One Dataset – Three Stories: Data Storytelling for Climate Change Awareness

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Data stories are a powerful way to present information and data in a way that is easy to understand and engage with. They consist of data, the visual form, and the narrative component. By combining these elements effectively, data stories can drive behavioral change and lead to a call to action. In two projects dedicated to data stories, we developed an approach that separates the data from possible narratives and adapts it to three audiences of different expertise and age, being inspired by the medieval philosopher Averroes. The method can help to take full advantage of data storytelling and describe complex data in a meaningful way that compels people to act on it.

Keywords — data stories, data visualization, Averroes, stepwise vulgarization, data driven decision making

I. Introduction

Data Stories are a powerful tool for communicating complex information and triggering action. In this paper, we present the development of Data Stories focused on climate change in the Geneva area, Switzerland. We conducted two projects, VIDAS (Visualization of Data Stories) [1] and MIDAS (Microclimate Data Stories) [2], as part of the Department of Information Science at Haute Ecole de Gestion, HES-SO Geneva. Inspired by the approach of Averroes, we created three versions of the Data Stories for different audiences. Our own data collection and analysis were facilitated through an online dashboard [3] and made accessible through a publicly available API.

The first Data Story, "Marronnier de la Treille," explored the long-term trend of the first leaf of the chestnut tree as a marker of spring, indicating the effects of global warming and urbanization. The second Data Story focused on the progressive melting of glaciers, water stock decrease, and temperature increase in rivers and lakes. This story was adapted for different audiences, including a general audience and young public, using various visualization formats. Citizen involvement was encouraged through data contribution and participation in hackathons. By tailoring the visual and narrative components of the Data Stories to different audiences, we aimed to maximize their impact in raising awareness and calling for action.

II. Background

A. The evolution of data stories

The mechanisms of the human brain are stimulated by storytelling. Storytelling stimulates the mechanisms of the human brain, thus facilitating the faster assimilation and retention of information [4]. Stories have the ability to create emotions. Those who receive them carry them with them for a long time, do not forget them, and can pass them on [5]. According to Duarte [6], "If the brain lights up when a story is told, imagine the power of using storytelling elements to help your audience understand your DataPOV. The techniques of storytelling seem to be an interesting way to make the understanding of data easier. Without them, visualizations do not provide explanations about the topic. They rely too much on the audience's ability to interpret the data [7].

In this context, data stories are an important aspect of data visualization because they help to communicate the insights and findings of data analysis in a clear and concise way. They can be used to support decision making or to persuade others to take a particular course of action by making complex data more accessible and understandable to a wider audience. While visualizations allow the viewer or reader to explore the data, understand it, and connect information to draw conclusions, data stories go further: "Data storytelling combines data visualization with guided narrative. It pairs the data and graphics with words that not only describe what can be seen in the image, but also tell a story to guide you through the analysis process" [8].

Data stories are becoming increasingly important, both in academia and in the media. In the literature, too, there are numerous, maybe too many definitions of data stories. They resonate with each other and sometimes overlap. They all emphasize that a narrative is developed and that a story needs to be told. According to Dykes [9], data storytelling is a "structured approach to communicating data insights using narrative elements and explanatory visuals". A data story therefore consists of three important elements: data, visuals and narrative. The balance between these three aspects is essential, and it is always necessary to start with the data and

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the insight (the information that emerges from it). Furthermore, according to Nussbaumer Knaflic [5], telling a story with data involves several steps: understanding the context, choosing an effective visual, removing cognitive overload, focusing attention on something before telling a story. Context here refers to the available data, the audience, and what the audience needs to know or do. Rodriguez, Nunez, and Devezas also bring up this idea of context to refer to the medium that is being used and the way in which the story is going to be delivered. In fact, [storytelling] "strategies are very much dependent on the medium and the genre of the story." [7].

From our point of view, data stories include different types of elements that need to be considered when telling a story: the data, the visual form, and the narrative component. The balanced combination of these elements is intended to drive behavioral change by integrating a narrative into the data presentation. The narrative should lead to a call to action.

B. *The principle of Averroes' commentaries*

Born in Cordoba, Spain, Averroes, also known as Ibn Rushd, was an Andalusian philosopher and theologian of the 12th century. He is most famous for his commentaries on the works of Aristotle, which were instrumental in the reintroduction of Aristotelian thought to the Latin-speaking world [10].

The commentaries of Averroes can be divided into three categories: the literal, the metaphysical, and the political. The literal commentaries were straightforward interpretations of Aristotle's texts. Their purpose was to explain the meaning of the words and phrases used. The metaphysical commentaries were more interpretive in nature, exploring the underlying principles and implications of Aristotle's ideas. The political commentaries analyzed the strengths and weaknesses of various forms of government, applying Aristotelian thought to issues of governance and political theory.

In data stories that address scientific, social, and educational issues, Averroes' approach to differentiation and structuring can play a role.

III. Data and Story Concepts

The quality of data stories and of data literacy do heavily depend on one striking factor, i.e. the quality of the underlying data. With respect to the limited time frame of both projects it was decided to start with a small and already existing data set to create the first data story, followed by a second attempt with several and more complex data sets, collected, analysed and interpreted by ourselves.

A. *Data set I: The Geneva Chest Nut Tree*

While looking for ideas of Data Stories with a local context being relevant for MIDAS, we came across the history of the Treille (i.e. a location on the border of the old town of Geneva) chestnut tree on the City of Geneva website [11], a very simple and useful data set. Since 1818, the date of the blossoming of the first leaf has been observed and recorded as a marker for the arrival of spring.

This theme seemed particularly relevant to us as it is rooted in local history and tangibly illustrates the impact of climate change on our environment. The data stories developed on this theme also seemed to be an appropriate communication tool to raise awareness of the effects of global warming among different target groups (children, adults, decision-makers). The shift in the timing of the emergence of the first leaves of the horse chestnut to earlier and earlier dates could be linked to the warming of Geneva due to climate change.

B. *Data set II: Glaciers, lakes and rivers in the Lemanic Region*

The inital interest focused on the worrying effects of climate change on glaciers and was continously expanded to a broader topic that also includes rivers and lakes in the area called The Greater Geneva (in french: Le Grand Genève): Searching for effects warming in the waters of Greater Geneva", the data sets comprised data and visualisations of the air temperature in Geneva, the decrease in the volume of the Rhône glacier, the increase in temperature of the Rhône (river), the Arve (river) and Lake Geneva (75% of the water in Lake Geneva comes from the Rhône glacier). The data set was finally completed with data on greenhouse gas emissions in Switzerland.

IV. Data Stories

A. *Threefold Data Story I: Marronnier de la Treille (The Geneva Chestnut Tree)*

Since 1818, the date of the first leaf of the official chestnut tree of Geneva has been recorded as a marker for the first day of spring. The statistical analysis of this record shows a long-term trend towards earlier and earlier dates. This trend is linked to local changes in Geneva, such as the effects of global warming and the urbanisation of the city.

Three versions of this story were created in different formats. First, an annotated chart is produced for a scientific audience. Then, two other ones were inferred from this version: a slideshow for decision and policy makers and a Data Comic for young public. In the context of this article, which is more focused on the methodological approach and the connection between data literacy and data stories, only three basic visualizations will be juxtaposed to illustrate the procedure (see Figures 1, 2, and 3).

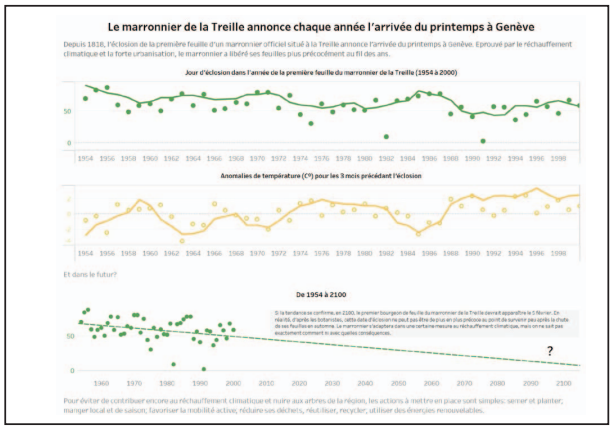

Fig. 1. Annotated chart for scientific audience.

The complete data stories can be found under https://midas.gexplore.ch/. All versions of the data stories combine the visualization of the hatching dates and the number of frost days per year in Geneva, with explanatory text. It seems that a decrease in the number of frost days would be a good indicator of local warming. The corresponding data were provided by MeteoSwiss. The second part of the Data

Stories focuses on the statistical analysis of the hatching dates, as well as on the future projection of the detected trend and the future impacts on the behavior of the chestnut tree.

We also made the experience that it is wise to match the data with the expertise of a scientist, in our case a botanist from the Conservatoire et Jardin Botaniques de Genève. The final message of the Data Story was then based on the results of a Master's thesis [12].

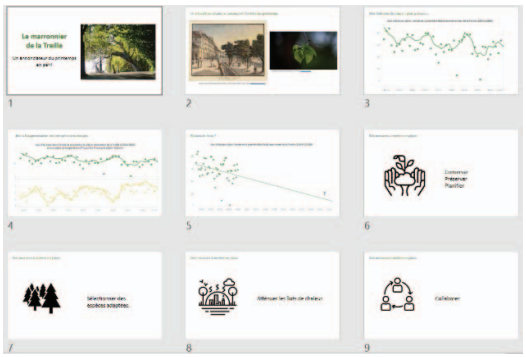

Fig. 2. Slide Show for decision makers

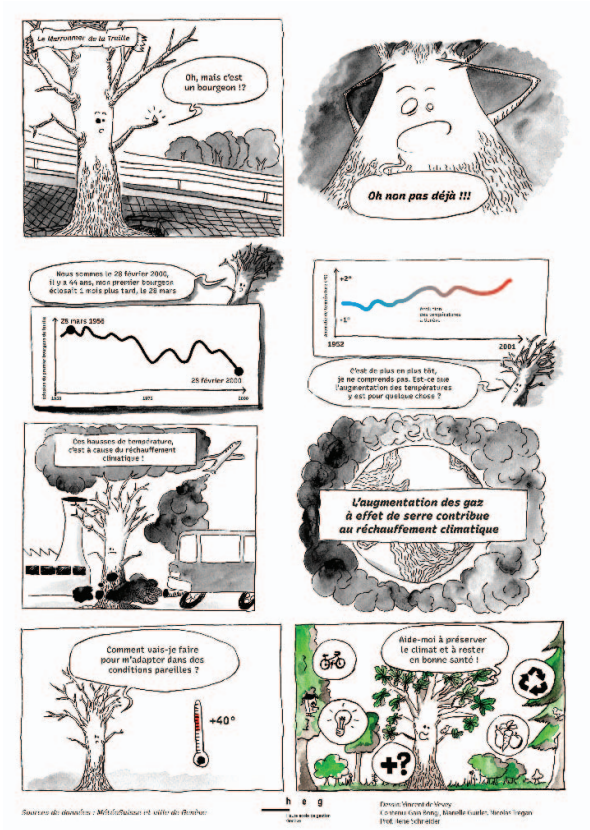

Fig. 3. Data Comic for children and adolescents

B. *Threefold Data Story II: Glaciers, Rivers and Lake Geneva: Water Temperature and its impact*

The progressive melting of glaciers, the decrease of the water stocks and the temperature increase of rivers and lakes are worrying effects of climate change in the region of Geneva and its surroundings. Starting from an initial version of this Data Story that targeted a scientific audience, we applied graphic design principles to its visualizations to make it more accessible to a general audience [13]. In the third version of the story, the data visualizations were abstracted further, and visualized with LEGO™ bricks, in stop-motion animation for making them more appealing and engaging [14] to a younger audience. The complete data stories based on this topic can be found on the corresponding website to gather them: https://vidas.gexplore.ch/.

Once more only three basic visualizations all visualising the same data chart are juxtaposed (see Figures 4, 5, and 6) for illustrative purposes, reproducing the principle followed in an easy-to-follow way. On the website, a click of any of these icons will lead to the corresponding data story.

Fig. 4. Statistical chart for scientists

Fig. 5. Simplified chart for grand public

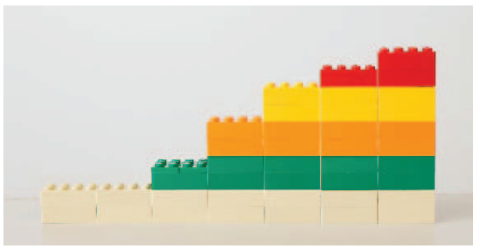

Fig. 6. Stop motion animation for children

V. Conclusions

With the two use cases described in this paper, we demonstrate the ability to produce three different Data Stories using the same data, but with a visual form and a narrative component adapted to three different audiences, according to their knowledge of the topics, their level of scientific expertise, and the expected field of action. This is the only way we believe the Data Story will have a full impact on the target audience. For example, it will raise awareness and call for action.

In our specific case, data stories can be a helpful way to communicate about climate change. They can help illustrate the impacts and consequences of climate change in a way that is easy for people to understand and relate to. After the first data set was created, self-assessment procedures were used to gain insights. These insights were then applied to the second data set.

It is important to note that the creation of a single and simple data story already requires a significant investment of time and effort. There is also a need for the contribution of different skills within the team that creates it. Tripling the number of data stories and targeting different audiences therefore has an impact on time and all other resources, as well as the need for even more skills and a diverse group of experts. We will continue to explore and develop Data Stories on other

topics, maintaining the principle of stepwise vulgarization as introduced into thinking by Averroes since we believe that the method used in the case studies presented seems to be promising, as the partitioning of data stories can help a larger number of people or groups to understand complex data by using a combination of text, images, and interactive visualizations. Tailoring to the audience makes it easier to identify patterns that are relevant to their personal lives.

The approach also allows them to develop their critical thinking skills based on their knowledge, cognitive and intellectual levels, and is likely to increase the likelihood that they will critically evaluate the information presented to them.

Finally, data stories tailored to the abilities to user groups will help them make better-informed decisions based on evidence rather than intuition.

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