Interactive Dashboard | GitHub

Dashboard Report

1. Introduction

This project is based on the data of the *World Happiness Report*, which is published yearly on the International Day of Happiness. The first World Happiness Report was published in 2012 by the Earth Institute. The three founding editors John Helliwell, Richard Layard, and Jeffrey D. Sachs were later joined by Jan-Emmanual De Neve, Lara B. Aknin, and Shun Wang. Since 2013, the reports have been published by the Sustainable Development Solutions Network (SDSN) and the Center for Sustainable Development (CSD) at Columbia University (Helliwell et al., 2022, pp. 3–4).

The first report in 2012 brought up the strong contradictions the world is facing. On the one hand, we have sophisticated technologies that enhance productivity like never before. On the other hand, a large share of the world population does not have enough food for a day. Moreover, the high levels of productivity contribute to the destruction of the natural environment. These different realities are paired with anxieties and unhappiness and require urgent attention (Helliwell et al., 2012, p. 3).

The *Easterlin paradox* states that human well-being and satisfaction can improve in the short term when income is increasing, especially from a very low level. However, in the long run, higher incomes do not necessarily improve well-being. Affluence can even have negative consequences like fostering addictions, eating or psychological disorders, and anxieties (Helliwell et al., 2012, p. 4).

After two years of a worldwide pandemic, the World Happiness Report 2022 aims to bring light into the dark and emphasize everyone's desire to be happy and the will to support each other in difficult times (The World Happiness Report, 2022b).

The reports are based on a variety of global survey data, where people evaluate their lives. However, the main source has been the Gallup World Poll. In light of the importance of Gallup's research contribution, they have become the data partner for the World Happiness Report (Helliwell et al., 2022, p. 3).

With this project, we aimed to create an interactive dashboard that transforms the data of the World Happiness Report into meaningful visualizations helping the user to gain useful and interesting insights from it.

2. Dataset Description

We used the datasets published on Kaggle, as they were available altogether and were ready to use for data visualization without the necessity of major data cleaning steps. The datasets are covering the years from 2015 to 2022 (Aché, 2022).

Each dataset is a flat table containing between 147 and 158 items and 9 to 20 attributes, depending on the year. The attribute *Country* is *categorical*, all the others are *Ordered*. From these attributes, the *Happiness Score* is *ordinal* and the others are *quantitative*. The data used is *static* and the ordering direction is *sequential*.

Table 1 shows all the attributes included in the eight datasets. Some attributes were the same, some had different names but represented the same thing (see which attributes we grouped below under *Name of Attribute*), and some new attributes were added throughout the years. For simplicity reasons, we considered the transformed *Explained by* attributes (e.g. *Explained by: GDP per capita*) and the attribute itself (e.g. *GDP per Capita*) as the same in the table.

Table 1: Overview of attributes used in each dataset between 2015 and 2022.

Name of feature	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Country / Region / Country or region / Country name / Regional indicator	x	x	x	x	x	x	x	x
Happiness Rank / Overall rank / RANK	x	x	x	x	x			x
Happiness Score / Score / Ladder score	x	x	x	x	x	x	x	x
Standard Error / Standard error of ladder score	x					x	x	
Economy (GDP per Capita) / GDP per capita / Logged GDP per capita / Explained by: GDP per capita	x	x	x	x	x	x	x	x
Family / Social Support / Explained by: Social support	x	x	x	x	x	x	x	x
Health (Life Expectancy) / Healthy life expectancy / Explained by: Healthy life expectancy	x	x	x	x	x	x	x	x
Freedom / Freedom to make life choices / Explained by: Freedom to make life choices	x	x	x	x	x	x	x	x
Trust (Government Corruption) / Perception of corruption	x	x	x	x	x	x	x	
Lower Confidence Interval / Whisker.low / lowerwhisker / Whisker-low		x	x			x	x	x
Upper Confidence Interval / Whisker.high / upperwhisker / Whisker-high		x	x			x	x	x
Generosity	x	x	x	x	x	x	x	
Dystopia / Dystopia Residual	x	x	x			x	x	x
Ladder score in Dystopia						x	x	

In the preprocessing phase, we removed the statistical attributes *Standard Error*, *Lower* and *Upper Confidence Interval* which were not relevant for our project. We also renamed the attributes that were named differently across the years to have consistent attribute names. In the datasets from 2020 and 2021, the *Happiness Rank* was missing. Here we added an attribute for the *Happiness Rank* based on the *Happiness Score* provided.

In the end, we used the following ten attributes to plot our visualizations: *Country*, *Year*, *Happiness Rank*, *Happiness Score*, *Economy (GDP per Capita)*, *Social support*, *Health (Life Expectancy)*, *Freedom*, *Corruption Perceptions*, and *Generosity*.

The number of countries included in the datasets ranges from 147 to 158. The countries that are missing are not the same across the different datasets. There are 195 countries in the world, which means there are around 37 to 48 countries for which we don't have any data regarding the happiness of their population (Worldometer, 2022).

The *Happiness Score* is calculated by using data from the Gallup World Poll surveys for the three years prior to the year of the report (e.g. *World Happiness Report 2022* uses data from the surveys from 2019 to 2021). The survey uses the *Cantril ladder* which asks people to rank their current lives based on a scale from 0 to 10, where 10 is the best and 0 is the worst possible life. The *Gallup Weights* are used to make the samples representative (The World Happiness Report, 2022a).

3. Visualizations & Interactions

When searching for a dataset to visualize we wanted to focus on a positive topic. Therefore, the datasets of the World Happiness Report were a great fit. We also remembered the widely known and successful exhibition called *The Happy Show* by Stefan Sagmeister, an Austrian graphic designer and art director. The setup of the exhibition served as inspiration for the design of our dashboard.

Our dashboard is comprised of 7 different visualizations. Users can explore the datasets for the years 2015 to 2022, compare the happiness rankings of different countries and interact with the data in many different ways.

At the top, the dashboard shows a *Choropleth Map* which is based on the *Happiness Score* for each country. There are three options to interact with the map. Firstly, the user can choose to view the countries worldwide or a specific continent (Europe, Asia, Africa, North America, and South America) and the year for which the *Happiness Score* should be displayed (2015 to 2022). The choice will adjust the map accordingly. Moreover, by moving the cursor over each country, the user can see the *Happiness Score* of that country in the given year. All the other visualizations will display the data according to the year chosen at the top of the dashboard.

The second visualization shows the relationship between a chosen attribute and the *Happiness Score* by plotting the distribution of data according to two quantitative attributes. The distribution is visualized with two boxplots and a scatterplot with an OLS regression. Moving the cursor over each dot gives the user information about the *Happiness Score* and the score of the selected attribute for that specific country.

Below, the users can see which 10 countries have the highest *Happiness Score* and what that score is. Additionally, a heatmap shows the correlation between each attribute and the *Happiness Score*. Moving the cursor over the objects displays additional information about the

country, its score and the attributes that the correlation refers to. The charts will adapt automatically, if a different year gets selected.

The next part consists of a line chart comparing the *Happiness Rank* and a bar chart comparing the *Happiness Score* of multiple countries. The user can select which countries to display, up to as many countries as they want. Moving the cursor on the objects will show information on the respective year, rank or score.

The last part of our dashboard is the comparison of two different countries by their score and rank, supported by a radar chart. Users can choose two different countries and get a comparison of the *Happiness Score* and *Happiness Rank*. Moreover, the radar chart will show the comparison of the scores for each of the impact factors. By moving the mouse over one of the areas in the radar chart, the tooltip will display the scores of all the attributes for that specific country.

4. Reading the Visualization

Encoding

The *Choropleth Map* uses the country as a geographic attribute to display the quantitative attribute of the Happiness Score. The map is color encoded: The colors of the countries indicate the level of the *Happiness Score* ranging from yellow (low), orange (medium) to pink (high). Missing countries are indicated in white on the choropleth map.

The scatterplot includes only quantitative attributes. The yellow line represents the OLS trendline and the dots represent each country. In the heatmap, the color is the main visual encoding, representeting the different levels of correlation between the Happiness Score and one of the other features. The barcharts are based on a quantitative and qualitative attribute. In the second barchart each bar was encoded with a color representing a different country. For the dot and line chart, the different countries were encoded with color as well. The radar plot also used color encoding for the countries chosen for comparison.

Filtering

With our interactive dashboard, data can be filtered by continent, year, country, and attributes, depending on the visualization.

In the Choropleth Map, the user can filter the data according to the continent and year. The year filter is automatically applied to the other visualizations.

In the second visualization, including the boxplots and the OLS distribution, the user can display the distribution of records based on the *Happiness Score* and one of the following attributes: *Economy (GDP per capita)*, *Social Support*, *Health (Life Expectancy)*, *Freedom*, *Corruption Perceptions*, and *Generosity*. The bar chart and correlation Heatmap are changed when a different year gets selected.

In the third part of the Dashboard, the users have the choice to select multiple countries to compare the development of the Happiness Score throughout the years.

In the last part, the user can choose the countries for comparison of the Happiness Rank and their Happiness Score.

5. Technical aspects

We used Plotly's open-source library Dash to create a web-based interactive dashboard with Python. For the implementation, we used the IDE Pycharm. The library Plotly is used to generate Data Visualizations. As Dash is built on top of Plotly, it enables the implementation of Plotly figures in Dash apps. The Dash app consists of two main parts: The layout determining the visual components and the callback function connecting the Dash Components and defining their interactive attributes (Lianne and Justin, 2021).

The dashboard app was deployed online to Heroku. The code used to create the dashboard is available on GitHub. The links are provided at the top of the Report and in the *References* section.

6. Discussion

Our project aimed to create visualizations that help to see how the world's happiness changed over the last few years, see which factors contribute to the happiness of people, and compare the happiness of different countries. With the visualization elements we chose, we believe to have achieved the objective of creating and designing a dashboard that communicates information to the users and that persuades them by telling stories through data, was accomplished.

However, we faced some challenges while working with the *World Happiness Report* data. The datasets used different names for the same attributes, but they also included some new attributes for which we did not precisely understand their meaning. We struggled to identify the meaning of some of the attributes as the explanations given to us in the *World Happiness Reports* were not clear and a lot was left open for interpretation. The datasets also did not always contain the same countries, so we were not able to compare the happiness of every country over time. Another limitation we faced was that *Australia* is not integrated into Plotly. Therefore, the users can't filter the map by the continent of *Australia*.

For future work, we think the datasets should include more attributes that could influence the *Happiness Score*. These could be the birth and mortality rates of the countries, the age structure, population density, literacy rate, or income stability.

7. References

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Dashboard: https://worldhappinessreportapp.herokuapp.com/

Code on Github: https://github.com/TJZLiu/NovaIMS_DSBA2021_DataVisualization_Project