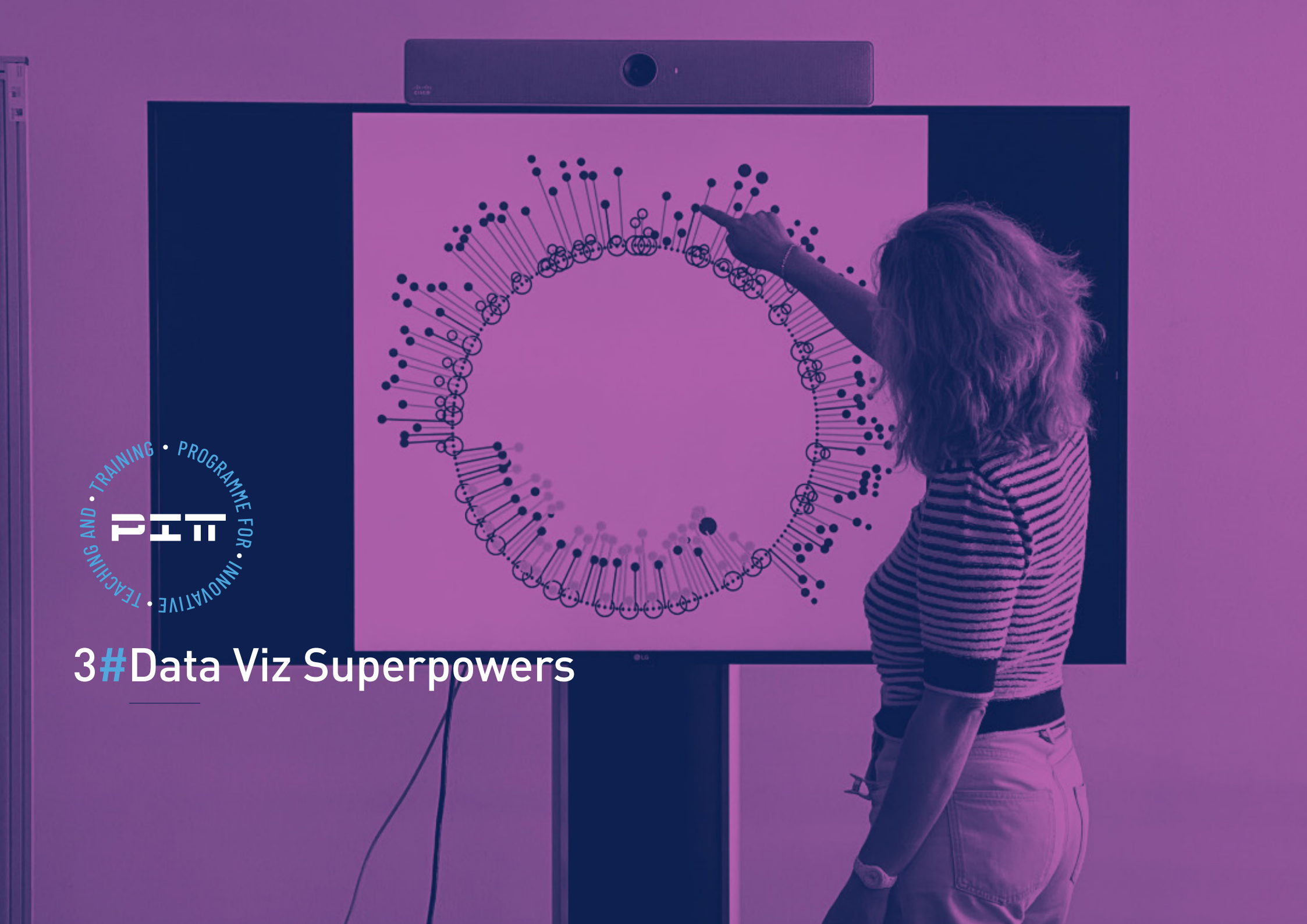


3#Data Viz Superpowers

3.1 Didactic commentary

Ann Kiefer & Thomas Lenz

In the modern world, enormous quantities of data are being produced, collected, and analysed everywhere and all the time. Companies keep records of sales receipts, stocks, prices, and interactions with their clients. Governments collect data on births and deaths, and tax income and outgoings. Every day, millions of people use electronic devices to count their steps and the calories they burn, or to measure how much sleep they get. These are just a few simple examples that demonstrate the massive amounts of data that accumulate day after day which need to be examined, processed, and evaluated.

It can be difficult to extract information and draw clear conclusions from raw data. Data visualization can help bring some order and sense to the chaos of numbers. It is a way of making data visual by transforming it into graphs, diagrams, tables, etc., and thereby helping patterns, links, and characteristics emerge. Data visualization – or dataviz – translates data and abstract numbers into stories, producing knowledge and expertise. Nonetheless, information which is created in this way should still be approached with care. For the content of the visual representation varies according to the way in which it is presented. Tables and graphs, therefore, are not just objective ways of presenting numbers but they always reflect the decision to emphasise a certain result or, on the contrary, to gloss over something.

We can find one of the first examples of the power of data visualization in the work of an English doctor, John Snow, in 1854. At the time, London was in the grip of a devastating cholera epidemic and the city's population was defenceless. People did not yet know that cholera is transmitted by bacteria in the water, and so they had no idea how to defeat the disease. Snow took a map of the city and marked the households that were most affected by the epidemic, and from this he realised that all of the houses got their water from the same limited number of sources. And so, he quite rightly concluded that cholera was being spread through the water from these contaminated sources. Although he did not know that cholera was transmitted by bacteria, Snow's visualization of the data literally helped identify and cut off the sources of disease (Gilbert, 1958).

Some scientists, like Wesley Willett and Petra Isenberg, have compared data visualization to the comic book superheroes' superpowers (Willett et all., 2021). Data viz helps make visible the invisible, and recognise relations which were previously unknown. In this way, it expands the cognitive skills of the person who uses it. The story of John Snow is a good example here: even without knowing about bacteria, he was able to work out how to overcome cholera. This was a superpower which he gained through data visualization.

The *#Data Viz Superpowers* module demonstrates how important data have become in our lives, and how the way in which they are presented can give us superpowers. Pupils will be able to see and understand things which they couldn't have seen or understood before. Thanks to the #Data Viz Superpowers module, they will be able to work autonomously on five of these 'superpowers' through 16 small exercises, four of which help them transform into "superheroes" and one that makes them into a "supervillain".

First of all, the pupils will discover the "enhanced attention" superpower. The idea here is to show how dataviz can be used to filter relevant information from the 'noise' of numbers. Next, focus shifts to the "enhanced comparison" superpower which helps pupils to make links between different datasets in a meaningful way. Then the pupils learn to anticipate the future with the help of data, thereby gaining the "enhanced prediction" superpower. After the future comes the past as pupils encounter the "enhanced memory" superpower. Next, the fifth superpower can transform the superheroes into supervillains, as we explore how dataviz can be used to trick and cheat people.

The *#Data Viz Superpowers* module shows pupils that numbers are not "dead" but, quite the contrary, they have stories to tell us. However, these stories do not emerge of their own accord; we need data visualization in order to shed light on them. It also helps us understand that the way in which data or numbers are presented affects our perception of the stories they tell. Pupils therefore learn not only to use data in a critical and confident manner, but also to develop an analytical approach to engaging with information which is supposed to be objective.

References:

Gilbert, Edemund. W. (1958). Pioneer Maps of Health and Disease in England. *The Geographical Journal, 124,* 172-183.
Willett, Wesley, Aseniero, Bon Adriel, Carpendale, Sheelagh, Dragicevic, Pierre, Jansen, Yvonne, Oehlberg, Lora & Isenberg, Petra. (2021). Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization. *IEEE Transactions on Visualization and Computer Graphics*, 28(1), 22-32

3.2 Lesson planning

01 | Theme of the lesson in the overall structure of the axes

Module	Axes	Focus	Interdisciplinary ideas and link with other subjects
#Involution	Topic 1 My digital world and me!	• Games and algorithms • Algorithm of the shortest path	• Mathematics • Geography
#Climate Killer Internet	Topic 2 Understanding the internet: the World Wide Web and me	• Internet and climate • Judgement skills	• VIESO (Life and Society) • Geography • German • French
#Data Viz Superpowers	Topic 3 Do you speak Informatique?	• Different types of data visualisation • Manipulation of graphics	• Artistic education • Mathematics
#Discover Life on Mars with a Rover	Topic 5 Robots, partners for better or worse?	• Programmation en Scratch • Educational Robotics	• VIESO
#Pupils vs Machine	Topic 6 Is there a machine as intelligent as I am?	• Basic functioning of AI	• Mathematics • VIESO

Since the modules are independent from each other, it is not necessary to be acquainted with the previous modules to tackle this one.

This module has been developed in collaboration with Aida Horaniet Ibañez, a doctoral researcher at the Luxembourg Centre for Contemporary and Digital History (C²DH) at the University of Luxembourg.

02 | Conditions of unit

1. Target audience: 5e-7e
2. Room: can be presented using a video projector.
3. Equipment required: each pupil needs a tablet or computer in order to access the different links.
4. Time: 2 hours of teaching time.

03 | Contextualisation of knowledge

Data visualization is everywhere nowadays. Diagrams, tables, and graphs are the most common and simplest forms of visualization. The combination of different types of visualizations and information is called "infographics".

The *National Report on Education in Luxembourg* is a good example of the use of infographics. It contains data and complex facts about the school system and education in Luxembourg and explains them in a graphic form. Data visualizations are used in the report to present the facts in a clear way and to shed light on different trends. As is often the case, different forms of visualization are used in the text to convey different messages:

- column and bar charts are used to clarify the relations between the different data and enable us to make comparisons between the numbers;
- pie charts illustrate different parts of a whole;
- curves are used to demonstrate the evolution of key figures over time;
- maps make it possible to show geographical data visually.

Nonetheless, as this module shows, the modern world of dataviz has many possibilities.

According to Edward Tufte (Tufte, 2001), statistics professor at Yale University, a good dataviz gives the viewer the maximum number of ideas in the minimum possible time, using as little ink and space as possible. It has to show data without deforming them, and it should invite our eyes to compare different elements of the data.

Data visualizations make the invisible visible, and reveal the hidden structures behind data. This is why Wesley Willett and Petra Isenberg talk about "superpowers" (Willett et al., 2021). Superhero comic books often feature characters with fantastic powers which enable them to see and interpret the world in a way that transcends normal human perception. Willett and Isenberg demonstrate how the language of superpowers can be used to characterise the different modes of visualization that currently exist. They describe a series of "visualization superpowers" which make the invisible visible.

The relevant "superpowers" in relation to school work are, above all:

- enhanced attention", allowing pupils to distinguish between relevant and irrelevant information;
- "enhanced comparison" which helps pupils make appropriate comparisons between different data;
- "enhanced prediction" which helps pupils make well-founded conjectures about the future;
- "enhanced memory" enabling pupils to use dataviz to tell stories.

Researchers also warn us against the danger of data being manipulated. There is the possibility that numbers and information might be presented in a way that transforms the "truth behind the data" into nonsense.

04 | Didactic transposition

a. Learning outcomes and target skills

Pupils know what data are and are able to recognise them. They are also able to collect and classify data. They know the advantages of good dataviz, but are also aware of the power to trick people through the manipulation of graphs.

Pupils have seen at least one example of a dataviz that is more creative and unusual than more common styles of graph.

Target skills from the *Media Compass*[1]

Competences 1 – Information and data: 1.1 Filtering and researching data, information and digital content, 1.2 AAnalysing and assessing data, information and digital content, 1.3 Storing and managing data, information and digital content, 1.4 Processing data, information, and digital content

Competences 2 – Communication and collaboration: 2.1 Working with others

[1] https://www.edumedia.lu/medienkompass/medienkompass/

b. Didactic justification

Whether in our everyday life or in the field of research, we are confronted by ever more enormous amounts of data. Sometimes, data visualization is the only way to understand these data and draw useful conclusions from them. Now, in the twenty-first century, it is therefore important to be familiar with the basics of dataviz and know how to use it.

c. Didactic reduction

For a given question, pupils are able to extract non-structured numbers, essential information and data, and to explain how they made their choice. They learn how to carefully compare the different data, and to reach new conclusions on the figures. In doing so, they may realise that comparisons do not just happen by themselves, but that they are made by human beings. Moreover, pupils learn to recognise what can be predicted using data and numbers.

They increase their ability to use data and numbers in a critical and confident way. Moreover, they become aware of the potential dangers of data manipulation.

Pupils learn to recognise the different types of data (quantitative, categorical, discrete, continuous) and practice making links between them. Using examples, they also learn about the different possibilities for data visualization.

05 | Over the course of the lesson

The lesson contains 16 exercises.

The lesson starts with an Instagram post from Cristiano Ronaldo (**exercise 1**). Pupils complete exercise 1 in pairs. Then they discuss their answers and reflection with the rest of the class in a moderated discussion. It is important to make a distinction with the pupils between, on the one hand, the data relating to the photo itself (e.g. the colour of Cristiano Ronaldo's shirt), and on the other hand, the data linked to the Instagram post (e.g. the number of likes, the verified Instagram account, publication date, the fact that the photo is the first in a series of four, etc.).

All the data that the pupils find is then noted on the board or in a digital word cloud.

Exercise 2: The point of this exercise is to classify the data by category and type. The data that pupils identified in exercise 1 are taken and classified according to the different categories which are explained.

Exercise 3: Exercise 3 checks whether pupils have understood exercises 1 and 2. Pupils should complete exercise 3 individually.

Exercise 4: This exercise provides a simple demonstration of how to make a table and organise data. The topic of football players should motivate pupils to complete the table. Pupils can use the internet to search for any missing information. The completed table should look like this:

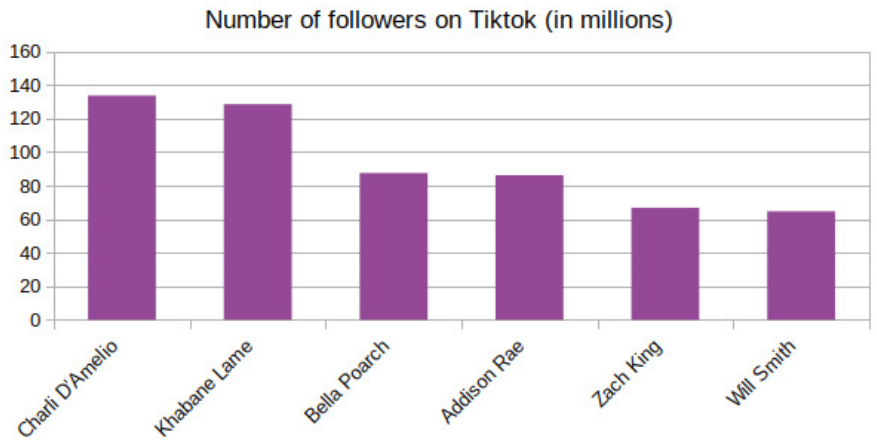
Player	Club	Year of birth	Nationality	Favourite dish
Cristiano Ronaldo	Al Nassr	1985	Portuguese	Bacalhau à Brás
Lionel Messi	PSG	1987	Argentinian	His mother's Milanesa Napolitana
Neymar Jr.	PSG	1992	Brazilian	Italian and Japanese
Kylian Mbappe	PSG	1998	French	Tiramisu
Zlatan Ibrahimovic	Associazione Calcio Milan	1981	Swedish	Falukorv

Exercise 5: In this exercise, the pupils themselves have to collect data about their classmates. Walking around the classroom and mingling with each other gives pupils a bit of breathing space. The teacher can let pupils choose their own topics, or can set a theme: social media, football, the use of smartphones, etc. The choice of topic can be used to link the module to the course of Digital Sciences.

Next, we move onto superpowers. In the following exercises, pupils will become familiar with the dataviz superpowers. This section is inspired by the article (Willett et al., 2021). **Exercises 6 to 10** serve to illustrate the three first superpowers. For these exercises, pupils first work individually, and then they discuss their results in a moderated discussion. The 4th superpower (enhanced memory) is a bit different: for this exercise (**exercise 11**), we suggest that pupils work in pairs and then collect their answers together.

The penultimate section is probably the most important: **exercises 12 to 15** show the four main techniques for manipulating graphs.

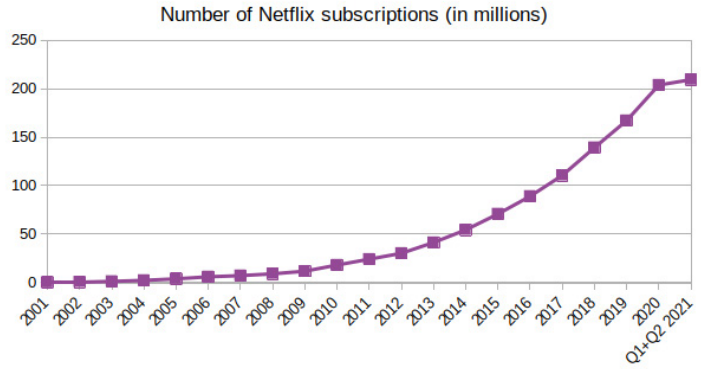
In **exercise 12**, the baseline has been manipulated. When we use a bar chart, the baseline should start at 0. By starting the baseline at another point, we can manipulate how the numbers are perceived. The same graph as in exercise 12, with a y-axis starting at zero, would look like this:



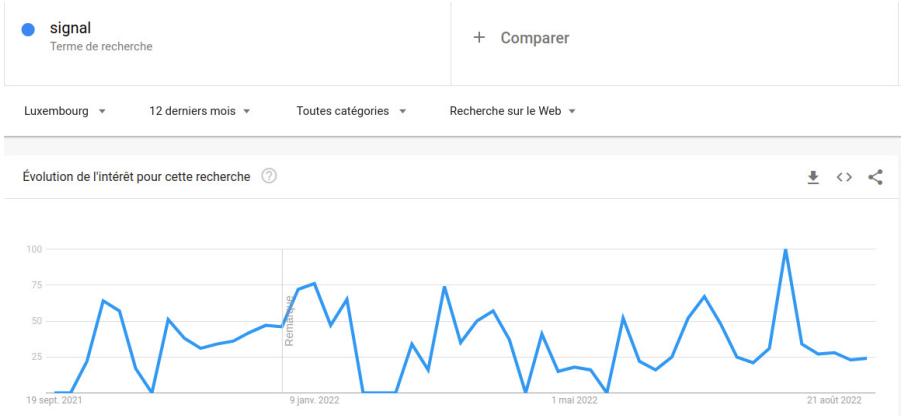
Here, we can clearly see that it is not at all true that the first two TikTokkers have twice as many followers than the others.

Exercise 13 illustrates what happens when you enlarge the y-axis, so that the graph gives the impression that the data are far less significant. The same graph as shown in exercise 13, with the y-axis proportional to the data, would look like this:
Here, we can clearly see that subscriptions to Netflix have been increasing over the past 20 years. This growth is particularly clear over the last 10 years.

This graph comes after would look like this :



Exercise 14 illustrates the principle of "cherry picking": this principle applies when only a part of the data is shown. If we look closely, we can see that the graph only shows data from 23 to 26 June 2022. A graph spread over 12 months would look quite different:



Source : https://trends.google.fr/trends/explore?geo=LU&q=signal

On this graph, we can clearly see that the number of Google searches for the word "signal" frequently goes up and down.

Finally, **exercise 15** demonstrates what happens if we use the wrong graph. In this exercise, we want to compare data which show what proportion of the population of Luxembourg uses a particular social media network. The sum of these percentages does not equal 100, but clearly exceeds 100%. This means that a pie chart is not at all appropriate for comparing these data.

In **exercise 16**, the idea is to show that graphs can be interactive and more creative than simple histograms. As an example here, we have chosen a graph made by the researcher Aida Hora-

niet Ibañez. Pupils first explore this graph on their own. Next, in a moderated discussion, they discuss what they have found out. If you see that pupils are having problems with the exercise, give them the following instructions:

1. At the top, you can see a bar graph. Hover over the different bars with your mouse to see how many messages the person sent on that day in each language.
2. Click on each circle in the languages to see what words were mentioned the most.
3. Click on the words to see how many times they were used over time.

06 | Differentiation possibilities

Exercise 11 on the enhanced memory can be set aside. This is the least important of the four superpowers, and the corresponding exercise is more complicated than the others.

In exercises 12 to 15 about the manipulation of graphs, the teacher can give extra hints to help pupils who are struggling.

In the section "Over the course of the lesson", interactive visualization is explained in detail. The teacher is free to allow pupils to discover visualization on their own, or to give some tips to help them.

07 | Further criteria to be met as part of the lesson series

a. **The Luxembourgish context:** The module was developed in collaboration with Aida Horaniet Ibañez, doctoral researcher at the Luxembourg Centre for Contemporary and Digital History at the University of Luxembourg. Moreover, numerous examples related to Luxembourg have been used.
b. **Differentiation:** Depending on the level of the class or the pupils, the teacher can opt to give more or less support to pupils either to help them complete the tasks, or to leave aside some of the exercises.
c. **Media Compass:** see the learning objectives set out by the Media Compass in the teaching analysis section in this document.
d. **The 4Cs model:** Critical Thinking, Creativity, Cooperation, Communication. The 4Cs model is taken into account in different ways by the different social forms and teaching activities.
e. **Relation to current research:** In the section More on this topic, the LUX: TIME Machine project at the University of Luxembourg is described and explained.
f. **Relation to research in Luxembourg:** In the podcast at the end of the module, Aida Horaniet Ibañez talks about her research on data visualization at the Centre for Contemporary and Digital History at the University of Luxembourg.

References:

Lupi, Giorgia & Posavec, Stefanie. (2013). Dear Data. http://www.dear-data.com/theproject

Lupi, Giorgia & Posavec, Stefanie. (2018). *Observe, Collect, Draw! : A Visual Journal : Discover the Patterns in Your Everyday Life*. Hudson, New York: Princeton Architectural.

Davis, Nicola. (2016). Can you get to know a person through data alone ? The Guardian. https://www.theguardian.com/artanddesign/2016/aug/21/dear-data-stefanie-posavec-giorgia-lupi

Tufte, Edward R. (2001). *The Visual Display of Quantitative Information. Cheshire CT: Graphic Press.*

Willett, Wesley, Aseniero, Bon Adriel, Carpendale, Sheelagh, Dragicevic, Pierre, Jansen, Yvonne, Oehlberg, Lora & Isenberg, Petra. (2021). Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization. *IEEE Transactions on Visualization and Computer Graphics, 28(1), 22-32.*

08 | Detailed planning of the lesson

Theme of the lesson: Basics of data visualization

Learning objectives and skills to be developed during the lesson: The pupils are aware of the concepts and basic aspects of data visualization. They know that good data visualization can improve our understanding of data, but that it can also trick us and distort the truth. They have experienced this all through the different exercises.

Option for evaluation (if planned): Some options for evaluation at different levels are suggested in 3.5 Evaluation ideas.

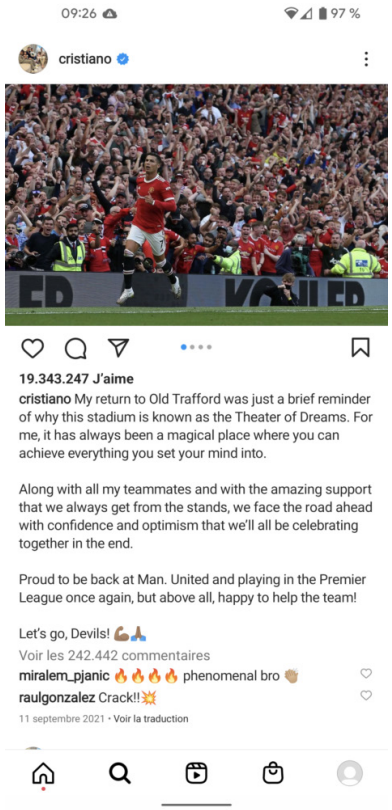
Length	Phases	Focus	Social forms/Methods	Materials and media	Learning process
Lesson 1 of 2					
5min	Introduction	**Data in an Instagram post**	• Work in pairs • Moderated discussion	• Word cloud • Exercise	The pupils... ... become **familiar** with the concept of data. ... **understand** that everything that surrounds us is made up of data. ... **understand** the difference between data related to the Instagram post and data related to the image in the post.
10min	Going deeper into the topic	**Classification of data**	• Moderated discussion	• Resuming responses to the word cloud • Exercise 2	The pupils... ... **classify** the data they found earlier.
10min	Individual exercise	**Test the subject**	• Autonomous work	• Exercise 3	The pupils... ... **test their understanding** of the material from the earlier individual exercise.
10min	Next stage	**Collecting and organising data**	• Autonomous work or in small groups	• Exercises 4 and 5 • Computer or tablet with internet access	The pupils... ... **know how** to collect data. ... **organise** data in a table.
15min	2 first superpowers	**"Enhanced attention" and "enhanced comparison" superpowers**	• Autonomous work • Moderated discussion	• Exercises 6, 7 et 8	The pupils... ... **understand** the impact of colours in a visualization. ... **understand** the importance of being able to compare data.
Lesson 2 of 2					
5min	Revision of final superpower	**"Enhanced comparison" superpower**	• Autonomous work • Moderated discussion	• Exercise 9	The pupils... ... **complete** a second comparison exercise (to provide continuity with the previous lesson).
5min	3rd superpower	**"Enhanced prediction" superpower**	• Autonomous work • Moderated discussion	• Exercise 10	The pupils... ... **learn** how to make predictions with the help of a graph.
10min	4th superpower	**"Enhanced memory" superpower**	• Work in pairs • Moderated discussion	• Exercise 11	The pupils... ... **explore** a story told using dataviz.
15min	New topic	**Manipulating graphs**	• Autonomous work or in small groups • Moderated discussion	• Exercise 12 à 15	The pupils... ... **encounter** the 4 key techniques for manipulating graphs. ... are **able to recognise** a graph that has been manipulated. ... **learn** to pay attention to the details in a visualization.
15min	Final creative exercise	**Exploration of a creative and interactive visualization**	• Work in small groups • Moderated discussion	• Exercise 16 • Computer or tablet with internet access	The pupils... ... **experience** a more creative and interactive way to present data.

3.3 Teaching materials

01 | What are data?

Exercise 1

→ Look at the Instagram post below. What data do you see? Try to find as many as possible.



Cristiano Ronaldo's first steps out in the Manchester United shirt received **19.3 million** likes.

Exercise 2

We have just seen that pretty much everything we see around us can be a form of data. Now let's try to classify the data we saw in the image above.

First of all, we can distinguish between **quantitative data** and **categorical data**. Quantitative data are expressed in numbers. Categorical data are data which cannot be measured or expressed using numbers. These data are classified according to different types.

Within quantitative data, we can distinguish **discrete data** which can only represent certain distinct values. For example, the number of people on the photo is a kind of discrete data, because there can only be 1, 2, 3 or more people (but not one and a half people).

→ Now it's your turn: look at all the data you have collected – which of them are discrete?

If quantitative data are not discrete, then they must be **continuous**. This means that they can take on any possible value between two figures. For example, Cristiano Ronaldo's height is a form of continuous data, because Ronaldo could be 1.87 metres tall, or 1.88 m, or even 1.875 m.

→ Now it's your turn: look at all the data you have collected – which of them are discrete?

The **categorical data** relate to what we see in different groups: on the photo, there are people wearing football shirts, or yellow safety vests, and other people wearing normal clothes.

→ Now it's your turn: look at all the data you have collected – which of these are categorical?

Categorical data which can be 'ordered', i.e. we are able to put into an order, are called ordinal data. The comment from miralem_pjanic is the first comment, while the one from raulgonzalez is the second. This means these are ordinal data.

When categorical data cannot be put into an order, we call them **nominal data**. The colour of the clothes of people on the photograph is a type of nominal data.

→ Did you find any other ordinal or nominal data?

Exercise 3

→ Have a go! Look at the following tweet from Science.lu and collect the data. Classify the data you have found according to the criteria you saw in the previous exercise.

Exercise 4

Once we have collected our data, we can organise them in a table. In every table, we collect the data on a topic which interests us, so that every line contains information on the same topic. And in every column, we collect data on a specific characteristic.

Let's look at an example!

→ Let's have a look at the five football players with the most followers on Instagram and compare their club, their age, nationality and their favourite food. Fill in the table.

Player	Club	Year of birth	Nationality	Favourite dish
	Al Nassr	1985		Bacalhau à Brás
Lionel Messi	PSG		Argentinian	
Neymar Jr.		1992		Italian and Japanese
	PSG	1998		
		1981		Falukorv

Every line represents a person or an object, while every column represents a characteristic.

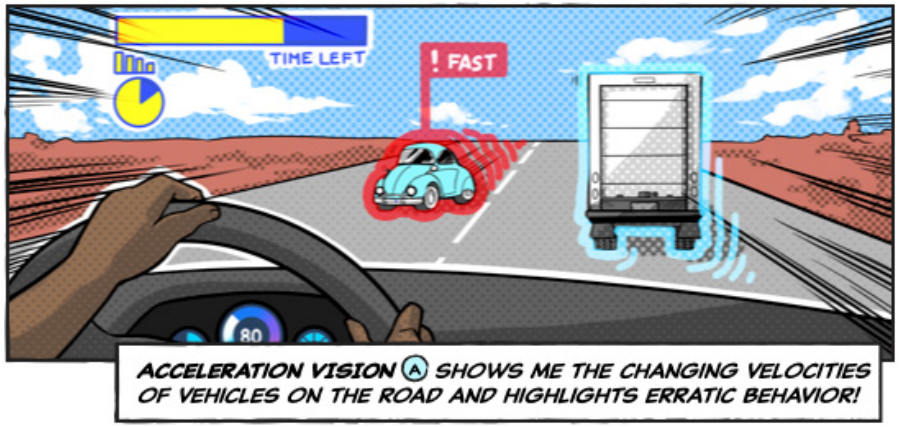
Exercise 5

→ Now it's your turn. Move around the classroom and collect data about your classmates. Make a table with one line per pupil (and maybe include your teacher too, if you want!), where every column corresponds to a characteristic. Select 5 different characteristics of your choice – be creative!

02 | The superpower of data visualization, or dataviz

Tables are very helpful for organising data, but if we want to find out one particular thing, then this can be a bit tricky. By transforming the information into data visualization, i.e. a visual representation of the data, we gain some superpowers: visualizations can "help make the invisible visible". We are able to take in more information through our vision than with all the other senses combined. Let's look more closely at some of these superpowers.

The "enhanced attention" superpower



Source : Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization
https ://arxiv.org/pdf/2108.03524.pdf

By boosting their ability to pay attention, superheroes can very quickly become aware of important information or visual details in their environment.

For normal human beings, this extra information would just go unnoticed.

Exercise 6

→ How many 5's can you see?

98734979027564790289472862409240603707057027907280320802900730250127023700837408207872027200708324780260270379377570970737797066746209709470278092797970972309723097959275092727979873497260802

→ Just by looking it is not very easy to see the 5's.
In the following drawing, the 5s are coloured. Count them again.

98734979027564790289472862409240603707057027907280320802900730250127023700837408207872027200708324780260270379377570970737797066746209709470278092797970972309723097959275092727979873497260802

By using a visual tool (such as colour), we can quickly see whatever we are interested in. A superpower that's easy to learn!

Exercise 7

a) Who has the most followers on Instagram?

Examine the table carefully. You can see that some accounts have more than 500,000 followers, while others have more than 400,000, and others more than 300,000, etc.

Instagram account	Number of followers (in millions)
arianagrande	309.96
beyonce	255.61
cristiano	440.41
Instagram	504.37
jlo	207.19
justinbieber	235.17
kendalljenner	236.47
khloekardashian	241.98
kimkardashian	309.84
kourtneykardash	176.39
kyliejenner	336.41
leomessi	326.06
natgeo	221.29
neymarjr	173.97
nickiminaj	188.95
nike	217.45
selenagomez	318.60
taylorswift	209.75
therock	315.04
virat.kohli	194.63

One colour is used to highlight the accounts with over 100,000 followers, while a second colour highlights accounts with more than 200,000 followers, and so on. Now you can see more easily who has lots of followers and who does not have very many.

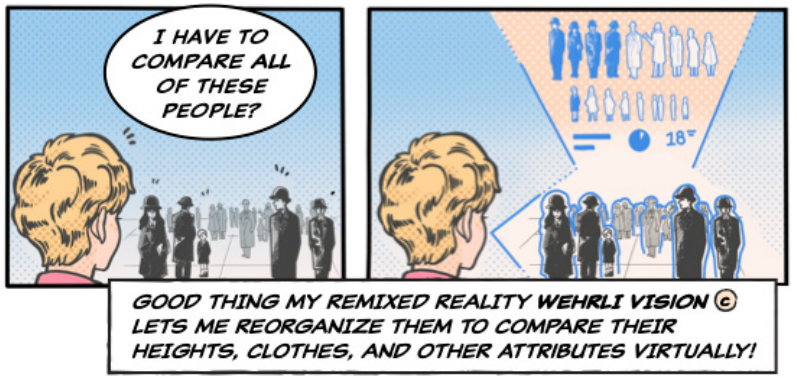
Instagram account	Number of followers (in millions)
arianagrande	309.96
beyonce	255.61
cristiano	440.41
Instagram	504.37
jlo	207.19
justinbieber	235.17
kendalljenner	236.47
khloekardashian	241.98
kimkardashian	309.84
kourtneykardash	176.39
kyliejenner	336.41
leomessi	326.06
natgeo	221.29
neymarjr	173.97
nickiminaj	188.95
nike	217.45
selenagomez	318.60
taylorswift	209.75
therock	315.04
virat.kohli	194.63

b) Look at the following statistics:

Instagram accounts with the most followers

→ Compare it with the previous tables. What differences do you see?

The "enhanced comparison" superpower



Source: Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization https ://arxiv.org/pdf/2108.03524.pdf

Exercise 8

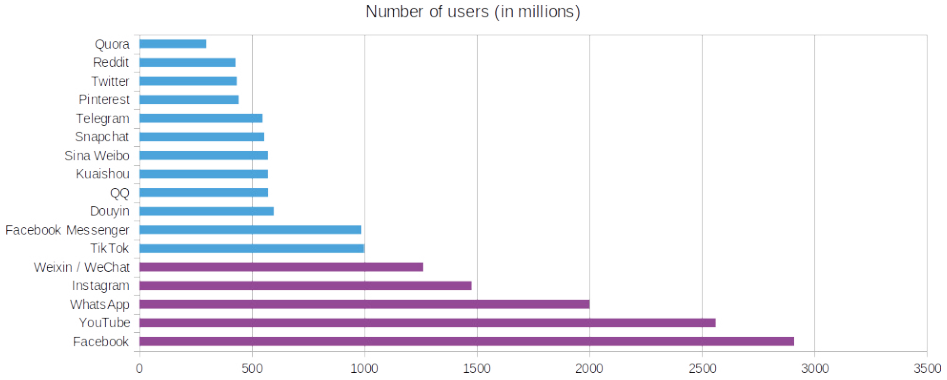
Superheroes also have an "enhanced comparison" superpower which enables them to quickly and precisely identify the differences and similarities between different phenomena.

Thanks to data viz, you can do it too!

Social Media	Number of users (in millions)
Douyin	600
Facebook	2910
Facebook Messenger	988
Instagram	1,478
Kuaishou	573
Pinterest	444
QQ	574
Quora	300
Reddit	430
Sina Weibo	573
Snapchat	557
Telegram	550
TikTok	1000
Twitter	436
Weixin / WeChat	1263
WhatsApp	2000

→ Which social media have more than 1 billion users?

If you transfer the figures into a bar chart, you will be able to answer the question much more easily.

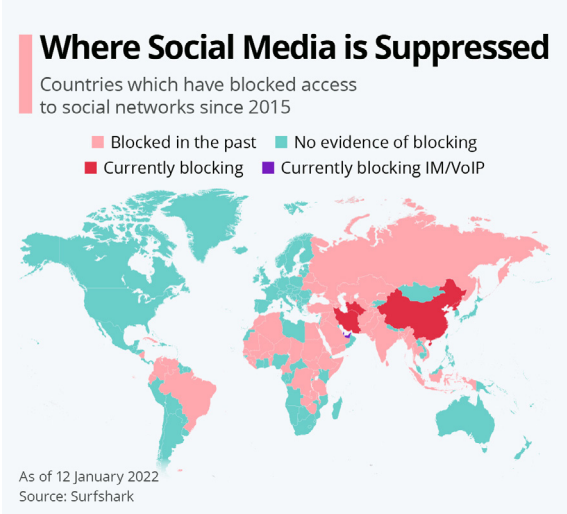


Exercise 9

In which countries are social media networks blocked? Below you can find a file with all the information about all the countries and a graph.

Social Media Censorchip Tracker

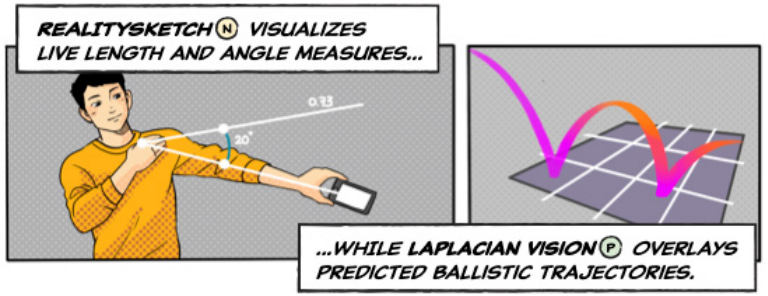
And now here's a graph:



Source: https://www.statista.com/chart/23804/countries-blocking-social-media/

→ Which tool helps you find the answer the fastest?

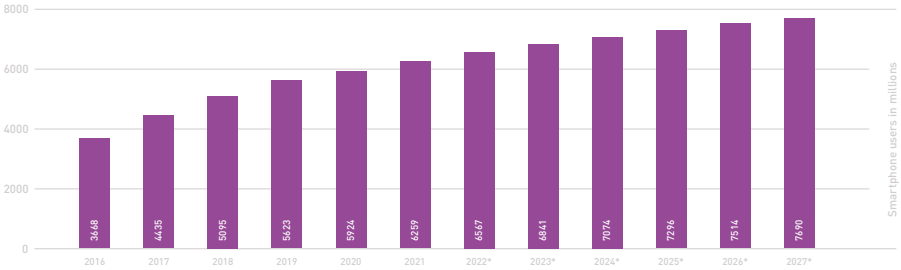
The "enhanced prediction" superpower



Source : Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization https://arxiv.org/pdf/2108.03524.pdf

Exercise 10

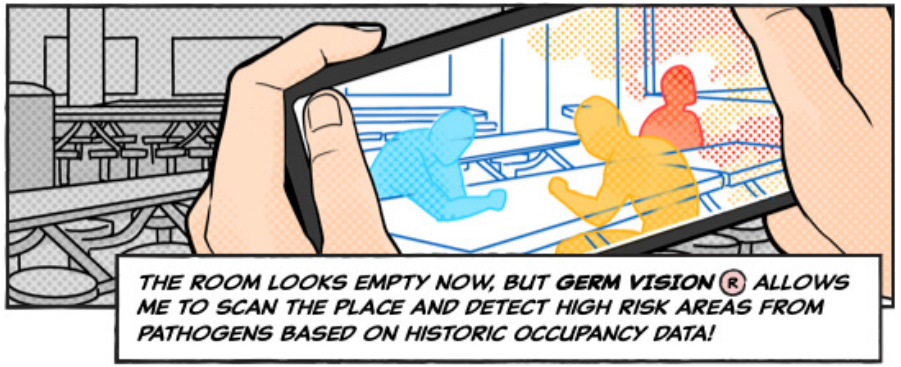
→ This graph predicts how many smartphones there will be in the world from 2023 to 2027.



Source : https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Can you predict how many there will be in 2028?

The "enhanced memory" superpower

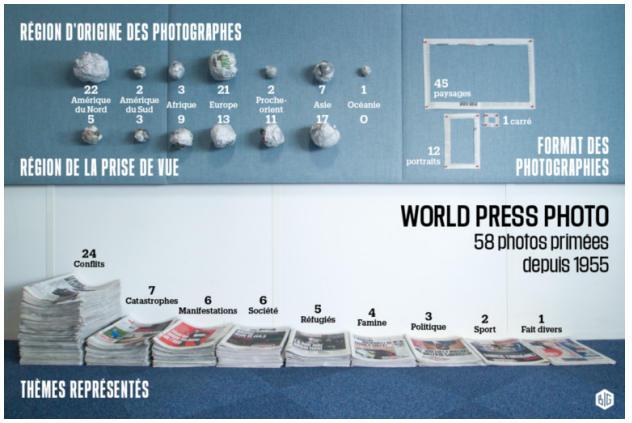


Source : Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization https://arxiv.org/pdf/2108.03524.pdf

Exercise 11

Dataviz superheroes also have better memories which allow them to quickly and accurately recall things they have observed in the past. This skill helps them quickly identify different phenomena or make links between past experiences and new observations or information. For this, we use data storytelling.

→ Look at the following image which uses data to tell you a story. Here you can see photos published in newspapers which were awarded with the "World Press Photo" prize. Write the story that it tells in your own words.



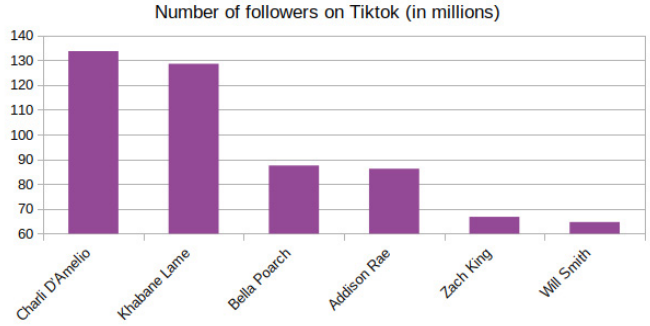
Source : http://claradealberto.com/portfolio/infographies-en-photos/

03 | Playing tricks with dataviz

You have to watch out! Sometimes, superheroes transform into supervillains and use dataviz to lie to us and make us believe something that's untrue.

Exercise 12

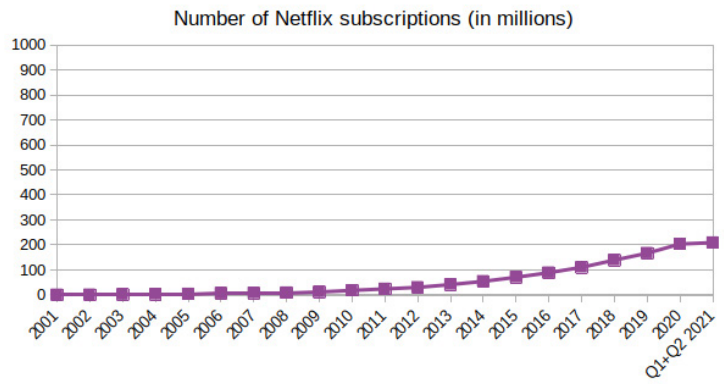
On the following graph, we can see that Charli d'Amelio and Khabane Lame have twice as many followers as the other stars on TikTok.



→ Is this statement correct? Explain and justify your answer.

Exercise 13

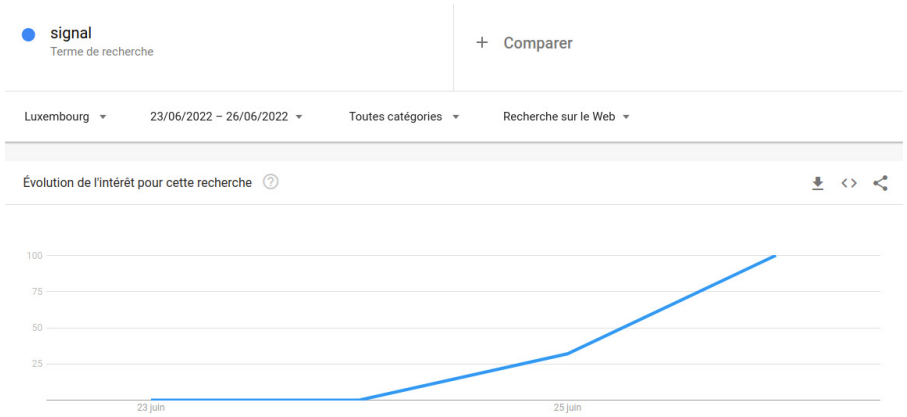
On the following graph, we can see that the number of subscriptions to Netflix has not increased substantially over the last 20 years.



→ Is this statement correct? Explain and justify your answer.

Exercise 14

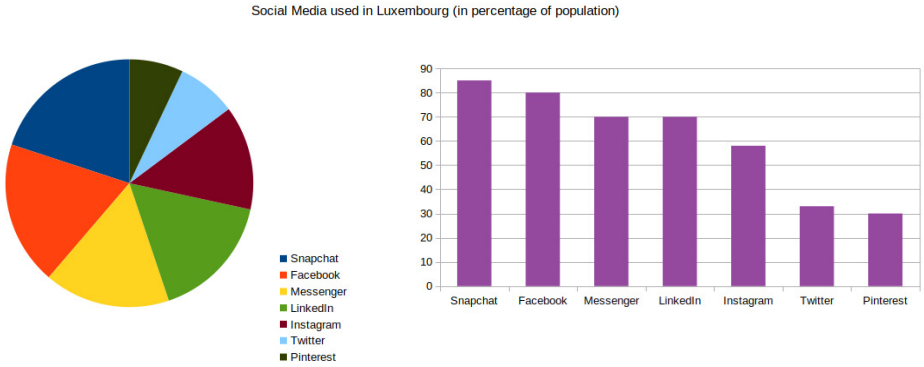
More and more people in Luxembourg are wanting to leave WhatsApp and join the Signal messaging service instead. The following graph clearly shows this:



→ Look carefully at the graph. Is the statement above really correct? Justify your answer.

Exercise 15

What social media networks are most popular in Luxembourg? Here are two graphs.



Source : https://www.lessentiel.lu/fr/story/snapchat-reseau-social-numero-1-au-luxembourg-46176496396

→ In your opinion, which of these two graphs is better for comparing the number of users of different social networks?

04 | Exploring interactive visualizations

Exercise 16

Here is a visualization made by researcher Aida Horaniet Ibañez from the University of Luxembourg. Working in groups, explore this visualization (using your mouse or finger) and note down all the information you can find. Then discuss and compare what you found.

Quantified self Whatsapp

3.4 Interdisciplinary ideas

It is possible to use the *#Data Viz Superpowers* module in other subjects.

Mathematics

This module can be used in maths class in 6eC. The topic of graphs[1] features in the new mathematics curriculum for the 6eC. The target knowledge includes: tables, evolving graphs/diagrams, bar graphs/diagrams, pie charts.

The target skills are as follows:

- reading and interpreting data drawn from a graph,
- making a table of values, an evolving graph or diagram, a bar graph or diagram, a pie chart,
- choosing an appropriate graph or diagram to represent data.

These are the very skills on which this module focuses, and which are practiced in the exercises and any evaluations

Art classes

The artistic component of the evaluation can be organised in collaboration with the pupils' art classes. The task of collecting the data is part of this module, while the visualization aspect can be conducted in collaboration with an art teacher.

[1]Chapter 13 in Amplitude 1re, Éditions Averbode/Erasme S.A., 9782874386848.

3.5 Evaluation ideas

In the context of the *#Data Viz Superpowers* module, three tasks for evaluation are suggested here for different levels of difficulty. They can be used and combined depending on what is needed. The tasks should be completed at home, because they require pupils to observe data over a week.

If this evaluation has to be completed in class, pupils can also observe data for a shorter amount of time and complete the classification, tables, and graphic representation in class during the following lesson.

An additional project can also be organised in collaboration with the pupils' art classes. It is up to the teacher to decide whether to include this in the evaluation.

These tasks, in particular the artistic component, have been inspired by Giorgia Lupi and Stefanie Posavec's Dear Data project. Over the course of one year, every week Giorgia and Stefanie collected and measured a certain type of data from their personal lives. Then they created an artistic visualization of the data they had collected in the form of postcards which they sent to each other (Davis, 2016). If the pupils complete this project, they can contact the designers and send their work to them. This is explained at the bottom of the page of the Dear Data project.

Level of difficulty: basic

Up to now we have seen a number of examples of data visualizations based on statistics. These have given us superpowers so we can read faster, find what we need, compare data, or find rare values. Now, it's the pupils' turn to play and combine everything together.

First, the pupils have to choose a theme. For example: "music that I hear". Then, over the course of one week, they collect all the data related to this theme. They should document every piece of music they hear, either by choice or by accident (in a shop, public transportation, etc.), with the option to set an upper limit if there are too many pieces of music. Then, the pupils have to:

1. classify the data (determine if they are discrete, continuous, ordinal, or nominal, etc.), put the data into a table,
2. put the data into a table,
3. **choose one superpower** and make a representation of the data using this superpower.

Level of difficulty: medium

Up to now we have seen a number of examples of data visualizations based on statistics. These have given us superpowers so we can read faster, find what we need, compare data, or find rare values. Now, it's the pupils' turn to play and combine everything together.

First, the pupils have to choose a theme. For example: "music that I hear". Then, over the course of one week, they collect all the data related to this theme. They should document every piece of music they hear, either by choice or by accident (in a shop, public transportation, etc.), with the option to set an upper limit if there are too many pieces of music. Then, the pupils have to:

1. classify the data (determine if they are discrete, continuous, ordinal, or nominal, etc.),
2. put the data into a table,
3. **choose one superpower** and make a representation of the data using this superpower, create a 'trick' graph based on the data, by using one of the 4 strategies that we studied for deceiving people.

Level of difficulty: advanced

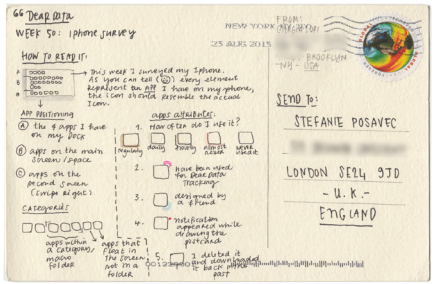
Up to now we have seen a number of examples of data visualizations based on statistics. These have given us superpowers so we can read faster, find what we need, compare data, or find rare values. Now, it's the pupils' turn to play and combine everything together.

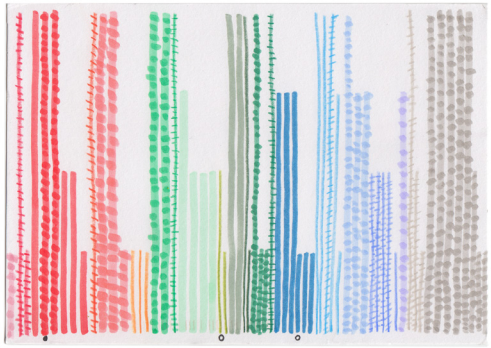
First, the pupils have to choose a theme. For example: "music that I hear". Then, over the course of one week, they collect all the data related to this theme. They should document every piece of music they hear, either by choice or by accident (in a shop, public transportation, etc.), with the option to set an upper limit if there are too many pieces of music. Then, the pupils have to:

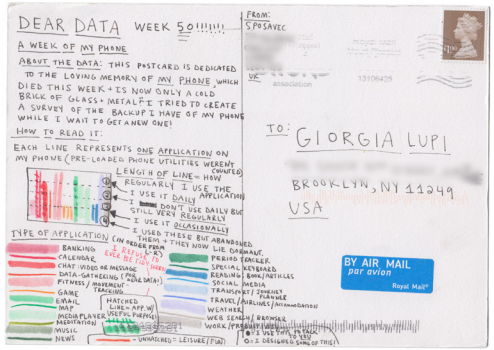
1. classify the data (determine if they are discrete, continuous, ordinal, or nominal, etc.),
2. put the data into a table,
3. make a representation of the data for **every superpower** using each of the superpowers,
4. create multiple 'trick' graphs based on the data, by using one of the 4 strategies that we have studied for deceiving people.

Artistic component

There are other ways to visualise data by using our own visual vocabulary. Let's take a look at two examples of visualizations made by the designers Giorgia Lupi and Stefanie Posavec: over the course of one week, they kept track of their activity on their smartphones and used this to make a visualization.







All of the examples, week by week, can be found here: http://www.dear-data.com/all.

The pupils should take the data that they collected in the evaluations above and use these to make their own visualization:

- on a postcard,
- on a sheet of A4 paper,
- on a digital poster,
- in the form of a video,
- or in any other form.

References:
Lupi, Giorgia & Posavec, Stefanie. (2013). Dear Data. http://www.dear-data.com/theproject
Lupi, Giorgia & Posavec, Stefanie. (2018). *Observe, Collect, Draw! : A Visual Journal : Discover the Patterns in Your Everyday Life*. Hudson, New York: Princeton Architectural.
Davis, Nicola. (2016). Can you get to know a person through data alone? The Guardian. https://www.theguardian.com/artanddesign/2016/aug/21/dear-data-stefanie-posavec-giorgia-lupi

3.6 More on this topic

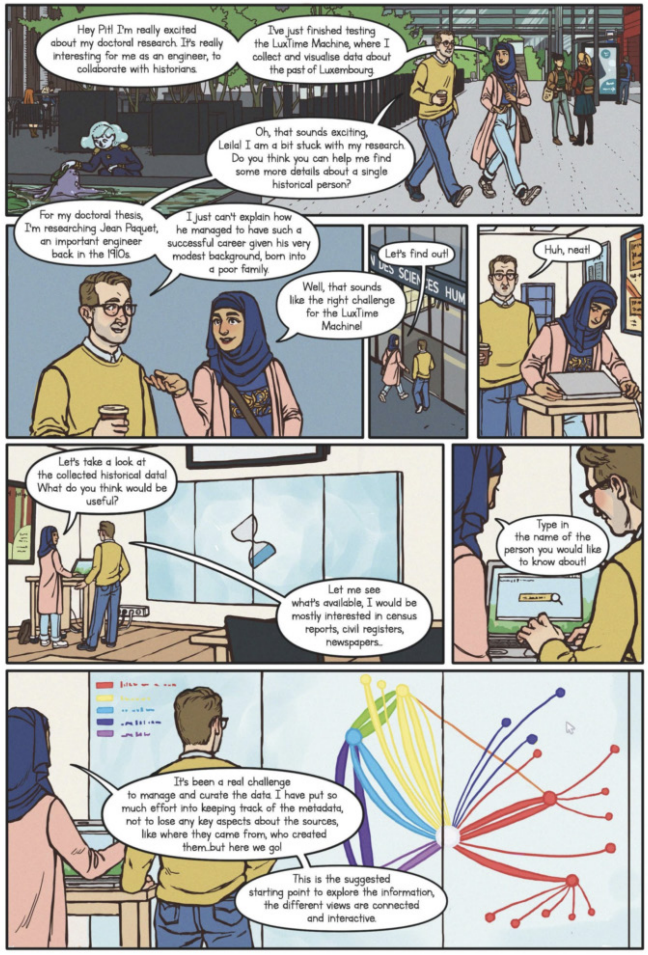
01 | Dataviz

Nowadays big data can be found everywhere, and the amount of existing data keeps growing. Yet there's no point in generating these enormous quantities of data if we don't know how to interpret or understand them. When we don't have that much data, it's enough to just put them into a table in Excel and analyse them one by one. However, in many fields of research or work, there is such a huge amount of data that it's impossible to understand them just by looking. Data visualization tools (or dataviz), allow us to better understand large quantities of data, and to extract tendencies or schemas.

Human beings are actually used to visualizations: we like colours and patterns. When we see graphs with colours, we can very quickly detect the tendencies and also remember them. As this module demonstrates, dataviz gives us superpowers (Willett et al., 2021).

However, dataviz is not just about collecting data and making graphs with them. A bad graph doesn't help us either understand or analyse anything. Good dataviz, on the other hand, tells a story and informs us, and this is why data visualization has become a field of research in its own right. Increasing numbers of researchers and artists are focusing on data visualization, as can be seen on this page. Data visualization is also playing an increasingly important role in human sciences. The following page contains a list of all the University departments around the world that focus part of their research on data visualization in the context of digital humanities. Here we can also find the Luxembourg Centre for Contemporary and Digital History (C²DH) at the University of Luxembourg. In the next section you can find out more about one of the centre's biggest projects.

Aida Horaniet Ibañez, Suzana Cascao, and Daniel Richter, researchers from C²DH, worked in collaboration with the artist Marion Dengler (and with support from the Doctoral Education in Science Communication (DESCOM) at the University of Luxembourg), to produce the following comic which provides an example of how data visualization can help in an interdisciplinary project involving an engineer and a historian.



Source : Lux:Plorations, Scientific Comics, Université du Luxembourg, https://sciencecomics.uni.lu/its-about-time/

To see the comic in other languages: https://sciencecomics.uni.lu/comics-vol-2

To find out even more about data visualization, we suggest you consult the Journal of the Data Visualization Society (https://nightingaledvs.com/) or this list of book recommendations (https://informationisbeautiful.net/visualizations/dataviz-books/).

02 | The LuxTime Machine project

LuxTime is an interdisciplinary and collaborative project between the Luxembourg Centre for Contemporary and Digital History (C²DH), to which researcher Aida Horaniet Ibañez belongs, the Luxembourg Centre for Systems Biomedicine (LCSB), and the Luxembourg Institute of Science and Technology (LIST).

The main objective of the LuxTIME project is to construct and visualise different data comprising information from three different fields and scientific perspectives, namely ecohydrology, environmental chemometrics and history.

The LuxTime project aims at using industrialisation of the Minett region as a testbed for methodological and epistemological reflections on how to study the impact of environmental changes on the health of the local population in a long-term perspective. By mixing 'contextual information' based on archival evidence with 'scientific evidence' deriving from chemical, biological, or medical investigations, the project explores new ground in interpreting "big data of the past" in a truly interdisciplinary setting.

The case of Belval will be used to test the analytical potential of a research concept on multiple levels. In the medium term, the ambition is to expand this concept into a national case study. The aim is to construct a real "Luxembourg time travel machine" which contains multiple types of data from many different types of institution.

The project is part of a larger European project titled "Time machine: Big data of the past for the future of Europe". This project will create artificial intelligence technologies to give some sense to the enormous quantities of information that can be gathered from complex sets of historical data.

For more information about the LuxTime project, please consult the project website or listen to the podcast with the researcher Aida Horaniet Ibañez.

References:
Willett, Wesley, Aseniero, Bon Adriel, Carpendale, Sheelagh, Dragicevic, Pierre, Jansen, Yvonne, Oehlberg, Lora & Isenberg, Petra. (2021). Perception ! Immersion ! Empowerment ! Superpowers as Inspiration for Visualization. IEEE Transactions on Visualization and Computer Graphics, 28(1), 22-32

3.7 A word from the scientists

Aida Horaniet Ibañez is a doctoral researcher at the Center for Contemporary and Digital History at the University of Luxembourg and works on the LuxTIME project.

She graduated in telecommunications engineering at the Polytechnical University of Madrid and holds an international master's degree in industrial management from the Technical University of Madrid, Politecnico di Milano, and KTH Royal Institute of Technology in Stockholm. She moved to Luxembourg in 2011 to write a master's thesis in business. Since then, she has worked on various projects related to data integration, reporting, and analysis and visualization of data in different fields and industries.

Aida Horaniet Ibanez (C2DH) - Data Visualisation

Source: https://scilux.buzzsprout.com/142332/10172586-episode-16

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