The Temperature of Feelings

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| Original Paper

The original paper, 'The Temperature of Emotions' (Barbosa Escobar et al., 2021) evaluates the relationship between temperature and emotions of people. Through two experiments, the findings provide evidence of temperature-emotion associations at both an implicit and explicit level, across languages.

Experiment 1

The first experiment conducted was a survey in which participants were asked how 'well-matched' a certain temperature range and a specific emotion are, on a scale of 1-5. The survey obtained information on the explicit associations between 5 temperature ranges and 12 emotions for 451 participants..

The results of the survey demonstrate that 0°C and 10°C were linked closely with negative-valenced, low-arousal emotions, while 20°C was associated with positive-valenced, low-to-medium arousal emotions. 30°C was linked to positive-valenced, high-arousal emotions, and 40°C was associated with high-arousal positive- or negative-valenced emotions.

These results are consistent with the hypothesis that such explicit temperature-emotion associations exist across languages.

Experiment 2

The second experiment recorded implicit associations between temperature and emotions using Implicit Association Tests (IATs) that record response times when pairs of congruent and contrasting emotion-temperature pairs were displayed to the participant. This was performed on 101 native English speakers.

The results of this experiment was that participants held implicit associations between the word 'hot' and positive-valenced, high-arousal emotions, while the word 'cold' was with negative-valenced, low-arousal emotions.

Given the scope of our projects, and the extensions we aimed to bring, the second experiment's data was not used, since it did not have a diversity of countries and languages as the former. However, the results of both experiments together are noted.

| Aim of our Project

We seek to extend the initial paper's findings, by examining the role of other parameters. The data collected by the authors included the gender and age of the participant, their country of residence, and the latitude and longitude of the location. This could give insights on whether and what variations can arise due to such demographic and location differences.

I focused on country of residence and latitude as parameters to look at.

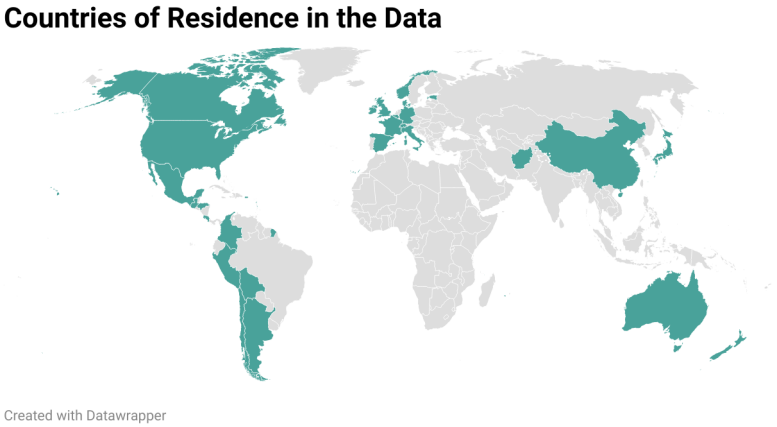
Country of Residence: There are several factors that can come into play when it comes to country of origin. For one, the average temperature of the place could affect how the person is conditioned to perceive temperature, thus altering their emotion associations with it. Secondly, the average climate of the country also could affect these associations for similar reasons. Thirdly, how developed a nation is could be an indication of the availability of temperature controlled and climate controlled spaces, once again, having an influence on how the individual perceives temperature. Also, other sociological conditions that vary based on the socio-economic environment could affect the perceptions of emotions and how they are understood and expressed.

Latitude: There is a significant correlation between a location's climate, average temperature, etc., and distance from the equator. This gives us a more detailed parameter to look at when compared to a general 'country of origin' bucketing, as there is more granular data available.

| Methodology

We aim to employ One-Way and Two-Way ANOVA tests, Mann-Whitney U Tests, regression, and Games-Howell post-hoc tests for our analyses.
For my part in this report, one-way ANOVA, Mann-Whitney and Games-Howell Post-Hoc tests were used.

| Country of Residence



The data has representation from 28 different countries, which were grouped on the basis of:
- Geographical Zone: temperate or tropical.
- Stage of Development: global north or global south.
- Average Yearly Temperature: above or below median (using Wikipedia data).

NOTE: Since we are doing three different tests by grouping the same independent variable in different ways, there is a need for some correction. So, we will apply the Benjamini-Hochberg Correction method after conducting the tests.

| Geography

Null Hypothesis: People belonging to countries that lie in the temperate zone and in the tropical zone demonstrate no differences between the ratings they give different temperature-emotion pairs
Alternate Hypothesis: People belonging to countries that lie in the temperate zone and in the tropical zone demonstrate significant differences between the ratings they give different temperature-emotion pairs
Statistical Method: Mann-Whitney U Test

We separate the 28 countries into two categories - temperate and tropical, and get the average scores for each of the 60 temperature-emotion pairs:

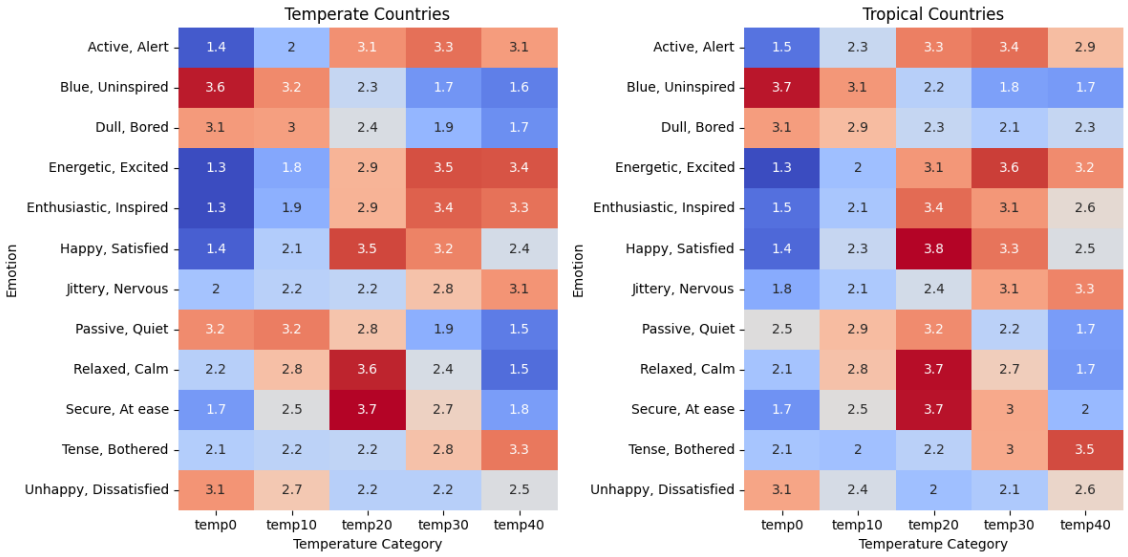
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.361111	1.975000	3.127778	3.300000	3.066667
1	Blue, Uninspired	3.625000	3.169444	2.272222	1.694444	1.566667
2	Dull, Bored	3.075000	3.047222	2.438889	1.930556	1.655556
3	Energetic, Excited	1.286111	1.816667	2.908333	3.450000	3.433333
4	Enthusiastic, Inspired	1.277778	1.877778	2.913889	3.372222	3.291667
5	Happy, Satisfied	1.383333	2.133333	3.486111	3.200000	2.388889
6	Jittery, Nervous	2.044444	2.186111	2.238889	2.791667	3.111111
7	Passive, Quiet	3.158333	3.233333	2.780556	1.872222	1.547222
8	Relaxed, Calm	2.175000	2.819444	3.611111	2.419444	1.463889
9	Secure, At ease	1.722222	2.466667	3.677778	2.655556	1.750000
10	Tense, Bothered	2.147222	2.208333	2.241667	2.797222	3.258333
11	Unhappy, Dissatisfied	3.108333	2.744444	2.169444	2.172222	2.458333

Tropical

temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.483516	2.318681	3.285714	3.373626	2.879121
1	Blue, Uninspired	3.714286	3.142857	2.186813	1.769231	1.725275
2	Dull, Bored	3.109890	2.890110	2.296703	2.142857	2.296703
3	Energetic, Excited	1.252747	2.010989	3.142857	3.593407	3.219780
4	Enthusiastic, Inspired	1.461538	2.076923	3.395604	3.142857	2.582418
5	Happy, Satisfied	1.417582	2.307692	3.758242	3.340659	2.472527
6	Jittery, Nervous	1.846154	2.109890	2.406593	3.076923	3.252747
7	Passive, Quiet	2.505495	2.890110	3.219780	2.219780	1.736264
8	Relaxed, Calm	2.054945	2.846154	3.736264	2.725275	1.714286
9	Secure, At ease	1.670330	2.516484	3.725275	3.032967	1.967033
10	Tense, Bothered	2.065934	2.021978	2.208791	3.021978	3.538462
11	Unhappy, Dissatisfied	3.054945	2.428571	2.010989	2.120879	2.637363

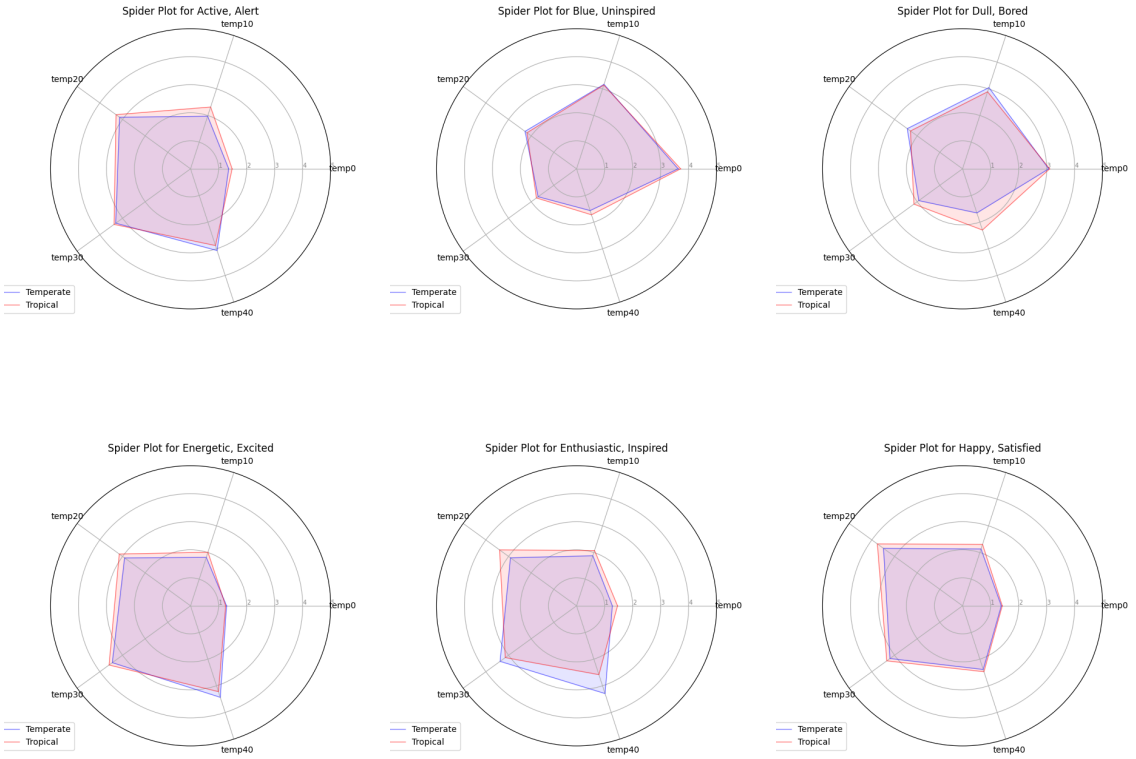
Temperate

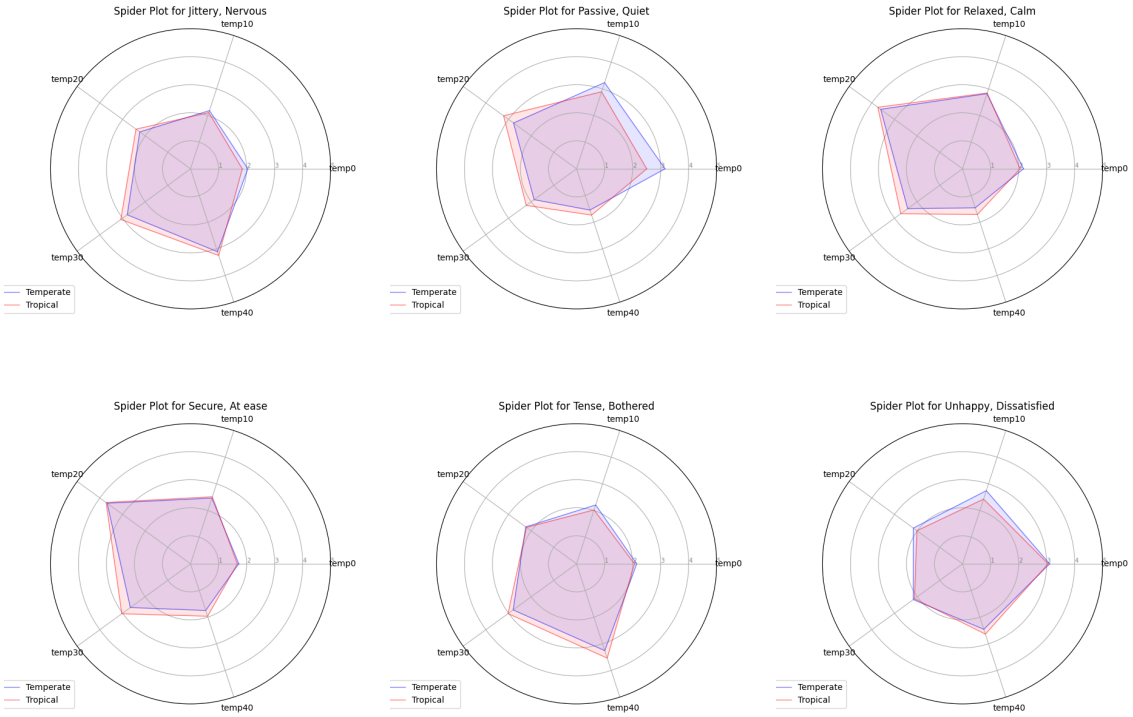
Representing that as a heatmap:



From the above figure, it seems as though the correlations are almost the same for the two.

We can alternately represent this as overlapping spiderplots to get a better comparative understanding.





From these, there is by and large a great overlap. Some of the emotions which have noticeable differences are Passive, Quiet and Enthusiastic, Inspired.

We now perform the Mann-Whitney U Test on this data to get any idea of whether there are any real differences between the two groups when it comes to the scores given to temperature-emotion pairs.

	emotion	p-value
0	Energetic, Excited	0.361451
1	Secure, At ease	0.079591
2	Jittery, Nervous	0.489087
3	Dull, Bored	0.149951
4	Passive, Quiet	0.990292
5	Unhappy, Dissatisfied	0.203030
6	Tense, Bothered	0.714263
7	Relaxed, Calm	0.116717
8	Active, Alert	0.136413
9	Happy, Satisfied	0.058224
10	Blue, Uninspired	0.651012
11	Enthusiastic, Inspired	0.871533

From this test, it is clear that none of the p-values are below 0.05, thus we fail to reject the null hypothesis, and hence the difference of temperature-emotion associations between the two groups temperate and tropical is not significant.

| Development

Null Hypothesis: People belonging to Global North countries and Global South countries demonstrate no differences between the ratings they give different temperature-emotion pairs
Alternate Hypothesis: People belonging to Global North countries and Global South countries demonstrate significant differences between the ratings they give different temperature-emotion pairs
Statistical Method: Mann-Whitney U Test

We separate the 28 nations based on whether that are commonly considered 'Global North' nations or 'Global South' nations, and get the average scores for the temperature-emotion pairs:

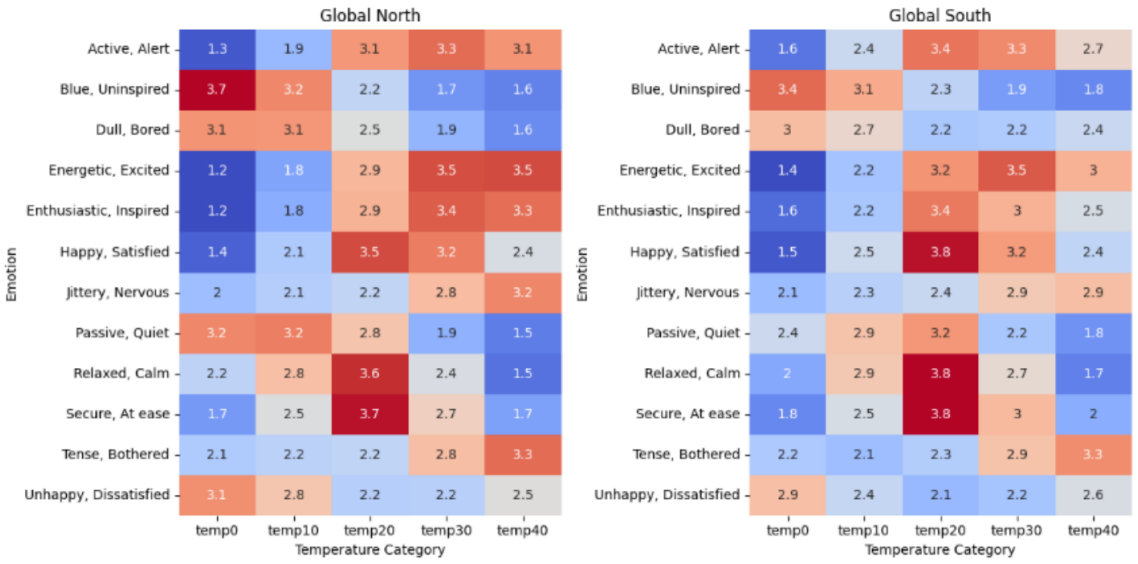
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.315493	1.938028	3.098592	3.323944	3.112676
1	Blue, Uninspired	3.695775	3.185915	2.230986	1.664789	1.557746
2	Dull, Bored	3.115493	3.095775	2.464789	1.901408	1.611268
3	Energetic, Excited	1.242254	1.771831	2.884507	3.470423	3.484507
4	Enthusiastic, Inspired	1.242254	1.842254	2.915493	3.402817	3.312676
5	Happy, Satisfied	1.363380	2.087324	3.484507	3.242254	2.416901
6	Jittery, Nervous	1.977465	2.135211	2.233803	2.847887	3.191549
7	Passive, Quiet	3.183099	3.233803	2.777465	1.870423	1.523944
8	Relaxed, Calm	2.202817	2.814085	3.597183	2.428169	1.461972
9	Secure, At ease	1.701408	2.459155	3.661972	2.667606	1.740845
10	Tense, Bothered	2.104225	2.183099	2.225352	2.825352	3.329577
11	Unhappy, Dissatisfied	3.140845	2.757746	2.152113	2.157746	2.478873

Global North

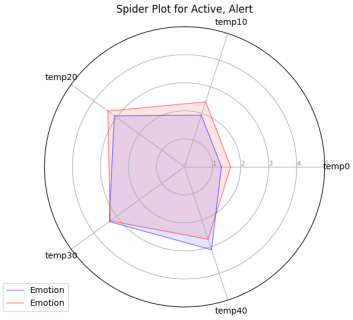
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.645833	2.437500	3.385417	3.281250	2.718750
1	Blue, Uninspired	3.447917	3.083333	2.343750	1.875000	1.750000
2	Dull, Bored	2.958333	2.718750	2.208333	2.239583	2.427083
3	Energetic, Excited	1.416667	2.166667	3.218750	3.510417	3.041667
4	Enthusiastic, Inspired	1.583333	2.197917	3.364583	3.041667	2.541667
5	Happy, Satisfied	1.489583	2.468750	3.750000	3.177083	2.364583
6	Jittery, Nervous	2.104167	2.302083	2.416667	2.854167	2.947917
7	Passive, Quiet	2.447917	2.906250	3.208333	2.208333	1.812500
8	Relaxed, Calm	1.958333	2.864583	3.781250	2.677083	1.708333
9	Secure, At ease	1.750000	2.541667	3.781250	2.968750	1.989583
10	Tense, Bothered	2.229167	2.125000	2.270833	2.906250	3.260417
11	Unhappy, Dissatisfied	2.937500	2.395833	2.083333	2.177083	2.552083

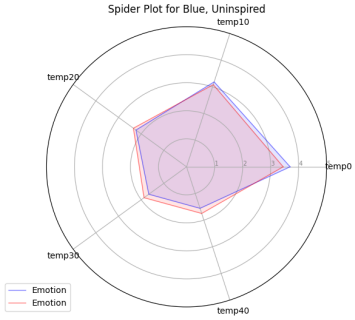
Global South

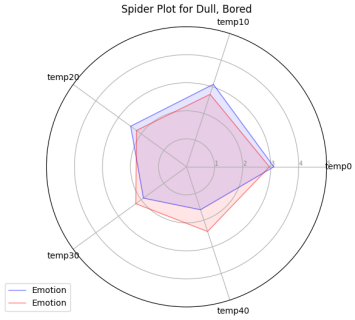
As a heatmap:

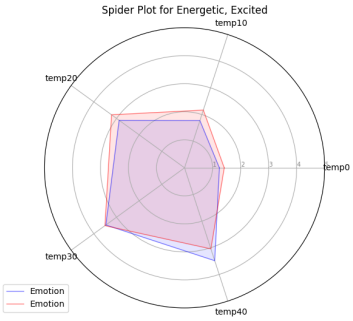


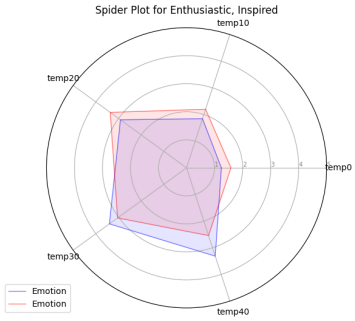
From the above two figures, some differences are notable, for instance the row corresponding to 'Enthusiastic, Inspired' has subtle differences. Observing the emotions through a spiderplot may be more effective to see differences.

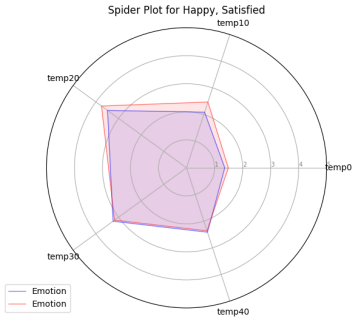

Spider Plot for Active, Alert
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

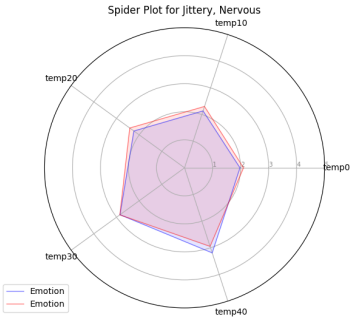

Spider Plot for Blue, Uninspired
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

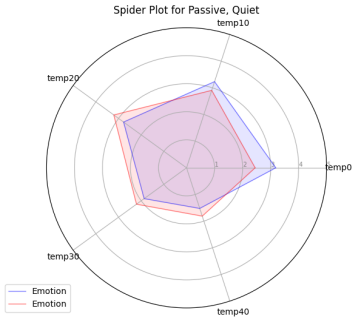

Spider Plot for Dull, Bored
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

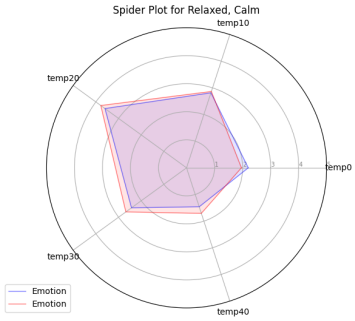

Spider Plot for Energetic, Excited
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

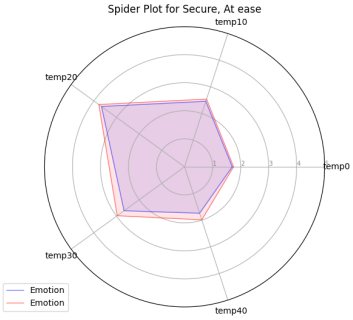

Spider Plot for Enthusiastic, Inspired
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

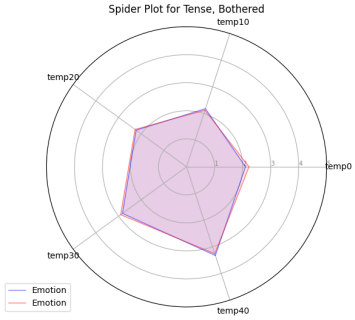

Spider Plot for Happy, Satisfied
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

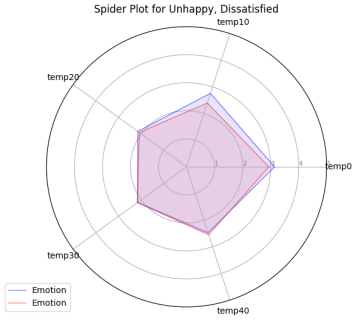

Spider Plot for Jittery, Nervous
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion


Spider Plot for Passive, Quiet
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion


Spider Plot for Relaxed, Calm
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion


Spider Plot for Secure, At ease
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion


Spider Plot for Tense, Bothered
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion


Spider Plot for Unhappy, Dissatisfied
temp10
temp20
temp0
temp30
temp40
Emotion
Emotion

Again, there is by and large an overlap. We do the Mann-Whitney U Test to get an idea of whether there are significant differences.

	emotion	p-value
0	Energetic, Excited	0.142190
1	Secure, At ease	0.022872
2	Jittery, Nervous	0.494739
3	Dull, Bored	0.304134
4	Passive, Quiet	0.850004
5	Unhappy, Dissatisfied	0.130003
6	Tense, Bothered	0.757569
7	Relaxed, Calm	0.140215
8	Active, Alert	0.037862
9	Happy, Satisfied	0.058664
10	Blue, Uninspired	0.636207
11	Enthusiastic, Inspired	0.855290

Here, we see a p-value of 0.023 for the emotion 'Secure, At ease' and a p-value of 0.038 for the emotion 'Active, alert'. This implies that there may be significant differences between what a Global North nation's temperature category scores and that of a Global South nation. However, before making any definitive conclusions based on this or performing post-hoc tests, we would need to undertake corrections due to the repeated measures, as mentioned in the beginning of the section.
For the rest of the data, the p-value is more than 0.05, so we fail to reject the null, implying that there are no significant differences between the two groups for any of the temperature-emotion scores.

| Average Temperature

Null Hypothesis: People belonging to countries which have a higher average temperature and those belonging to countries with a lower average temperature demonstrate no differences in their ratings of different temperature-emotion pairs
Alternate Hypothesis: People belonging to countries which have a higher average temperature and those belonging to countries with a lower average temperature demonstrate significant differences in their ratings of different temperature-emotion pairs
Statistical Method: Mann-Whitney U Test

Using data from Wikipedia on country-wise average temperatures, we grouped countries as above the median average temperature, and below the median average temperature. Following are the average scores for temperature-emotion pairs:

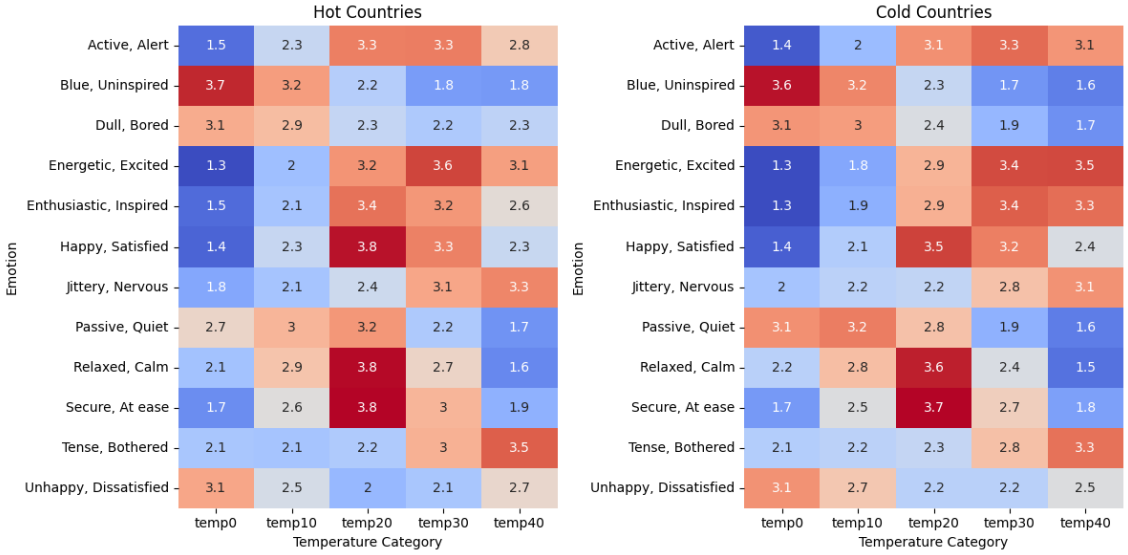
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.489130	2.336957	3.326087	3.336957	2.804348
1	Blue, Uninspired	3.717391	3.152174	2.206522	1.771739	1.750000
2	Dull, Bored	3.054348	2.923913	2.326087	2.152174	2.271739
3	Energetic, Excited	1.282609	2.043478	3.206522	3.608696	3.141304
4	Enthusiastic, Inspired	1.467391	2.097826	3.391304	3.184783	2.597826
5	Happy, Satisfied	1.423913	2.336957	3.771739	3.315217	2.347826
6	Jittery, Nervous	1.847826	2.097826	2.391304	3.086957	3.282609
7	Passive, Quiet	2.684783	2.978261	3.184783	2.152174	1.706522
8	Relaxed, Calm	2.076087	2.858696	3.793478	2.695652	1.641304
9	Secure, At ease	1.673913	2.554348	3.804348	2.978261	1.923913
10	Tense, Bothered	2.119565	2.097826	2.163043	3.010870	3.489130
11	Unhappy, Dissatisfied	3.086957	2.456522	1.989130	2.119565	2.652174

Above Median Temperature

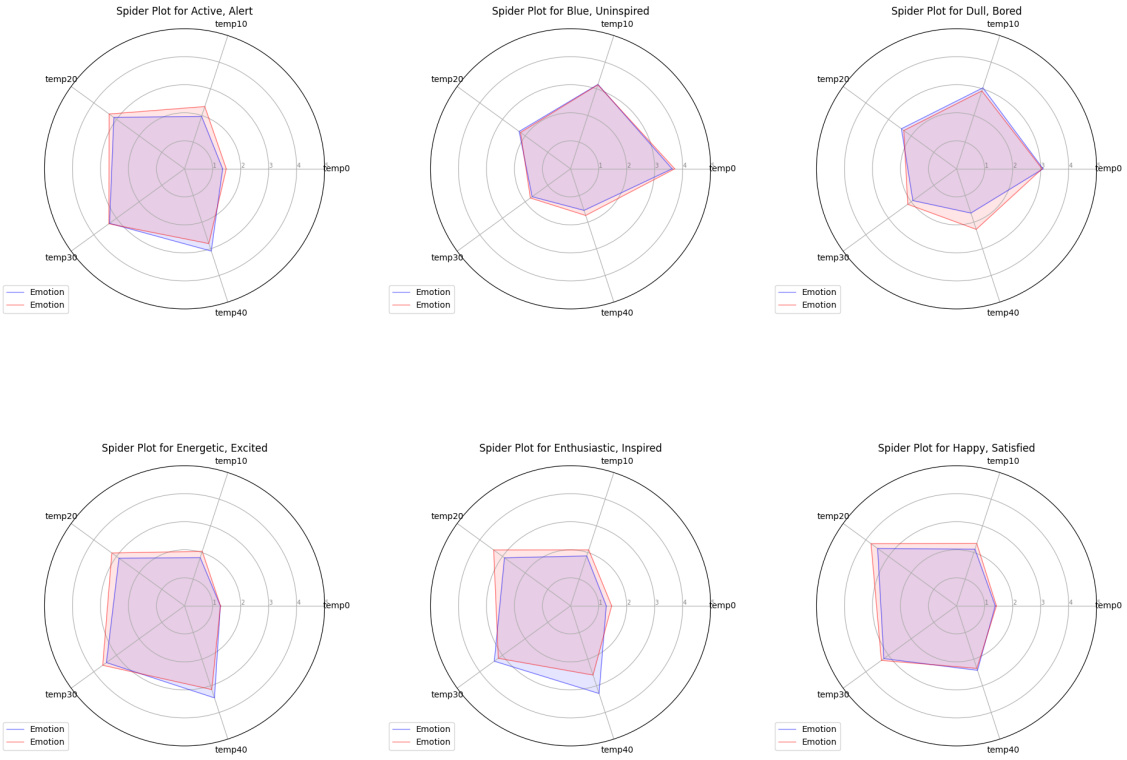
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.359331	1.969359	3.116992	3.309192	3.086351
1	Blue, Uninspired	3.623955	3.167131	2.267409	1.693593	1.559889
2	Dull, Bored	3.089136	3.038997	2.431755	1.927577	1.660167
3	Energetic, Excited	1.278552	1.807799	2.891365	3.445682	3.454039
4	Enthusiastic, Inspired	1.275766	1.871866	2.913649	3.362117	3.289694
5	Happy, Satisfied	1.381616	2.125348	3.481894	3.206128	2.420613
6	Jittery, Nervous	2.044568	2.189415	2.242340	2.788301	3.103064
7	Passive, Quiet	3.114206	3.211699	2.788301	1.888579	1.554318
8	Relaxed, Calm	2.169916	2.816156	3.596100	2.426184	1.481894
9	Secure, At ease	1.721448	2.456825	3.657382	2.668524	1.760446
10	Tense, Bothered	2.133705	2.189415	2.253482	2.799443	3.270195
11	Unhappy, Dissatisfied	3.100279	2.738162	2.175487	2.172702	2.454039

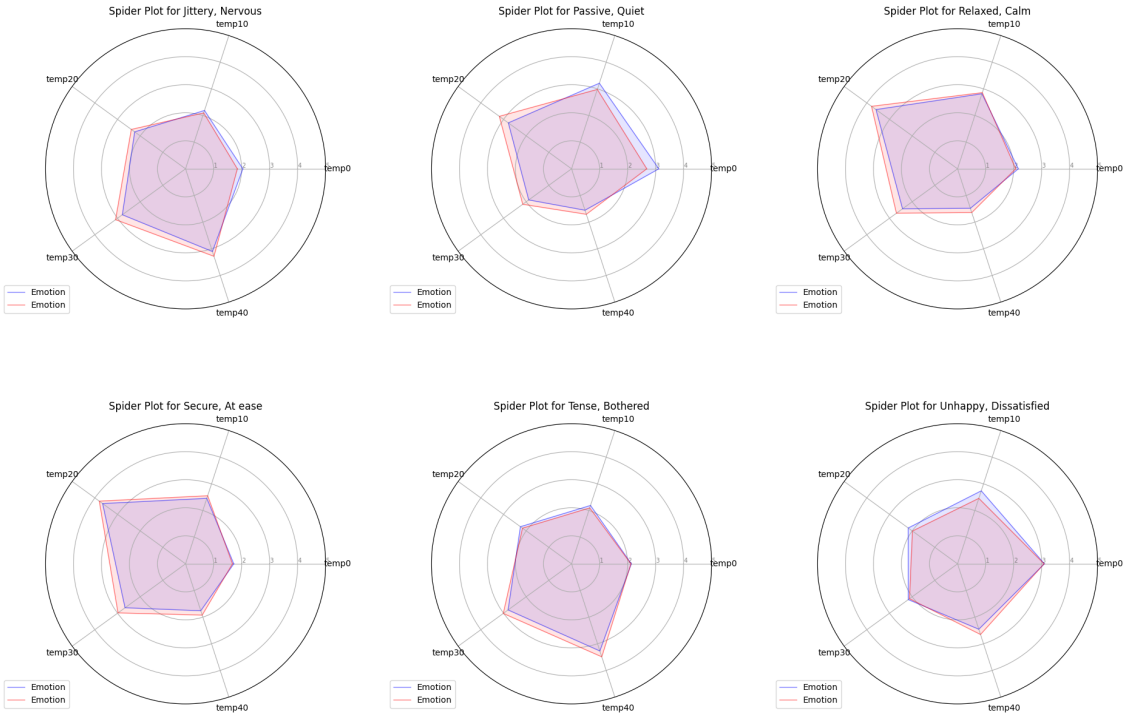
Below Median Temperature

As a heatmap:



From the above two figures, there are not many visible differences. Spider plots may give more insights into this.





THere are some visible differences between the temperature scores for 'Enthusiastic, Inspired', and 'Dull, Bored', but we must investigate further using the Mann-Whitney U Test.

	emotion	p-value
0	Energetic, Excited	0.254559
1	Secure, At ease	0.068730
2	Jittery, Nervous	0.445935
3	Dull, Bored	0.180173
4	Passive, Quiet	0.664803
5	Unhappy, Dissatisfied	0.266043
6	Tense, Bothered	0.632720
7	Relaxed, Calm	0.139607
8	Active, Alert	0.170142
9	Happy, Satisfied	0.123327
10	Blue, Uninspired	0.502073
11	Enthusiastic, Inspired	0.883936

Again, here there are no significant differences between the two groups, as none of the p-values are less than 0.05. Thus, we fail to reject the null hypothesis, and cannot comment conclusively on the differences between the two groups.

Benjamini-Hochberg Correction

As mentioned earlier, we are doing three different tests on the same data (country of residence), by grouping them in three different ways. What that means, is there is a significant possibility of false positives considering mutliple comparisons. Hence, we must employ some correction method to mitigate this.

We take up the Benjamini-Hochberg method, by which the p-values are sorted and ranked, and then adjusted by that rank, in order to get a more accurate estimate of the p-value. This adjusted p-value is checked again against the 0.05 threshold.

As we saw, there was some significant difference in the raw p-values for the experiment grouping countries based on their stage of development as a Global North or a Global South nation. Doing the Benjamini-Hochberg procedure on those obtained p-values:

	emotion	p-value_climate	p-value_dev	p-value_av_temp	climate_rank	dev_rank	av_temp_rank	bh_p_climate	bh_p_dev	bh_p_av_temp
0	Energetic, Excited	0.361451	0.142190	0.254559	3	1	2	0.361451	0.426569	0.381839
1	Secure, At ease	0.079591	0.022872	0.068730	3	1	2	0.079591	0.068616	0.103096
2	Jittery, Nervous	0.489087	0.494739	0.445935	2	3	1	0.733630	0.494739	1.337804
3	Dull, Bored	0.149951	0.304134	0.180173	1	3	2	0.449852	0.304134	0.270259
4	Passive, Quiet	0.990292	0.850004	0.664803	3	2	1	0.990292	1.275007	1.994408
5	Unhappy, Dissatisfied	0.203030	0.130003	0.266043	2	1	3	0.304545	0.390009	0.266043
6	Tense, Bothered	0.714263	0.757569	0.632720	2	3	1	1.071394	0.757569	1.898159
7	Relaxed, Calm	0.116717	0.140215	0.139607	1	3	2	0.350152	0.140215	0.209410
8	Active, Alert	0.136413	0.037862	0.170142	2	1	3	0.204619	0.113585	0.170142
9	Happy, Satisfied	0.058224	0.058664	0.123327	1	2	3	0.174672	0.087996	0.123327
10	Blue, Uninspired	0.651012	0.636207	0.502073	3	2	1	0.651012	0.954310	1.506218
11	Enthusiastic, Inspired	0.871533	0.855290	0.883936	2	1	3	1.307299	2.565871	0.883936

Analysis of Results (Country of Residence)

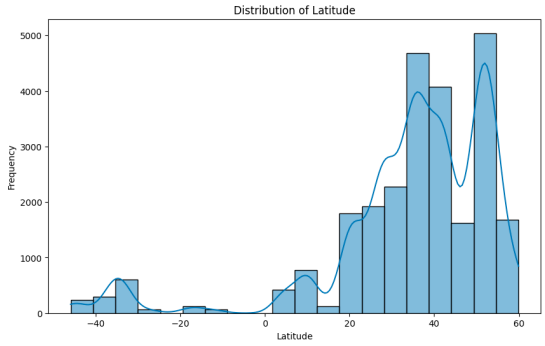
We see that none of the different groupings we chose demonstrated any significant difference between the two groups of nations.
- Temperate and tropical countries
- Global North and Global South
- Average temperature

This means that the associations of certain emotions with certain temperature is fairly universal across countries, despite differences in average temperatures, development and location.

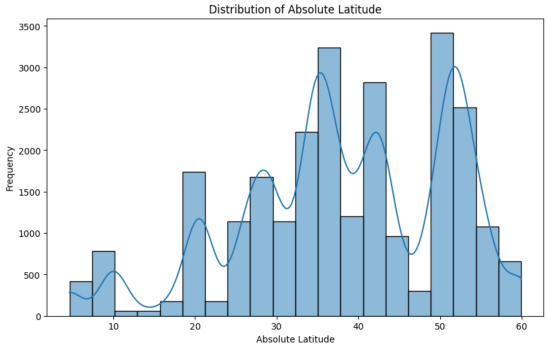
This is, in fact, a testament to the robustness of the initial findings of the paper, and the temperature-emotion association.

| Latitude

The data contains samples from Australia, Bolivia, Argentina, and other countries in the Southern Hemisphere. To observe how the distribution looks, we plotted a histogram, and it shows that there are very few samples in the negative latitudes (see left). Also, the differences between positive and negative latitudes are not extreme, and hence, it would be appropriate to take the absolute latitude, or the distance from the equator (see right).



Latitude



Distance from Equator

Null Hypothesis: There is no significant difference of the distance from the equator on the ratings of different temperature-emotion pairs
Alternate Hypothesis: There is a significant difference of the distance from the equator on the ratings of different temperature-emotion pairs
Statistical Method: ANOVA and Games Howell post-hoc

We group them into three buckets - 0-20, 20-40 and 40-60, and calculate the average temperature-emotion association score of each of those groups:

temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.62500	2.18750	3.25000	3.15625	2.87500
1	Blue, Uninspired	3.34375	3.06250	2.25000	1.87500	1.65625
2	Dull, Bored	3.00000	2.53125	2.09375	2.25000	2.21875
3	Energetic, Excited	1.25000	1.96875	3.28125	3.53125	3.46875
4	Enthusiastic, Inspired	1.46875	2.00000	3.46875	2.93750	2.75000
5	Happy, Satisfied	1.43750	2.31250	3.75000	3.37500	2.46875
6	Jittery, Nervous	1.75000	2.09375	2.37500	3.03125	3.28125
7	Passive, Quiet	2.50000	2.78125	2.96875	2.21875	1.81250
8	Relaxed, Calm	1.71875	2.65625	3.68750	2.59375	1.75000
9	Secure, At ease	1.62500	2.34375	3.84375	2.84375	2.03125
10	Tense, Bothered	2.00000	2.00000	2.25000	2.56250	3.37500
11	Unhappy, Dissatisfied	3.25000	2.56250	1.84375	1.87500	2.34375

Latitude 0-20

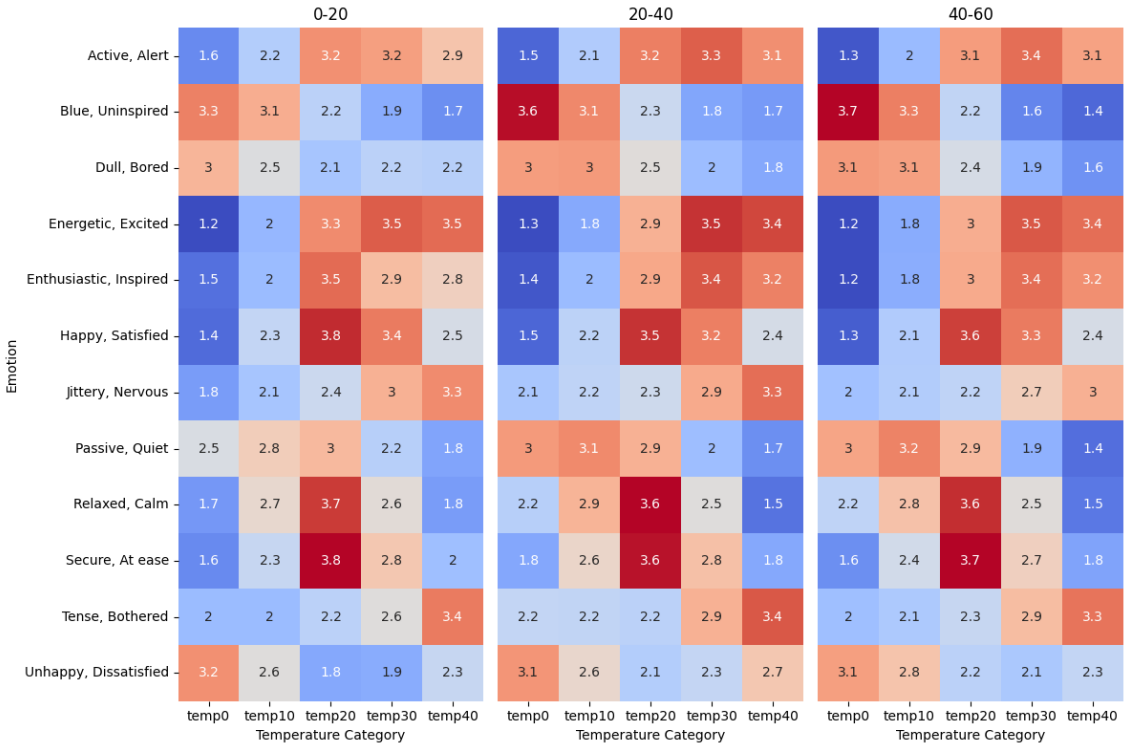
temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.452261	2.125628	3.170854	3.321608	3.095477
1	Blue, Uninspired	3.582915	3.125628	2.301508	1.814070	1.748744
2	Dull, Bored	3.015075	3.025126	2.482412	1.984925	1.834171
3	Energetic, Excited	1.311558	1.844221	2.889447	3.497487	3.427136
4	Enthusiastic, Inspired	1.366834	1.979899	2.949749	3.361809	3.160804
5	Happy, Satisfied	1.452261	2.206030	3.497487	3.170854	2.386935
6	Jittery, Nervous	2.070352	2.221106	2.326633	2.929648	3.251256
7	Passive, Quiet	3.025126	3.115578	2.889447	1.994975	1.673367
8	Relaxed, Calm	2.165829	2.869347	3.608040	2.477387	1.522613
9	Secure, At ease	1.829146	2.582915	3.577889	2.778894	1.834171
10	Tense, Bothered	2.246231	2.241206	2.195980	2.884422	3.351759
11	Unhappy, Dissatisfied	3.060302	2.562814	2.140704	2.256281	2.728643

Latitude 20-40

temp_cat	emotion	temp0	temp10	temp20	temp30	temp40
0	Active, Alert	1.296482	1.954774	3.095477	3.356784	3.060302
1	Blue, Uninspired	3.733668	3.261307	2.246231	1.572864	1.396985
2	Dull, Bored	3.105528	3.065327	2.417085	1.894472	1.648241
3	Energetic, Excited	1.236181	1.839196	2.984925	3.462312	3.351759
4	Enthusiastic, Inspired	1.236181	1.844221	3.005025	3.356784	3.180905
5	Happy, Satisfied	1.341709	2.125628	3.562814	3.281407	2.412060
6	Jittery, Nervous	2.010050	2.130653	2.226131	2.718593	2.964824
7	Passive, Quiet	3.040201	3.241206	2.884422	1.874372	1.432161
8	Relaxed, Calm	2.226131	2.824121	3.633166	2.507538	1.497487
9	Secure, At ease	1.628141	2.376884	3.738693	2.688442	1.768844
10	Tense, Bothered	1.994975	2.090452	2.291457	2.859296	3.326633
11	Unhappy, Dissatisfied	3.080402	2.804020	2.201005	2.085427	2.256281

Latitude 40-60

As a heatmap:



There are some distinctions to be seen, for instance in the emotions 'Blue, uninspired' and 'Passive, quiet' there is a difference of the 0-20 category and the other two.

Since there are three groups now, we can employ an ANOVA test to examine the differences between these groups in terms of temperature-emotion association scores.

	emotion	p-value
0	Energetic, Excited	0.573958
1	Secure, At ease	0.368100
2	Jittery, Nervous	0.042098
3	Dull, Bored	0.759843
4	Passive, Quiet	0.661848
5	Unhappy, Dissatisfied	0.260792
6	Tense, Bothered	0.310666
7	Relaxed, Calm	0.894317
8	Active, Alert	0.414523
9	Happy, Satisfied	0.530714
10	Blue, Uninspired	0.486219
11	Enthusiastic, Inspired	0.802812

ANOVA Test for Latitude

The ANOVA test yields that the emotion 'Jittery, nervous' shows a p-value of 0.042, which is below 0.05, and hence we can reject the null hypothesis for this emotion.
This implies that among the three groups, there is some significant difference when it comes to the scores given to the temperature pairs formed with 'Jittery, nervous'.

We can perform a Games-Howell Post-Hoc test on this data to determine exactly which groups demonstrate this significant difference.

Post-Hoc Test

A post-hoc test was performed:

group1	group2	meandiff	p-adj	lower	upper	reject
0-20	20-40	0.0535	0.8842	-0.2121	0.3192	False
0-20	40-60	-0.0962	0.6724	-0.3619	0.1695	False
20-40	40-60	-0.1497	0.0324	-0.2896	-0.0099	True

Post-Hoc Test for Latitude

Thus, the results of the post-hoc tests demonstrate to us that the significant difference is only between the 20-40 and 40-60 latitude groups, with a p-value of 0.032, which is less than 0.05.

This implies that when it comes to the emotion 'Jittery, nervous', the responses from participants responding from locations 20-40 degrees away from the equator differed significantly from that of participants responding from locations 40-60 degrees away.

Analysis of Results (Latitude)

We see that for most emotions, there is no significant difference between the temperature-emotion scores given to them on the basis of the latitude of the interview. Only for the emotion 'Jittery, nervous', was such a significant difference present. On performing a post-hoc test(Games-Howell), we found that the significant difference is between the 20-40 degrees and 40-60 degrees groups of participants. From the initial tables reported, the score give to the association between the 'Jittery, nervous' emotion is on average higher for the 20-40 category. That said, we cannot make a statement about which associates this particular emotion with warmer or cooler temperatures, and it is possible this significant difference is due to the fact that people in the 20-40 belt just score more extremely (in a purely statistical sense), and that is the cause of the difference.

| Analysis

Overall, we find that no matter what the criterion, there is by and large no significant difference between the scores for the temperature-emotion scores that they get, despite differences in country, or altitude, or even age or gender. This is testimony to the robustness of the initial findings that there exist such explicit and implicit associations between temperature and emotion, and that they cross-cut different demographic and geographic differences, such as gender, age, country, latitude, etc.

| References

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5. Lecture Slides from the Course

Team Contributions

Team Name - data based

Analyis on Gender, Regression - Himani
Analysis on Age, Literature Review - Tanveer
Analysis on Country of Residence, Latitude - Nanda

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