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Data Science Project

# SatisMap: Mapping Well-Being in Switzerland

## Project Report

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## Abstract

The project SatisMap is an interactive web application mapping and displaying various measures of well-being in Switzerland. With the data from the Swiss Household Panel (SHP) [1], the application displays average levels of well-being in psychological and sociological domains per Canton for the year 2020. Moreover, SatisMap displays the associations of various demographical and well-being variables. This report gives an overview of the data and data models for this project and documents the web-application.

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# 1 Project Objectives

The goal of this project was to create a web application that lets users interactively view a map of well-being of adults in Switzerland (SatisMap). The application describes and shows various forms of well-being from psychological (e.g., self-reported life satisfaction, affect, or self-efficacy) and sociological (e.g., education, income, work status) domains. On top of descriptively showing average values of these well-being measures per canton, the application variably displays associations of well-being with possible predictors and / or criteria of well-being (e.g., demographics or well-being measures from other domains).

The data used for all these analyses stems from the Swiss Household Panel (SHP) [1]. The SHP is an ongoing panel study that investigates households and individuals since 1998.

The web application SatisMap can be an important asset to get an overview of different domains of well-being in Switzerland. Governments (federal, cantonal, and municipal) can find starting points to initiate actions to promote well-being. SatisMap helps researchers to explore well-being and to build their hypotheses. And finally, SatisMap can be an interesting application to the general populace interested in well-being in Switzerland.

## 2 Methods

SatisMap was created using R software [2] as well as several specific R-packages. To name two of high importance, the packages tmap [3] (used to create maps in R) and shiny [4] (used to create web applications in R) were used. Guidance for the programming with geodata was found in the book “Geocomputation with R” by Robin Lovelace and colleagues [5]. Tutorials for the shiny package were used for the programming of the web-application [4].

Webhosting of the final application is carried by Shinyapps [6], a basic but scalable hosting service for Shiny applications. The running version of SatisMap can be found on the following Shinyapps-Webpage: <https://nilssommer.shinyapps.io/satismap/>

All programming code can be found at GitHub [7]: <https://github.com/nilssommer1/SatisMap>

## 3 Data

### 3.1 Data Origin

The data used for this project stems from the SHP [1], retrieved from SWISSUbase [8]. The SHP is “is a household panel study that follows a random sample of households resident in Switzerland over time” and aims to “observe social change, in particular, the dynamics of changing living conditions and social representations in the population of Switzerland” (SHP-Userguide, Page 5) [9]. In the SHP, representative households and their members are regularly interviewed about various topics concerning their daily lives. This includes several measures of the domains of well-being stated above, but also extensive data on demographics, work, finances, and so forth. Currently, 22 Waves of interviews are provided, conducted in consecutive years from 1999 to 2020. In the SHP, the relevant data is divided into two master files (describing households and individuals) and 44 annual

files (one household and one individual file per wave) [9]. For the SatisMap-application, only the most recent wave of interviews conducted in the year 2020 was used.

In accordance with the license agreement with the SHP [1], the raw data is not to be transmitted to third parties and was therefore stored exclusively on a personal, password protected cloud. No personal information of the participants of the SHP are included in the data and therefore no such data will be included in the final application.

To create maps in R, some basic geospatial data of Switzerland and its cantons is required. This data was retrieved from the Website of the Federal Statistical Office [10].

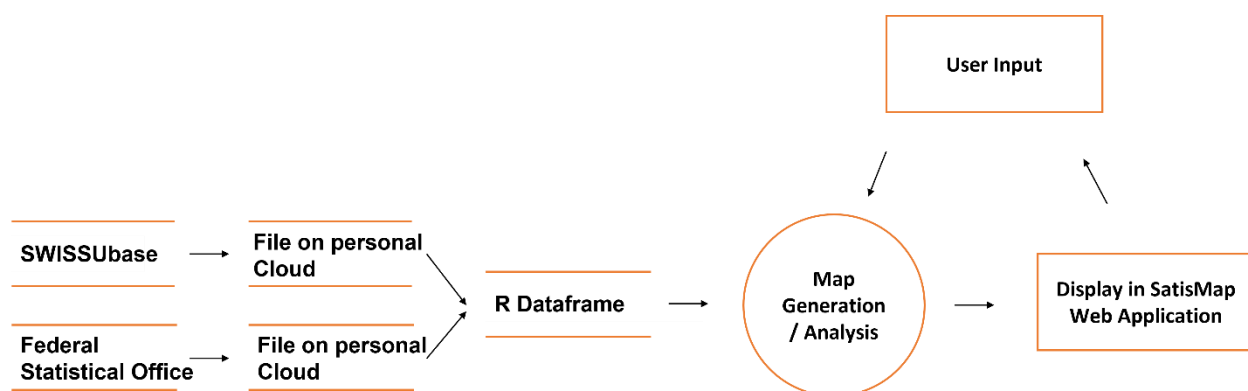
## 3.2 Metadata & Data Quality

Metadata in great detail (such as in the SHP Userguide [9]) concerning the SHP-data is available at SWISSUbase [9] free of charge, however requiring a license agreement to access it. Metadata concerning calculations and programming of the web application in the form of R-scripts is publicly available on GitHub (direct link: <https://github.com/nilssommer1/SatisMap>).

To achieve the goals of this project, data needed to be representative for the Swiss Population. Aside from a representative initial Sampling the SHP provides mathematical weights to adjust results for low response rates and high attrition rates [9]. The SHP also conducts primary data cleaning before releasing the data [9].

## 3.3 Data Flow

Figure 1 displays the data flow for this project. Data was initially retrieved from SWISSUbase (SHP data) [8] and the Federal Statistical Office (geospatial data) [10] and was then stored in a personal cloud. These data files were combined to a data frame in R. From there, the web application is created, and the data is analyzed to be displayed as maps according to user input. Users can manipulate the options in the web application and renew the analyses according to their input. The live web-application is hosted by Shinyapps [6].



**Figure 1.** Data flow of the project SatisMap.

### 3.5 Preprocessing

Please see the R Notebook “dataPreproc.Rmd” on GitHub (<https://github.com/nilssommer1/SatisMap>) for the exact preprocessing code. The geodata and SHP data were adapted so that canton names matched. The SHP data for households and individuals in 2020 were combined. Then, a subset of the SHP data was created that contained only the relevant demographic and well-being variables (see 3.6 Data Description). Individuals below age 16 were excluded. Some of the scoring schemes were slightly simplified for easier analysis. A dataset containing variable descriptions (questions and response scales) was created for display in SatisMap (see “varkey.Rda” on GitHub).

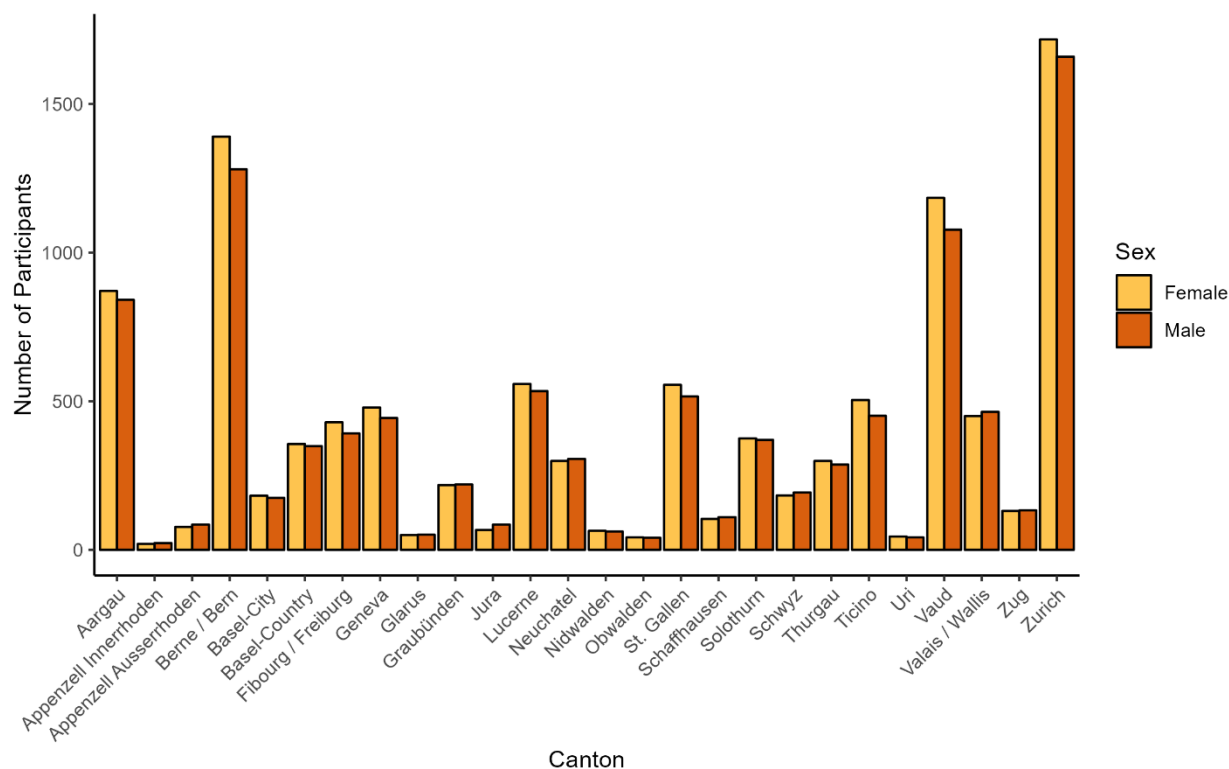
### 3.6 Data Description

Basic descriptive statistics of the dataset is shown in Table 1 and Figures 2 and 3. Further descriptive plots can be found in the application: <https://nilssommer.shinyapps.io/satismap/>

Survey Questions and Response Scales are listed in Table A1 in the Appendix.

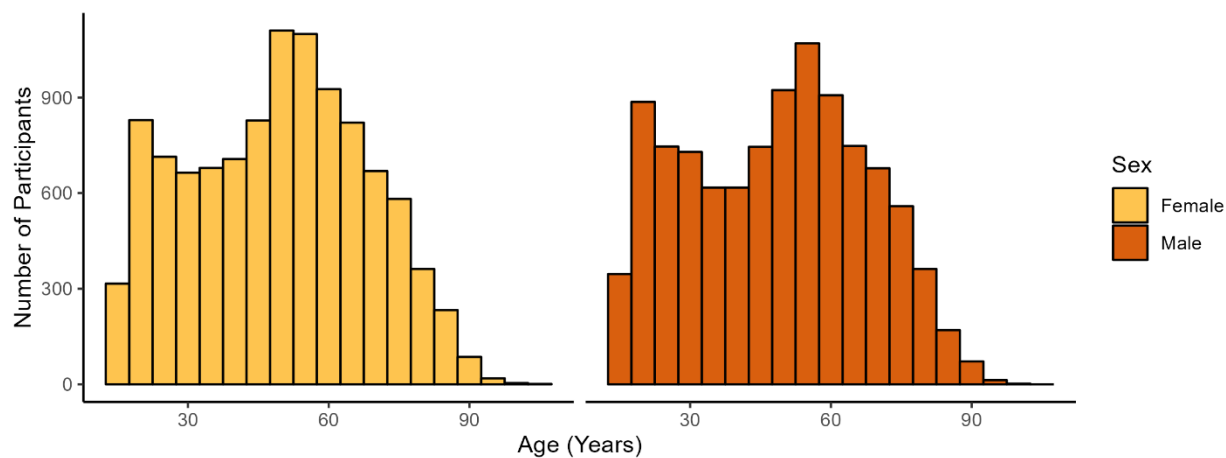
**Table 1.** Sample sizes, means, and standard deviations, of analyzed variables.

<b>Categorical Variables</b>	<b><i>n</i></b>	<b><i>n<sub>0</sub></i></b>	<b><i>n<sub>1</sub></i></b>
Sex	20839	10190	10649
Work status	10601	284	10238
<b>Numeric Variables</b>	<b><i>n</i></b>	<b><i>M</i></b>	<b><i>SD</i></b>
Age	20839	48.69	19.01
Life Satisfaction	15399	8.12	1.42
Satisfaction with relationships (general)	15327	8.22	1.50
Happiness with partner	11863	8.65	1.47
Satisfaction with health	15390	7.81	1.75
Satisfaction with studies	1337	7.53	1.69
Satisfaction with finances	15255	7.26	2.18
Satisfaction with job	10218	7.95	1.54
Satisfaction with free time	15204	7.37	2.42
Satisfaction with democracy	14914	6.87	1.91
Negative emotions	15341	2.19	2.19
Positive emotions	15343	7.05	1.87
Women penalized	15048	5.56	2.49
Own sex penalized	15092	2.12	2.64
Importance of promotion of women	14912	6.34	2.79
Education	17573	3.44	1.12
Socioeconomic status	9313	6.37	2.64
Individual income (year)	13092	72042.32	69395.08
Household income (year)	17246	142018.65	98399.30
Number of own kids	15002	1.46	1.27



**Figure 2.** Participants by canton and sex.

SHP wave 22 (2020), n = 20839.



**Figure 3.** Participants by age and sex.

SHP wave 22 (2020), n = 20839.

## 4 Documentation of the Web-Application

A running version of SatisMap can be found at <https://nilssommer.shinyapps.io/satimap/>.

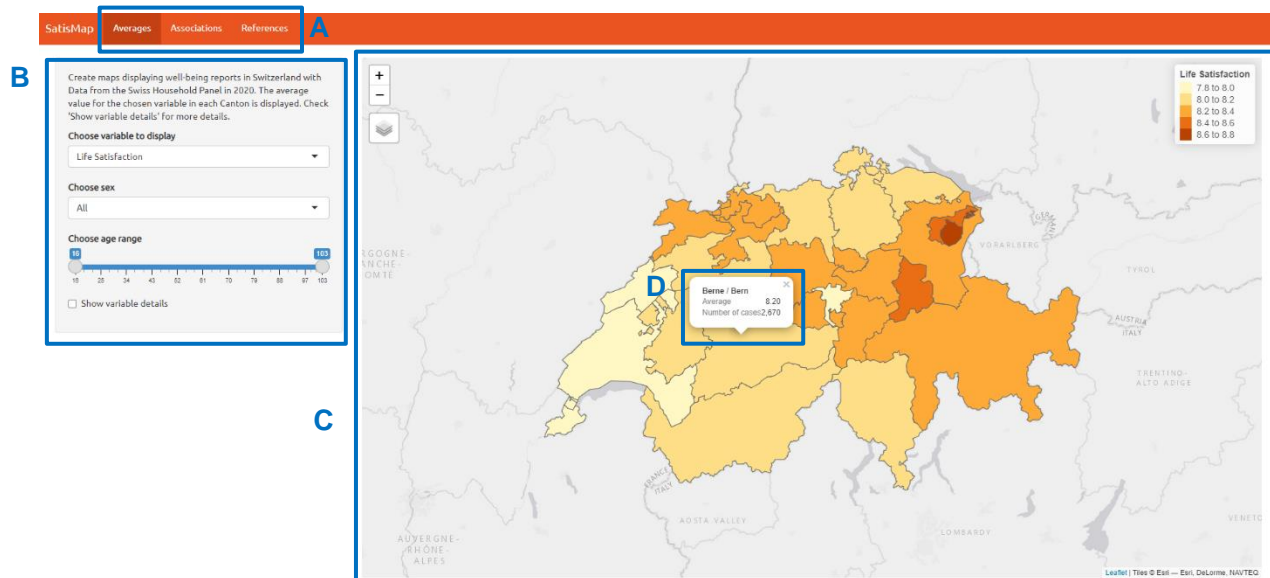
### 4.1 Code

The R code used to construct SatisMap is publicly available on GitHub (<https://github.com/nilssommer1/SatisMap>; see “app.R”). Code for Shiny applications usually consists of three blocks [4]: A preparatory block (packages, data, helper functions, etc.), a block defining the user interface of the app (“user interface”), and a block that constructs the displayed contents according to the selections of the user (“server logic”). Each responsive element in the user interface (labeled “output”) requires calculations specified in the server logic block depending on the input options defined in the user interface.

### 4.2 General Layout

In SatisMap, users can select one of three tabs (see Figure 4, part A). The tab “Averages” lets users display average values of the selected variables per canton. The tab “Associations” lets users display correlations between two selected variables for each canton. The tab References lists a number of resources used in the creation of SatisMap.

In both tabs “Averages” and “Associations”, users can select various options in the left panel (see Figure 4, part B). According to these selections, data is then displayed in the form of a map of Switzerland in the right panel (see Figure 4, part C). The map itself is interactive, meaning that users can click on different cantons to receive further information in a popup window. At the bottom of the left panel, further details of the selected data can be displayed (see Figure 4, part D).



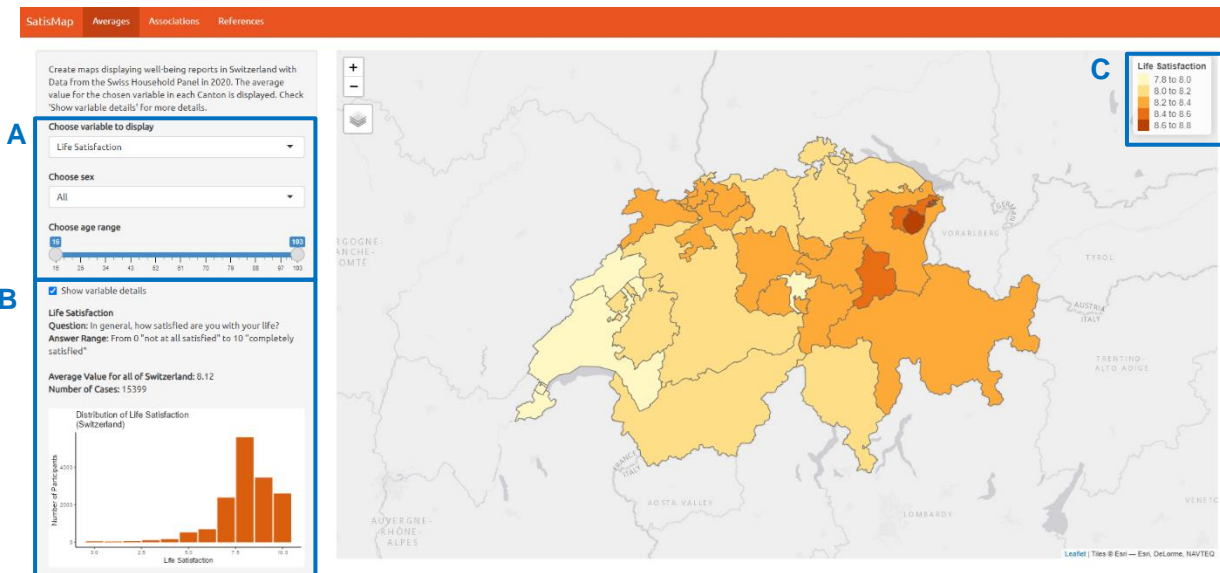
**Figure 4.** General Layout of SatisMap.



### 4.3 Tab “Averages”

In the “Averages” tab, users can choose the variable to display (e.g., life satisfaction) in the left panel (see Figure 5, part A). They can further specify the sample used to calculate averages by selecting a specific sex or age range, which subsets the dataset accordingly prior to calculations. As an option, they can display further details concerning the variable, such as the survey question and response scale, an overall average, and the number of respondents for all of Switzerland, as well as a plot of the response distribution (see Figure 5, part B).

In the right panel the application automatically displays an interactive map of Switzerland’s cantons. Each canton’s area is colored according to the color scale based on the calculated average values of the chosen variable (displayed in the top right corner; see Figure 5, part C). Canton names are displayed as popups when users hover over the respective areas, and when clicking inside the canton borders, the specific average value for the canton and the number of respondents is displayed (see Figure 4, part D).



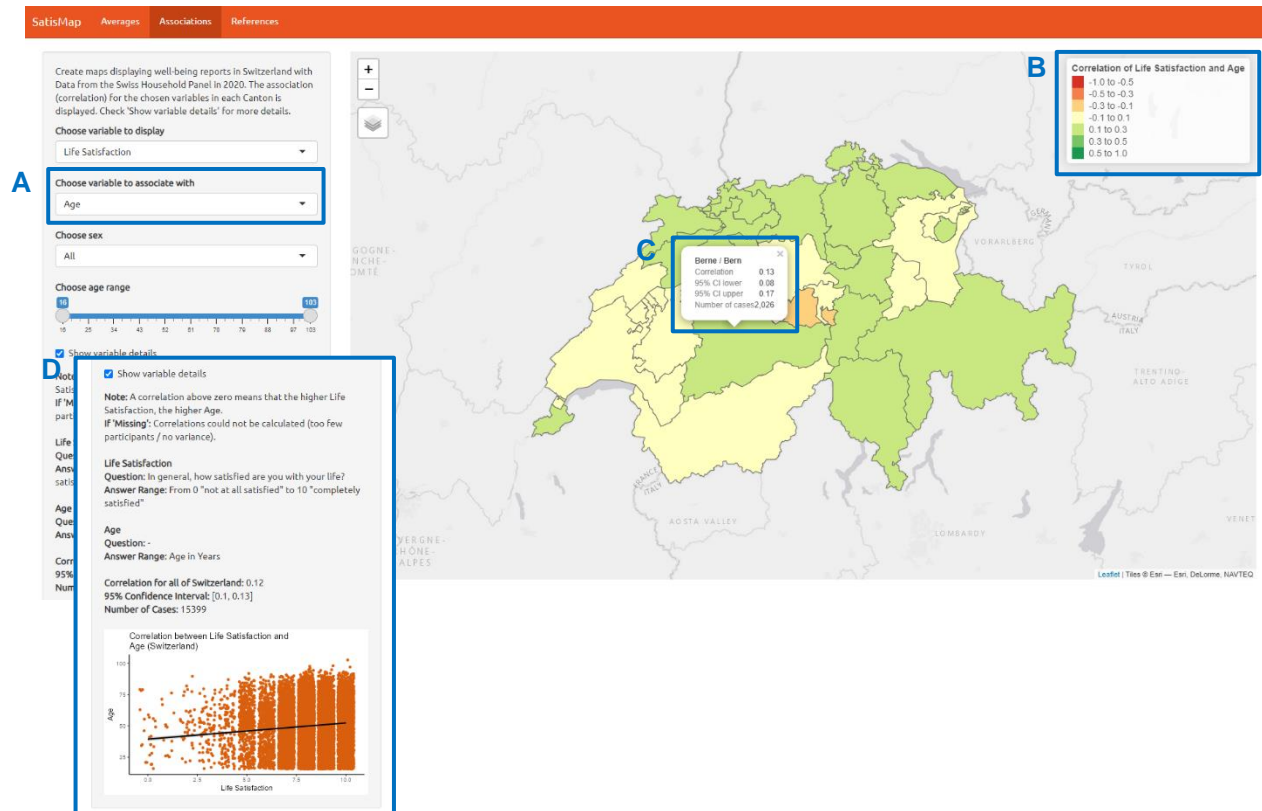
**Figure 5.** “Averages” tab of SatisMap.

### 4.4 Tab “Associations”

Like in the “Averages” tab, in the “Associations” tab, users can specify the variable to display and subset the dataset by sex and age. However, they can now choose another variable to relate to the first one (see Figure 6, part A). Again, further details of both selected variables can be displayed.

In the right panel, the Map of Switzerland now shows correlations per Canton. Spearman’s rank correlation coefficients are calculated to correctly represent associations with categorical and ordinal variables. The color scale is built to represent the effect size conventions by Cohen [11]: Irrelevant effects (-0.1 to 0.1) are colored beige, small effects ( $\pm 0.1$  to  $\pm 0.3$ ) in light orange or light green, medium effects ( $\pm 0.3$  to  $\pm 0.5$ ) in dark orange and medium green, and large effects ( $\pm 0.5$  to  $\pm 1.0$ ) in

red and dark green (see Figure 6, part B). The further details and popup windows also show 95% confidence intervals for the calculated correlations (see Figure 6, part C). If selected, the variable details now show a plot of the bivariate distribution with data points (including a slight jitter to prevent overplotting; see Figure 6, part D).



**Figure 6.** “Associations” tab of SatisMap.

## 5 Conclusion and Outlook

With SatisMap, an interactive tool for the graphical display of well-being in Switzerland was created. It can be an important asset to explore well-being in Switzerland for governments, researchers, and the general population. Future versions of the application will include the possibility to display data for other years of the SHP and perform longitudinal analyses.

## References and Bibliography

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- [4] Shiny; Rstudio (<https://shiny.posit.co/>)
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- [10] Generalisierte Gemeindegrenzen: Geodaten; Federal Statistical Office, Switzerland (<https://www.bfs.admin.ch/bfs/en/home/services/geostat/swiss-federal-statistics-geodata/administrative-boundaries/generalized-boundaries-local-regional-authorities.assetdetail.22484210.html>)
- [11] J. Cohen; A power primer; Psychological Bulletin, 112(1), 155-159. (<https://doi.org/10.1037/0033-2909.112.1.155>)

## Appendix

**Table A1.** Survey questions and response scales of the analyzed variables.

<b>Categorical Variables</b>	<b>Survey Question</b>	<b>Scale</b>
Sex	-	0 "Male" and 1 "Female"
Work status	-	0 "unemployed" and 1 "occupied"
Age	-	Age in years
Life satisfaction	In general, how satisfied are you with your life?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with relationships (general)	How satisfied are you with your personal, social and family relationships?	From 0 "not at all satisfied" to 10 "completely satisfied"
Happiness with partner	In general, how happy are you in your current couple relationship?	From 0 "very unhappy" to 10 "very happy"
Satisfaction with health	How satisfied are you with your state of health?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with studies	Can you indicate your degree of satisfaction with the studies you are currently engaged in?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with finances	Overall how satisfied are you with your financial situation?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with job	In general, how satisfied are you with your job?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with free time	How satisfied are you with the amount of free time you have?	From 0 "not at all satisfied" to 10 "completely satisfied"
Satisfaction with democracy	Overall, how satisfied are you with the way in which democracy works in our country?	From 0 "not at all satisfied" to 10 "completely satisfied"
Negative emotions	Do you often have negative feelings such as having the blues, being desperate, suffering from anxiety or depression	From 0 "never" to 10 "always"
Positive emotions	Are you often plenty of strength, energy and optimism?	From 0 "never" to 10 "always"

**Table A1.** Survey questions and response scales of the analyzed variables.

Categorical Variables	Survey Question	Scale
Women penalized	Do you have the feeling that in Switzerland women are penalized compared with men in certain areas?	From 0 "not at all penalized" to 10 "strongly penalized"
Own sex penalized	Do you, in your everyday life, feel penalized compared with the opposite sex?	From 0 "not at all penalized" to 10 "strongly penalized"
Importance of promotion of women	Are you in favour of Switzerland taking more steps to ensure the promotion of women?	From 0 "not at all in favour" to 10 "totally in favour"
Education	<i>International Standard Classification of Education ISCED 1997</i>	0 "Not completed primary (compulsory) education"; 1 "Primary or first stage of basic education"; 2 "Lower secondary or Second stage of basic education"; 3 "Upper secondary education"; 4 "Post-secondary education non tertiary (preparation for an institution for higher education)"; 5 "First stage of tertiary education"; 6 "Second stage of tertiary education"
Socioeconomic status	European Socio-Economic Classification (ESeC), main current job	1 "Routine"; 2 "Lower technical"; 3 "Lower sales and service"; 4 "Lower supervisors and technicians"; 5 "Small employers and self-employed (agriculture)"; 6 "Small employers and self-employed (non-agriculture)"; 7 "Intermediate occupations"; 8 "Lower mgrs/professionals, higher supervisory/technicians"; 9 "Large employers, higher mgrs/professionals"

**Table A1.** Survey questions and response scales of the analyzed variables.

<b>Categorical Variables</b>	<b>Survey Question</b>	<b>Scale</b>
Individual income (year)		Yearly income in CHF
Household income (year)		Yearly income in CHF
Number of own kids		Number of own kids born