World Happiness Report

Happiness Trends and Contributing Factors (2011-2024)

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```
import polars as pl
import numpy as np
from plotnine import *
from great_tables import GT

# Read CSV with polars
whr_pl = pl.read_csv("data/whr.csv")

theme_whr = (
  theme_minimal()
  + theme(
    plot_subtitle=element_text(size=12),
    plot_title=element_text(size=14)
  )
)
```

Introduction

This report analyzes the data from the 2025 World Happiness Report, which looks at global happiness trends and factors that contribute to national happiness levels from 2011 to 2024. The dataset contains happiness rankings and scores for 169 countries.

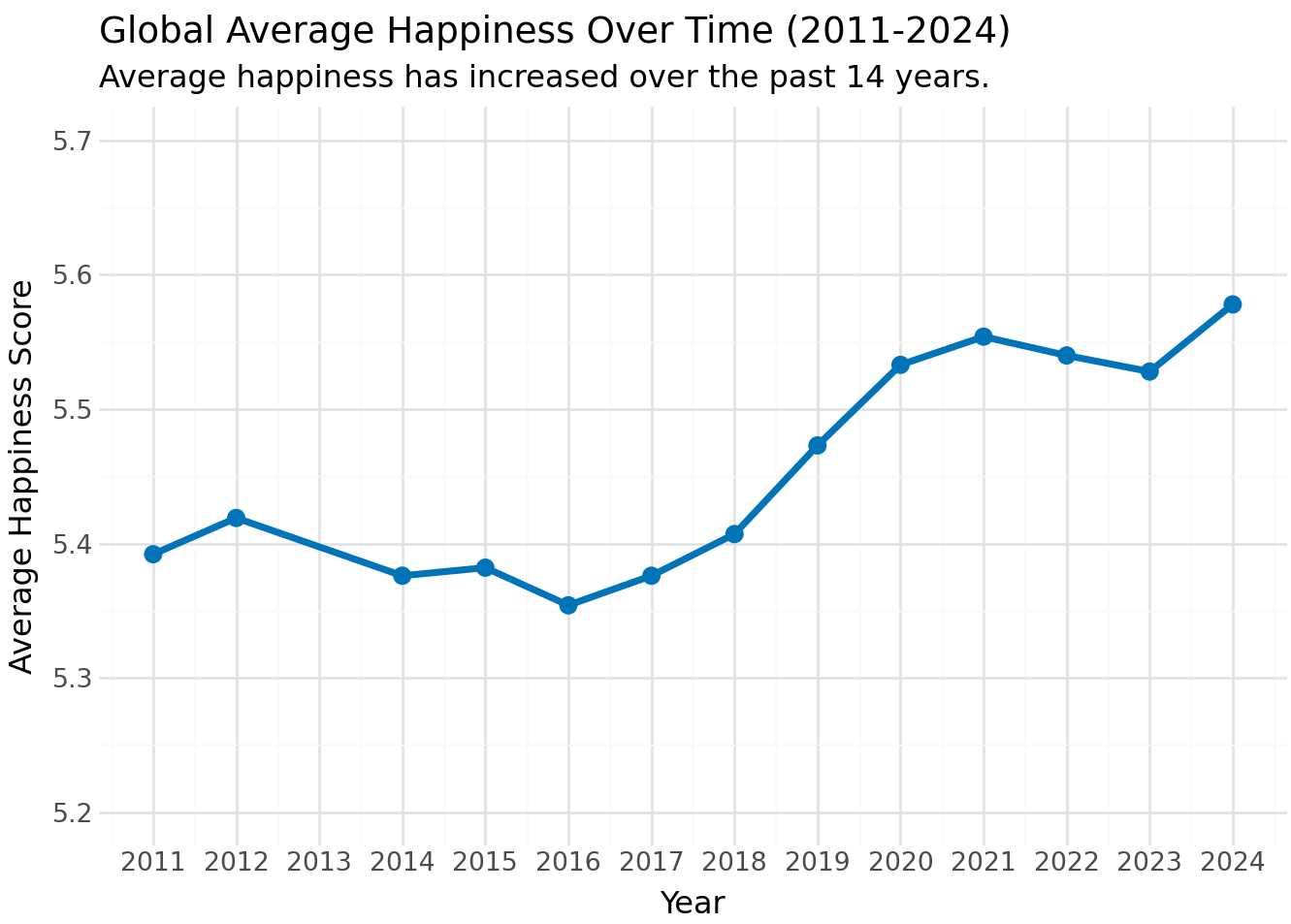
Global Happiness Trends

Overall Trends (2011-2024)

```
global_trends = (
    whr_pl
    .group_by('year')
    .agg([
        pl.col('ladder_score').mean().alias('mean_happiness'),
        pl.col('ladder_score').median().alias('median_happiness'),
        pl.col('ladder_score').min().alias('min_happiness'),
```

```
        pl.col('ladder_score').max().alias('max_happiness'),
        pl.col('ladder_score').count().alias('countries_count')
    ])
    .sort('year')
)

numeric_cols = ['mean_happiness', 'median_happiness', 'min_happiness',
'max_happiness']
global_trends = global_trends.with_columns([
    pl.col(col).round(3) for col in numeric_cols
])
```

```
global_plot = (
    ggplot(global_trends, aes(x='year', y='mean_happiness'))
    + geom_line(size=1.5, color='#0076BA')  # Using a nice blue color
    + geom_point(size=3, color='#0076BA')
    + scale_x_continuous(breaks=range(2011, 2025, 1))
    + scale_y_continuous(limits=(5.2, 5.7), breaks=np.arange(5.2, 5.8, 0.1))
    + theme_whr
    + theme(
        axis_title=element_text(size=12),
        axis_text=element_text(size=10)
    )
    + labs(
        title="Global Average Happiness Over Time (2011-2024)",
        subtitle="Average happiness has increased over the past 14 years.",
        x="Year",
        y="Average Happiness Score"
    )
)

global_plot
```



Key findings

- **Gradual Improvement**: Average global happiness has increased from ~5.39 (2011) to ~5.58 (2024)
- **2011-2016**: Relatively stable around 5.35-5.40
- **2017-2019**: Beginning of upward trend
- **2019-2024**: Higher plateau around 5.50-5.58

Country-Level Analysis

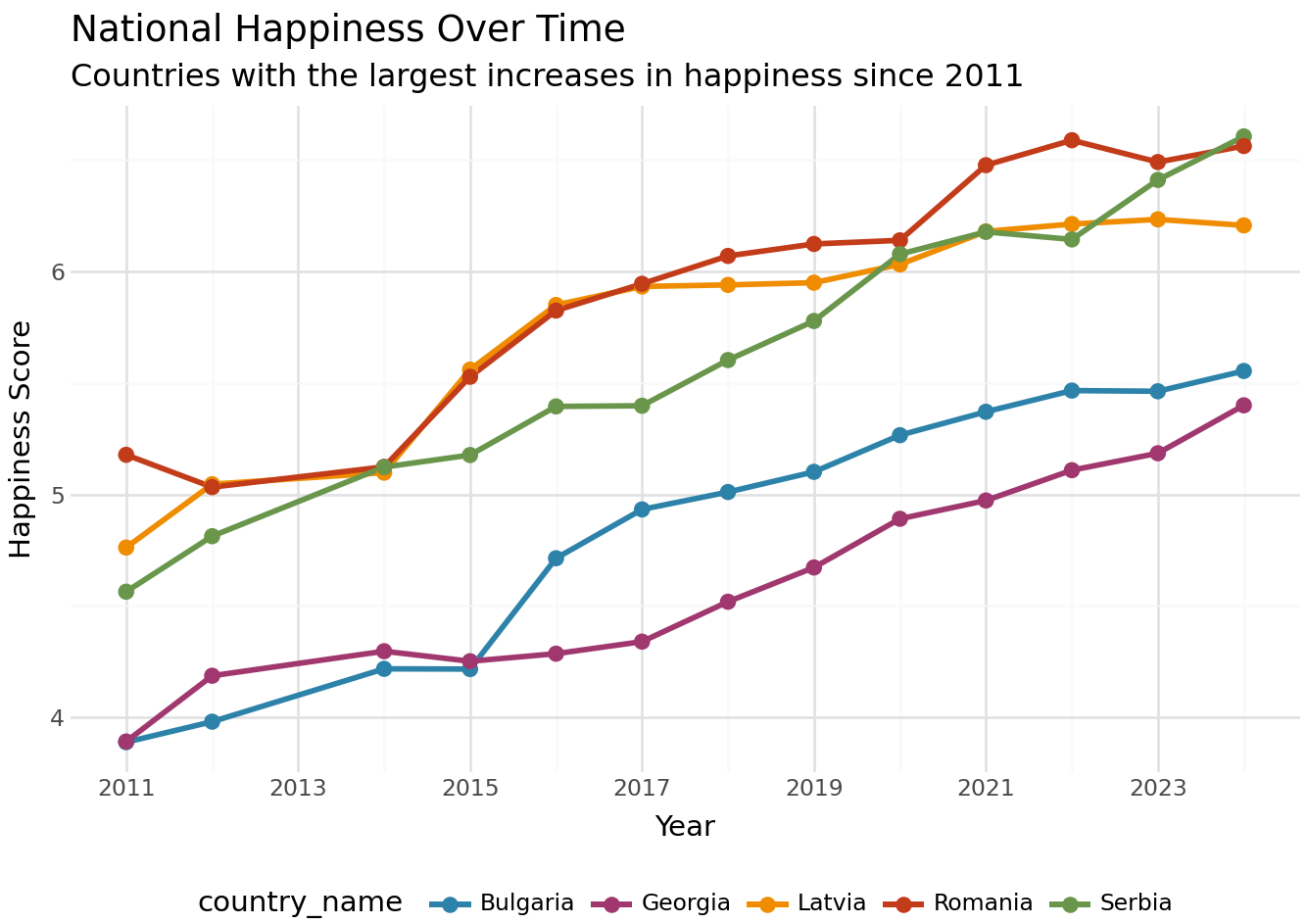
Countries with Largest Changes in Happiness

```
country_stats = (
    whr_pl
    .drop_nulls(['year', 'ladder_score'])
    .sort(['country_name', 'year'])
    .group_by('country_name')
    .agg([
```

```
        pl.col('year').min().alias('first_year'),
        pl.col('year').max().alias('last_year'),
        pl.col('ladder_score').first().alias('first_score'),
        pl.col('ladder_score').last().alias('last_score')
    ])
)

most_changed_countries = country_stats.with_columns([
    (pl.col('last_score') - pl.col('first_score')).alias('change'),
    (pl.col('last_year') - pl.col('first_year')).alias('years_span')
])

most_changed_countries = most_changed_countries.filter(pl.col('years_span') >=
10)

most_changed_countries = most_changed_countries.with_columns([
    (pl.col('change') > 0).alias('improvement'),
    pl.col('change').abs().alias('abs_change')
])

improvements = (
    most_changed_countries
    .filter(pl.col('improvement'))
    .sort('abs_change', descending=True)
    .head(5)
)

declines = (
    most_changed_countries
    .filter(~pl.col('improvement'))
    .sort('abs_change', descending=True)
    .head(5)
)

improvements_df = (
    whr_pl
    .join(
        improvements.select('country_name'),
        on='country_name',
        how='inner'
    )
)

declines_df = (
    whr_pl
    .join(
        declines.select('country_name'),
        on='country_name',
```

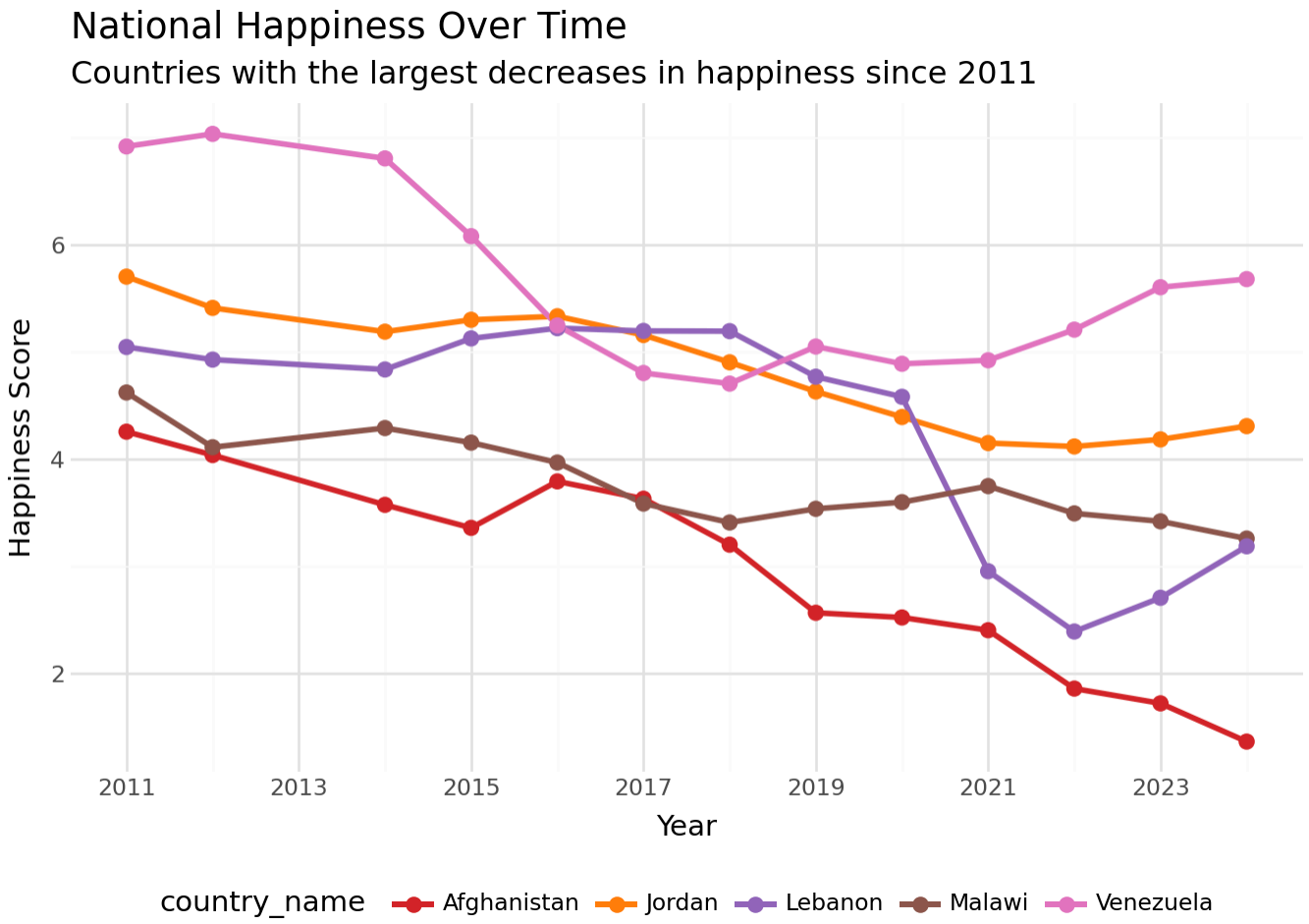
```
        how='inner'
    )
)
```

```
improvements_plot = (
    ggplot(improvements_df, aes(x="year", y="ladder_score",
color="country_name"))
    + geom_line(size=1.2)
    + geom_point(size=2.5)
    + scale_x_continuous(breaks=range(2011, 2025, 2))
    + scale_color_manual(
        values=["#2E86AB", "#A23B72", "#F18F01", "#C73E1D", "#6A994E"],
        name=""
    )
    + theme_whr
    + theme(
        legend_position="bottom",
        legend_direction="horizontal"
    )
    + labs(
        title="National Happiness Over Time",
        subtitle="Countries with the largest increases in happiness since
2011",
        x="Year",
        y="Happiness Score"
    )
)

improvements_plot
```




```
declines_plot = (
    ggplot(declines_df, aes(x="year", y="ladder_score", color="country_name"))
    + geom_line(size=1.2)
    + geom_point(size=2.5)
    + scale_x_continuous(breaks=range(2011, 2025, 2))
    + scale_color_manual(
        values=["#D62728", "#FF7F0E", "#9467BD", "#8C564B", "#E377C2"],
        name=""
    )
    + theme_whr
    + theme(
        legend_position="bottom",
        legend_direction="horizontal"
    )
    + labs(
        title="National Happiness Over Time",
        subtitle="Countries with the largest decreases in happiness since
2011",
```

```
        x="Year",
        y="Happiness Score"
    )
)

declines_plot
```



Key findings

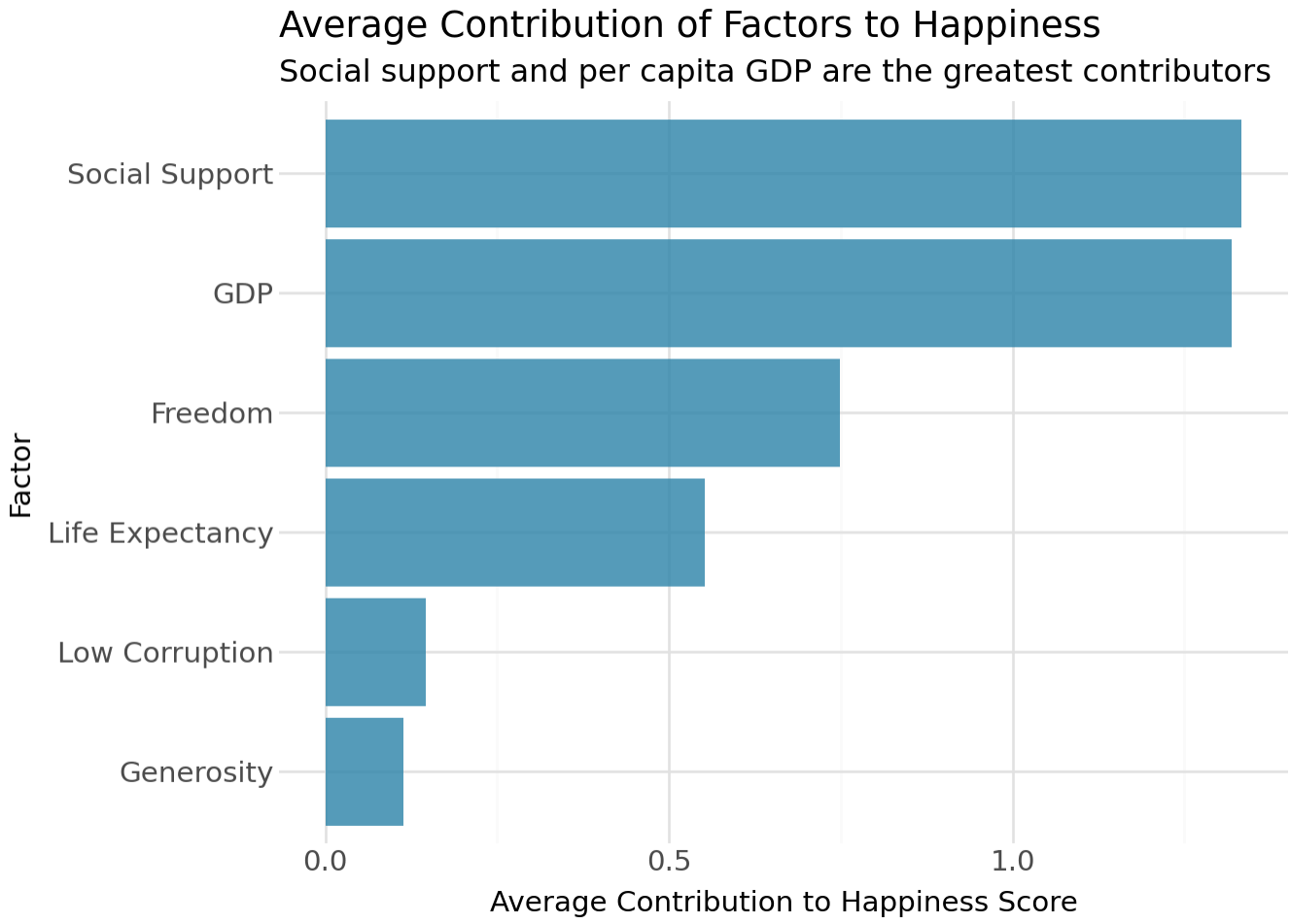
- Post-Soviet and eastern European countries showed improvement trends, with Serbia, Bulgaria, and Georgia having the largest improvements in happiness.
- Afghanistan, Lebanon, and Jordan had the most severe declines in happiness, coinciding with major political and economic events.

Happiness Contributing Factors

Contributing factors 2024

```
latest_year = 2024
factor_data_2024 = whr_pl.filter(pl.col('year') == latest_year)

factor_contributions = pl.DataFrame({
    'Factor': ['GDP', 'Social Support', 'Life Expectancy', 'Freedom',
'Generosity', 'Low Corruption'],
    'Average_Contribution': [
        factor_data_2024.filter(pl.col('explained_by_log_gdp_per_capita') !=
"NA")
        .select(pl.col('explained_by_log_gdp_per_capita').cast(pl.Float64).mean())
            .item(),
        factor_data_2024.filter(pl.col('explained_by_social_support') != "NA")
         .select(pl.col('explained_by_social_support').cast(pl.Float64).mean())
            .item(),

factor_data_2024.filter(pl.col('explained_by_healthy_life_expectancy') !=
"NA")
        .select(pl.col('explained_by_healthy_life_expectancy').cast(pl.Float64).mean())
            .item(),

factor_data_2024.filter(pl.col('explained_by_freedom_to_make_life_choices') !=
"NA")
        .select(pl.col('explained_by_freedom_to_make_life_choices').cast(pl.Float64).mean())
            .item(),
        factor_data_2024.filter(pl.col('explained_by_generosity') != "NA")
            .select(pl.col('explained_by_generosity').cast(pl.Float64).mean())
            .item(),

factor_data_2024.filter(pl.col('explained_by_perceptions_of_corruption') !=
"NA")
        .select(pl.col('explained_by_perceptions_of_corruption').cast(pl.Float64).mean())
            .item()
    ]
}).sort('Average_Contribution', descending=True)

factor_plot = (
    ggplot(
        factor_contributions,
        aes(x='reorder(Factor, Average_Contribution)',
y='Average_Contribution')
    )
    + geom_col(alpha=0.8, fill='#2E86AB')
    + coord_flip()
    + labs(
        title="Average Contribution of Factors to Happiness",
```

```
        subtitle="Social support and per capita GDP are the greatest
contributors",
        x="Factor",
        y="Average Contribution to Happiness Score"
    )
    + theme_whr
    + theme(
        axis_text=element_text(size=11)
    )
)

factor_plot
```



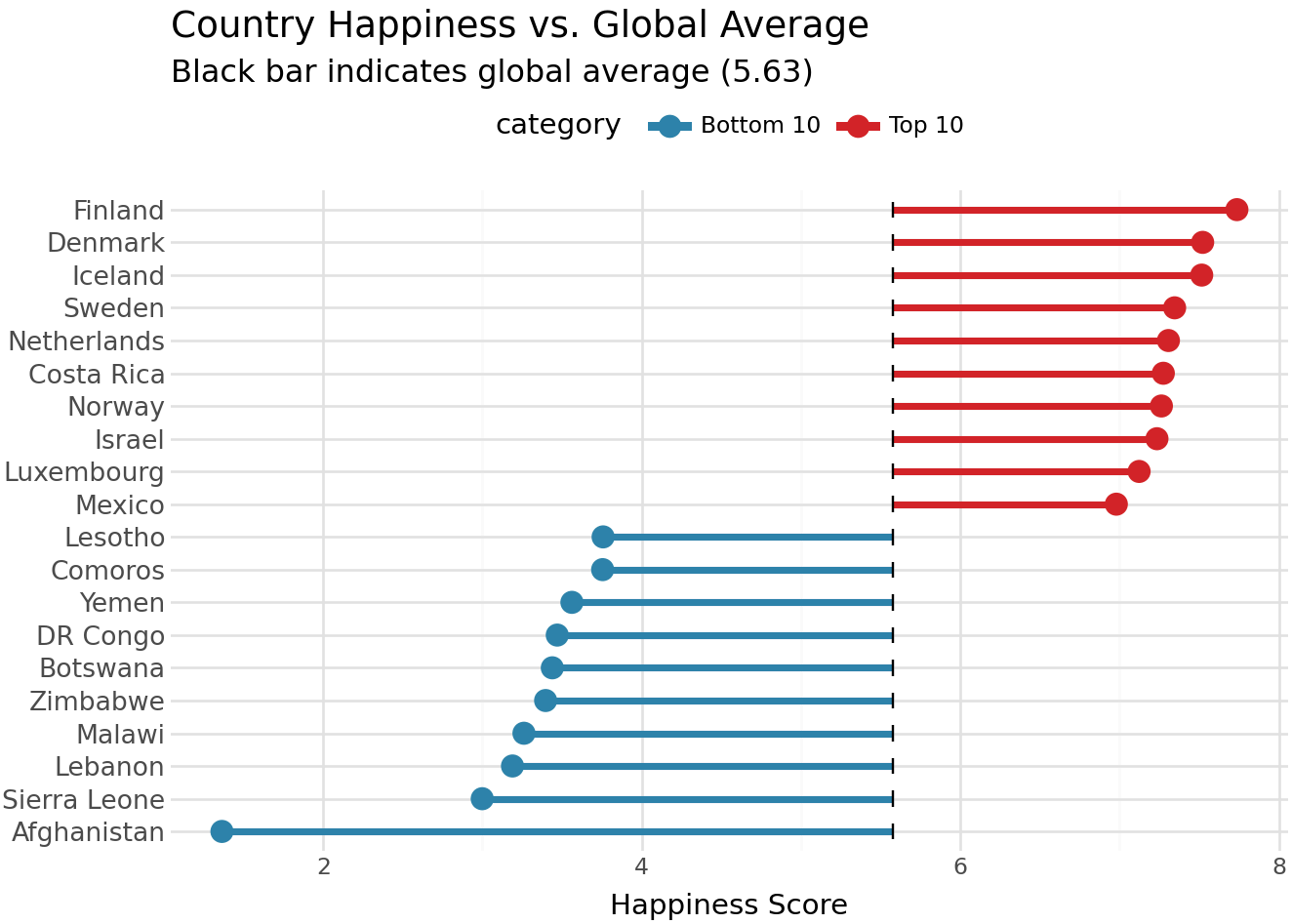
The top contributors to happiness worldwide in 2024 were social support, GDP per capita, and having a sense of freedom.

Happiness Factor Breakdown for Top 10 Countries (2024)

```
latest_sorted = (
    whr_pl
    .filter(pl.col('year') == latest_year)
    .sort('ladder_score', descending=True)
)

top_10_countries = (
    latest_sorted
    .head(10)
    .select(['country_name', 'ladder_score'])
    .with_columns(pl.col('ladder_score').round(3))
)

bottom_10_countries = (
    latest_sorted
    .tail(10)
    .reverse()  # Reverse to show worst first
    .select(['country_name', 'ladder_score'])
    .with_columns(pl.col('ladder_score').round(3))
)
```

```
top_with_category = top_10_countries.with_columns(
    pl.lit("Top 10").alias("category")
)
bottom_with_category = bottom_10_countries.with_columns(
    pl.lit("Bottom 10").alias("category")
)

all_countries = pl.concat([top_with_category, bottom_with_category])

global_mean_2024 = whr_pl.filter(pl.col('year') == 2024)
['ladder_score'].mean()

dumbbell_data = all_countries.with_columns([
    pl.lit(global_mean_2024).alias('global_avg')
])

dumbbell_plot = (
    ggplot(dumbbell_data)
    + geom_segment(
        aes(x='reorder(country_name, ladder_score)',
xend='reorder(country_name, ladder_score)',
            y='global_avg', yend='ladder_score', color='category'),
        size=1.5
    )
    + geom_point(
        aes(x='reorder(country_name, ladder_score)', y='ladder_score',
```

```
color='category'),
        size=4
    )
    + geom_point(
        aes(x='reorder(country_name, ladder_score)', y='global_avg'),
        color='black', shape='|', size=3
    )
    + coord_flip()
    + scale_color_manual(
        values=["#2E86AB", "#D62728"],
        name=""
    )
    + theme_whr
    + theme(
        axis_text_y=element_text(size=10),
        legend_position='top'
    )
    + labs(
        title="Country Happiness vs. Global Average",
        subtitle="Black bar indicates global average (5.63)",
        x="",
        y="Happiness Score"
    )
)

dumbbell_plot
```




```
top_countries_2024 = (
    whr_pl
    .filter(pl.col('year') == 2024)
    .sort('ladder_score', descending=True)
    .head(10)
    .select(['rank', 'country_name', 'ladder_score',
'explained_by_log_gdp_per_capita',
             'explained_by_social_support',
'explained_by_healthy_life_expectancy'])
    # Convert string columns to numeric
    .with_columns([
        pl.col('explained_by_log_gdp_per_capita').cast(pl.Float64),
        pl.col('explained_by_social_support').cast(pl.Float64),
        pl.col('explained_by_healthy_life_expectancy').cast(pl.Float64)
    ])
)

gt_top10 = (
```

```
    GT(top_countries_2024)
    .tab_header(
        title="Top 10 happiest countries in 2024",
        subtitle="Based on the World Happiness Report ladder scores"
    )
    .cols_label(
        rank="Rank",
        country_name="Country",
        ladder_score="Happiness Score",
        explained_by_log_gdp_per_capita="GDP per Capita",
        explained_by_social_support="Social Support",
        explained_by_healthy_life_expectancy="Healthy Life"
    )
    .fmt_number(
        columns=['ladder_score', 'explained_by_log_gdp_per_capita',
                 'explained_by_social_support',
'explained_by_healthy_life_expectancy'],
        decimals=3
    )
    .data_color(
        columns=['ladder_score'],
        palette="Blues",
        domain=[7, 8]
    )
    .tab_source_note(
        source_note="Source: World Happiness Report 2025"
    )
    .opt_stylize(style=1, color='blue')
    .opt_horizontal_padding(scale=1.5)
)

gt_top10
```

Top 10 happiest countries in 2024

Based on the World Happiness Report ladder scores

Rank	Country	Happiness Score	GDP per Capita	Social Sup-port	Healthy Life
1	Finland	7.736	1.749	1.783	0.824
2	Denmark	7.521	1.825	1.748	0.820
3	Iceland	7.515	1.799	1.840	0.873
4	Sweden	7.345	1.783	1.698	0.889

Source: World Happiness Report 2025

Top 10 happiest countries in 2024

Based on the World Happiness Report ladder scores

Rank	Country	Happiness Score	GDP per Capita	Social Sup-port	Healthy Life
5	Netherlands	7.306	1.822	1.667	0.844
6	Costa Rica	7.274	1.492	1.600	0.680
7	Norway	7.262	1.902	1.711	0.863
8	Israel	7.234	1.695	1.743	0.824
9	Luxembourg	7.122	2.028	1.558	0.864
10	Mexico	6.979	1.435	1.504	0.550

Source: World Happiness Report 2025

Patterns Among Top Countries

- **Nordic countries tend to be happy**: Finland, Denmark, Iceland, Sweden, and Norway show similar balanced patterns.
- **Effect of GDP varies**: Luxembourg has the highest GDP contribution, while Costa Rica has high happiness with lower GDP contribution, but strong social factors.
- **Balanced Approach**: No single happiness factor dominates.

Country Spotlight: 2020 vs 2024

```
selected_countries = ['Finland', 'France', 'United States', 'Japan', 'Brazil']

country_comparison = (
    whr_pl
    .filter(pl.col('year').is_in([2020, 2024]))
    .filter(pl.col('country_name').is_in(selected_countries))
    .select(['country_name', 'year', 'ladder_score'])
    .pivot(values='ladder_score', index='country_name', on='year')
)

country_comparison = country_comparison.with_columns([
    ((pl.col('2024') - pl.col('2020')) / pl.col('2020') *
100).alias('pct_change')
]).sort('2024', descending=True)

gt_country_comparison = (
    GT(country_comparison)
    .tab_header(
        title="Country Happiness Trends",
```

```
        subtitle="Comparing happiness scores between 2020 and 2024"
    )
    .cols_label(
        country_name="Country"
    )
    .fmt_number(
        columns=['2024', '2020'],
        decimals=3
    )
    .fmt_percent(
        columns=['pct_change'],
        decimals=1,
        scale_values=False
    )
    .tab_spanner(
        label="Happiness Score",
        columns=['2020', '2024']
    )
    .data_color(
        columns=['pct_change'],
        palette=['#ef553b', '#ffffff', '#3b82f6'],
        domain=[-5, 5]
    )
    .opt_stylize(style=3, color='cyan')
)

gt_country_comparison
```

Country Happiness Trends

Comparing happiness scores between 2020 and 2024

	Happiness Score		
Country	2020	2024	pct_change
Finland	7.842	7.736	−1.4%
United States	6.951	6.724	−3.3%
France	6.690	6.593	−1.4%
Brazil	6.330	6.494	2.6%
Japan	5.940	6.147	3.5%

Detailed Country Profiles

```
countries_detail = ['Finland', 'United States', 'Brazil', 'Japan', 'France']
```

```
country_profiles = (
    whr_pl
    .filter(pl.col('country_name').is_in(countries_detail))
    .group_by('country_name')
    .agg([
        pl.col('ladder_score').filter(pl.col('year') ==
2024).first().alias('score_2024'),
        pl.col('rank').filter(pl.col('year') ==
2024).first().alias('rank_2024'),
        pl.col('ladder_score').min().alias('min_score'),
        pl.col('ladder_score').max().alias('max_score'),
        pl.col('ladder_score').mean().alias('avg_score'),
        pl.col('ladder_score').alias('score_history')
    ])
    .sort('rank_2024')
)

country_profiles_stats = country_profiles.with_columns([
    (pl.col('score_2024') - pl.col('avg_score')).alias('change_from_mean'),
    ((pl.col('max_score') - pl.col('min_score'))).alias('range')
])

gt_profiles_stats = (
    GT(country_profiles_stats)
    .tab_header(
        title="Comparative Analysis of National Happiness Indices",
        subtitle="Temporal patterns and current status (World Happiness
Report, 2011-2024)"
    )
    .cols_label(
        country_name="Nation",
        score_2024="Score",
        rank_2024="Rank",
        avg_score="M",
        change_from_mean="Δ",
        range="Range"
    )
    .cols_hide(['score_history', 'min_score', 'max_score'])
    .fmt_number(
        columns=['score_2024', 'avg_score', 'range'],
        decimals=2
    )
    .fmt_number(
        columns=['change_from_mean'],
        decimals=2,
        force_sign=True
    )
```

```
    .tab_spanner(
        label="2024",
        columns=['score_2024', 'rank_2024']
    )
    .tab_spanner(
        label="Historical (2011-2024)",
        columns=['avg_score', 'change_from_mean', 'range']
    )
    .data_color(
        columns=['change_from_mean'],
        palette=['#d73027', '#fee08b', '#1a9850'],
        domain=[-0.5, 0.5]
    )
    .cols_width({
        'country_name': '25%',
        'score_2024': '12%',
        'rank_2024': '10%',
        'avg_score': '12%',
        'change_from_mean': '10%',
        'range': '12%'
    })
    .tab_source_note(
        source_note="Note: M = mean; Δ = change from historical mean; Range =
max−min across all years. All scores on 0-10 scale."
    )
    .opt_stylize(style=3, color='gray')
    .opt_horizontal_padding(scale=1.1)
)

gt_profiles_stats
```

Comparative Analysis of National Happiness Indices

Temporal patterns and current status (World Happiness Report, 2011-2024)

	2024		Historical (2011-2024)		
Nation	Score	Rank	M	Δ	Range
Finland	7.74	1	7.65	+0.09	0.45
United States	6.72	24	6.97	−0.24	0.55
France	6.59	33	6.61	−0.02	0.32
Brazil	6.49	36	6.52	−0.02	0.86

Note: M = mean; Δ = change from historical mean; Range = max−min across all years. All scores on 0-10 scale.

Comparative Analysis of National Happiness Indices

Temporal patterns and current status (World Happiness Report, 2011-2024)

	2024		Historical (2011-2024)		
Nation	Score	Rank	M	Δ	Range
Japan	6.15	55	6.00	+0.15	0.28

Note: M = mean; Δ = change from historical mean; Range = max−min across all years. All scores on 0-10 scale.

Conclusions

1. **Global happiness is gradually improving**: The world has become slightly happier over the past decade.
2. **Social connections and economic conditions are most important**: GDP per capita and social support are the strongest contributors to national happiness.
3. **Multiple pathways to happiness**: The top countries show that there are different combinations of factors that can lead to high happiness levels.
4. **Crises can severely affect happiness**: Countries experiencing political upheaval or economic crisis show dramatic happiness declines.