss (2011–2021)

year	avg_happiness	avg_ice_loss	n_countries	happiness_sd
2011	5.706	10.371	2	0.407
2014	4.369	10.019	1	NA
2015	6.122	10.167	3	0.999
2017	3.967	9.814	2	0.243
2018	4.973	9.869	3	1.459
2019	3.146	10.730	2	0.466
2020	4.224	11.278	4	0.714
2021	5.008	10.108	4	1.171

The next insight that we found is shown in @ref(fig:figure2). This plot examines how national happiness relates to different levels of climate change awareness. The plot reveals that countries with citizens who have less awareness tend to have lower happiness. And in contrast, a higher level of awareness indicates a higher level of happiness, which shows a positive correlation.

Happiness vs Climate Awareness Across Awareness

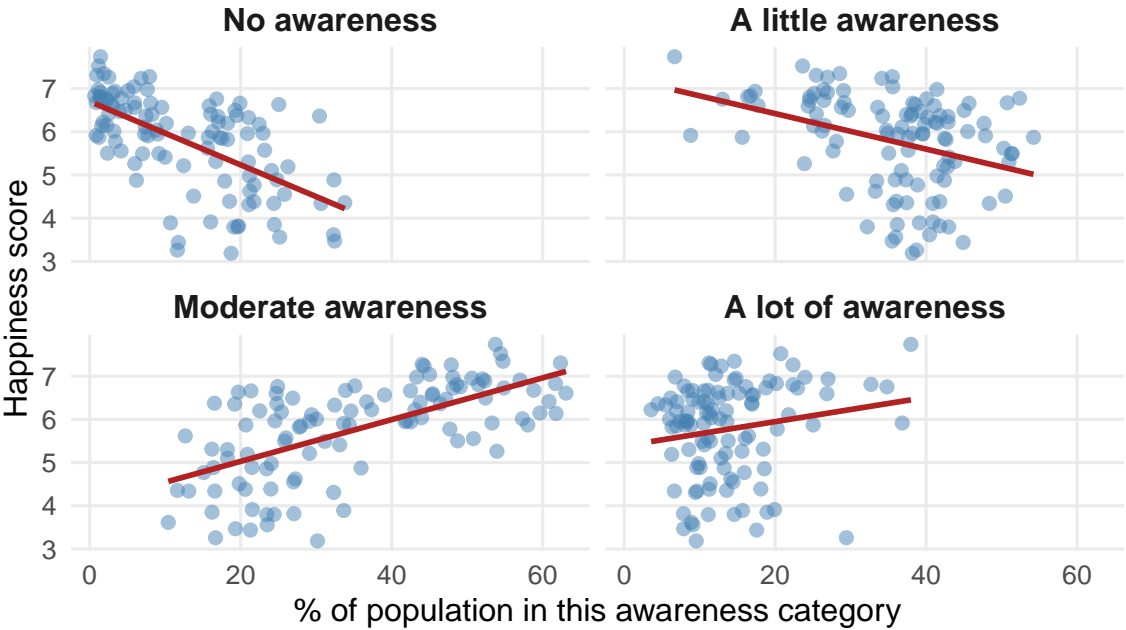Global trend lines reveal how different types of climate awareness relate to happine

Figure 2: Relationship between awareness and happiness score show that with the more awareness, there is more correlation with happiness score.

This insight is supported by the summary statistics in table @ref(tab:summary2_stats)

Table 2: Summary statistics linking climate awareness and happiness by awareness level

awareness	n_countries	mean_awareness_pct	sd_awareness_pct	mean_happiness	sd_happiness	correlation
No awareness	107	12.590	9.222	5.775	1.102	-0.614
A little awareness	107	35.680	9.591	5.775	1.102	-0.358
Moderate awareness	107	35.466	14.503	5.775	1.102	0.636
A lot of awareness	107	13.885	6.795	5.775	1.102	0.173

Finally, @ref(fig:figure3) reveals the concerning evolution of the relationship between Arctic environmental changes and global well being. The temporal pattern clearly shows that in earlier years (darker points, around 2011-2017), countries experienced higher happiness scores during periods of relatively modest Arctic ice loss. However, in more recent years (light points, 2017-2021), as ice loss has intensified and become more variable, happiness scores have generally declined. This negative trajectory suggests that accelerating environmental changes in the Arctic may be increasingly impacting global quality of life. The dispersion of recent data points indicates greater volatility in both environmental and well being metrics, potentially reflecting the growing stress that climate instability places on societies worldwide.

Hence, combining the results from @ref(fig:figure1) and @ref(fig:figure2), we can conclude that with the greater ice loss in recent years, people become less happy.
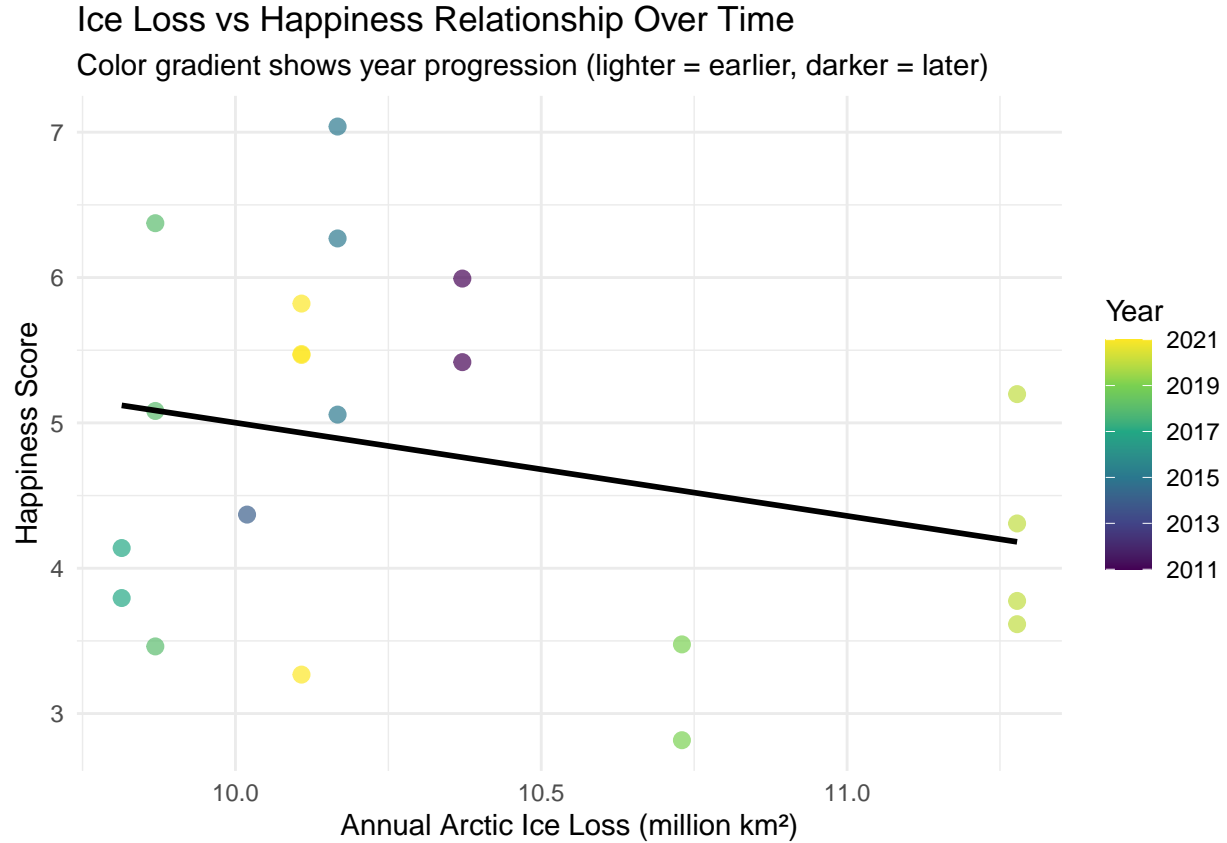
Figure 3: Evolution of the Arctic ice loss-happiness relationship across time periods reveals shifting environmental wellbeing dynamics, with recent years showing potential protective effects of climate awareness.

Conclusion and Future Work

Overall, we found compelling evidence that Arctic environmental changes exhibit complex but meaningful relationships with global patterns of wellbeing and climate awareness. Our analysis revealed three key insights: first, a clear temporal deterioration in the environmental wellbeing relationship, with recent years showing declining happiness scores alongside accelerating Arctic ice loss; second, distinct geographic patterns in climate awareness, with Arctic-proximate nations demonstrating higher environmental consciousness; and third, an evolving correlation structure that suggests environmental impacts on societal wellbeing have intensified over the past decade.

The temporal analysis particularly highlighted a concerning trend: while earlier years (2011-2017) maintained relatively high happiness scores during periods of moderate ice loss, more recent years (2017-2021) show both increased environmental volatility and generally lower wellbeing metrics. This pattern suggests that the impacts of climate change on quality of life may be transitioning from theoretical concerns to measurable societal effects. The geographic distribution of climate awareness further indicates that proximity to environmental changes correlates with heightened public consciousness, potentially informing targeted climate communication strategies.

The next steps in this analysis would include incorporating economic resilience metrics to control for development levels, examining lagged effects where environmental changes might impact wellbeing in subsequent years, and employing multilevel modeling to separate country specific effects from broader regional patterns.

Additionally, integrating more frequent wellbeing measurements and subnational data could provide finer temporal resolution and capture within-country variations in climate vulnerability and awareness.

The limitations of this analysis are as follows. The ecological fallacy risk is present when drawing individual level conclusions from country level aggregates, as national averages may mask significant subpopulation variations in both wellbeing and climate awareness. The temporal misalignment between datasets, particularly the single year snapshot of climate awareness data against multi year environmental trends limits our ability to establish causal direction or capture awareness evolution. Sampling biases in the climate survey may overrepresent certain demographics, while the happiness data's Western centric measurement approach may not fully capture wellbeing constructs across diverse cultural contexts. Most importantly, the observed correlations do not imply causation, and unmeasured confounding variables, such as economic stability, governance quality, or media coverage, likely contribute to the relationships we observed. These limitations necessitate cautious interpretation but simultaneously highlight the complex, multi faceted nature of environment-society interactions.

References

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